For each plant or animal addressed by the Plan, a ***Species Account*** was prepared. The Supergroup approved the list of 98 plant and animal species to be addressed by the Plan in 1996. The USGS then contracted with experts on each species, who prepared the species accounts for use in development of the Plan. A wildlife biologist or botanist possessing recognized expertise concerning the species in question authored each of these documents. These accounts describe the general status, habitat, life history, distribution, biological goals, and threats faced by each species, as well as a detailed bibliography. All species accounts were peer reviewed.

ALKALI MARIPOSA LILY
Calochortus striatus Parish

Authors: Julie A. Greene, P.O. Box 451, Los Alamitos, CA 90720 and Andrew C. Sanders, Herbarium, Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Management Status: Federal - USFWS Species of Concern; BLM Sensitive
California - S2.2; G2 (CDFG, 1998)
CNPS - List 1B, R-E-D Code 2-2-2 (Skinner and Pavlik, 1994)

General Distribution:

Alkali mariposa lily is a rare endemic of moist alkaline areas in the arid interior of southern California and southern Nevada. Specifically, it occurs in the southern Sierra Nevada; in the western, central and southern Mojave Desert; at the north base of the San Bernardino Mountains; in the southern San Joaquin Valley and disjunctly in southern Nevada. In Nevada, populations occur in Clark County near Las Vegas and in Nye County near Ash Meadows. It is considered “critically endangered” in Nevada and the two known populations are very small and apparently have not been seen recently (Mozingo and Williams, 1980; Kartesz, 1988; Morefield and Knight, 1992). In California, populations are scattered in Kern, northeastern Los Angeles, and southern and central San Bernardino counties. Outside the WMPA in California, there are twelve populations (900 total plants) around Lake Isabella (Mitchell, 1988), 14 populations (highest count 765 plants) at Beaver Pond on The Nature Conservancy's Kern River Preserve (Weldon Quad), and three populations (highest count 4074 plants) at the KVLI radio tower meadow adjacent to the Kern River Preserve (Tollefson, 1992). There is also a single collection from west of Bakersfield.

Distribution in West Mojave Planning Area:

There are five areas where this species occurs within the planning area (CDFG, 1997b): the San Bernardino Mountains at Cushenbury Springs and Box “S” Springs; Lucerne Valley (at Rabbit Spring); north of Barstow (which may be the same as the next); Paradise Springs near Ft. Irwin; Edwards Air Force Base (EAFB); north of Lancaster; and Red Rock Canyon State Park (CDFG, 1997b). In addition, the species was taken at 29 Palms in 1902 (SMASCH, 1998), but has apparently not been reported there since. The populations north of Lancaster are contiguous with, and undoubtedly part of, the huge populations reported at EAFB (Bagley, pers. com.). Specific sites, based on specimens at UCR, in this area include: “13 mi. N of Palmdale, Sierra Hwy at Ave. F, uncommon” (=scattered, occasional but rather regularly encountered); “12 mi. N of Palmdale, Sierra Hwy at Ave. G, fairly common (several hundred scattered through the area)”; “SW edge of Rosamond Dry Lake, near E end of Ave. C, just W of Piute Ponds and E of Sierra Hwy, fairly common” (several hundred at this site). In addition, Sanders (pers. obs.) remembers that in the 1980s there were numerous plants in the saltbush scrub immediately N of the Lancaster Sewer Ponds at Sierra Hwy and Ave B. We conclude that there is an extensive population of alkali mariposa lily along Sierra

Hwy for at least 5 mi. (8.3 km) from Ave. G (and probably S of that), all the way to the Kern Co. line, and certainly at least to Ave. B. It appears that only the cleared sites in this area don't have the species and there are thus several thousand acres (perhaps as much as 6400 acres/2590 ha) of probably occupied habitat. It appears that there are tens of thousands of plants in this area. A larger scale study of natural resources within the city of Lancaster (Tierra Madre, 1991) found populations of alkali mariposa lily in 24 of 67 sections surveyed in the saltbush scrub community and in 8 of 23 sections in the Joshua tree woodland community. Unfortunately, this study was primarily directed at rare animals so plant species were not censused in a more detailed way. UCR has a collection (*LaPré and Campbell s.n.*) from "Rosamond, east side of 20th St. W, 0.3 mi. S of Marie Ave." taken in 1988, with no population estimate given. This would appear to be a northern fringe of the "Sierra Ave." population just described.

Natural History:

Parish (1902) originally described alkali mariposa lily (Liliaceae) from his collection at Rabbit Springs in San Bernardino County, California. It is a perennial arising from a small membranous-coated corm and has two or three slender, grass-like, basal leaves 4-8 in. (10-20 centimeters) long that are withered by the time the plant flowers. The inflorescence is umbel-like with one to five erect bracts 0.5-1.25 in. (1-3 cm) long. The species flowers from April through June. The perianth is bell-shaped with a narrowed base and the sepals are 0.4-0.8 in. (10-20 mm) long. The petals are 0.8-1.2 in. (20-30 mm) long, irregularly toothed at the tip, and are white to lavender with conspicuous purple veins. The oblong nectary on the upper petal surface is not depressed and is densely simple-hairy. The fruit is erect, 1-1.5 in. (4-5 cm) long, linear in shape, but angled in cross section (Fiedler and Ness, 1993). The flower is perfect and is pollinated by flies and bees (Tollefson, 1992). It is unknown whether reproduction is most commonly from seedling establishment or corm division (deBecker, 1985).

This species is very distinctive and should not be confused with any other *Calochortus*. Most notably, it can be distinguished from other mariposa lilies by subumbellate inflorescence, oblong gland and obvious dark purple veins on the petals. Over much of its range the only other mariposa lily in the same general habitats is the desert mariposa lily (*Calochortus kennedyi)* with bright orange ("day glow") flowers.

A number of early authors (Jepson, 1921; Abrams, 1923; Jaeger, 1940) placed *Calochortus striatus* in synonymy with the related *Calochortus palmeri*, but this was based partly on a confusion of type specimens and this treatment has not been followed by more recent authors (e.g., Munz, 1959; Fiedler and Ness, 1993). It appears that the species has been uniformly accepted as distinct since the monograph of Ownbey (1940).

Habitat Requirements:

Alkali mariposa lily grows in calcareous sandy soil (Fiedler, 1985) in seasonally moist alkaline habitats such as alkali meadows (Mozingo and Williams, 1980), ephemeral washes, vernally moist depressions and at seeps within saltbush scrub at 300-4500 ft. (800-1400 m) elevation (Fiedler and Ness, 1993). These plants are not found in soils with surface salts, or wetter areas with permanent standing surface water (Mitchell, 1988). The bulb remains dormant and does not sprout in dry years.

At the Lake Isabella and Paradise Spring sites this species is found in low growing saltgrass (*Distichlis spicata*), but it is not found in stands of tall grasses. Associated species at Paradise Spring included Mexican rush (*Juncus mexicanus*), beak spike sedge (*Eleocharis rostellata*), arrow grass (*Triglochin concinna var. debile*), California blue eyed grass (*Sisyrinchium bellum*), alkali sacaton (*Sporobolus airoides*), and Emory's baccharis (*Baccharis emoryi*) (Bagley, 1989). Associated species on EAFB include wild rye (*Elymus cinereus*), honey mesquite (*Prosopis glandulosa* var. *torreyana*), alkali goldenbush (*Isocoma acradenia*), rabbitbrush (*Chrysothamnus nauseosus* ssp. *hololeucus*), baltic rush (*Juncus balticus*) and winter fat (*Krascheninnikovia lanata*) (Heckard and Moe, 1977). The Alkali mariposa lily is associated with saltbush (*Atriplex* spp.) at The Nature Conservancy's Kern River Preserve (CDFG, 1997b).

Population Status:

In considering the figures presented below, it must be stressed that abundance figures are complicated by large fluctuations from year to year (Tollefson, 1992). There were about 6,000 plants reported for Kern county (on Cantill, Lake Isabella South, Millux, Pinyon Mtn., Weldon and Woolstaff Creek 7.5' USGS Quads) from 1988-1992 (CDFG, 1997b). There is an unknown number at the Rosamond location mentioned above. There are as many 165,000 plants in 67 areas documented on EAFB (Los Angeles and Kern Counties: Bagley, pers. comm., 1998). There were 133 plants reported in 1990 at Red Rock Canyon (CDFG, 1997b). About 400 plants were reported at three sites around Lancaster in Los Angeles County in 1988 (CDFG, 1997b), but that clearly understates the situation in this area, as noted in the W Mojave distribution section, above. In San Bernardino County, about 100 plants were reported in 1982 below Box “S” Springs (north of Cushenbury Springs), about 50 were reported at Cushenbury Springs, about 100 plants were reported at Rabbit Springs in 1993, and about 1,500 plants were reported in 1989 at Paradise Springs near Fort Irwin (CDFG, 1997b).

Threats analysis:

Seasonally moist alkaline habitat is a critical limiting factor in the occurrence of this species. The greatest threat to this habitat is the lowering of water tables. The next greatest threat to this species is probably urbanization in the Lancaster area where the largest populations are concentrated. An additional threat is trampling and grazing by cattle, which may severely reduce its reproductive capacity. In a survey around Lake Isabella, plants in ungrazed areas were taller [12-15 in. (31-38.5 cm) compared to 3-4 in. (8-10 cm)], more robust and more numerous than those in grazed areas (Mitchell, 1988). Low intensity horse grazing was tested from 1984-1991 to determine if soil disturbance and/or the reduction of competing grasses and weeds would affect alkali mariposa lily productivity at The Nature Conservancy's Kern River Preserve. There was neither a dramatic increase or decrease in the grazed *Calochortus* population during this period compared to non-grazed control populations (Tollefson, 1992). This study did not measure the height of the plants.

Urbanization and road construction are also threats (Skinner and Pavlik 1994). A population of unknown size at Whiskey Springs was extirpated in 1920s by construction of Highway 18 (CDFG, 1997b). The Cushenbury Springs population declined due to expansion of Kaiser Cement in 1988 when they diked the flow of the spring for their use and added a parking lot (CDFG, 1997b). A population of 300 plants southeast of Highway 178 near the Radio Tower Meadow was destroyed in 1989 by development (Tollefson, 1992). The large populations along Sierra Highway are in the path of expanding urbanization from Lancaster. These populations are largely on private land and receive minimal protection.

The ongoing monitoring at The Nature Conservancy's Kern River Preserve indicate competition from taller grasses such as wild ryegrass (*Elymus triticoides*) and non-native barley species (*Hordeum* sp.) may contribute to population declines (Tollefson, 1992), but this may not be a general problem.

Biological Standards:

Due to wide fluctuations in population numbers, one documented example being at The Nature Conservancy's Kern River Preserve (low of 43 to a high of 765), long term monitoring is required to protect this species (Tollefson, 1992). Even though this species occurs on a large number of quads, most of the populations are small (Bowen, 1984), with the notable exception of the metapopulation extending from Lancaster to Edwards Air Force Base. The conservation of this species is a particular challenge because it faces four major threats: lowering water table, grazing, competition from weedy species, and land development. Interaction is needed with local water authorities regarding possible measures necessary to maintain (or restore?) the water table at its historic level and to remove or modify existing obstructions to natural spring or seep flows. Known population sites should be fenced to prevent trampling and grazing by cows. Partial or complete removal of introduced weeds would reduce competition for resources, and thus improve reproductive capability, but this has yet to be tested for this species and may not be possible or practical. Listing may discourage development on public lands. The Nature Conservancy's Kern River Preserve populations are currently protected from development.

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BARSTOW WOOLLY SUNFLOWER

Eriophyllum mohavense (Jtn.) Jeps.

Authors: James M. André, Director and Barbara Pitzer, Museum Scientist, Sweeney Granite Mountains Desert Research Center, University of Riverside, P.O. Box 101, Kelso, CA 92351.

Management Status: Federal: Species of Concern, BLM Sensitive
California: S2.2, G2 (CDFG, 1997a)
CNPS: 1B, R-E-D Code 2-2-3 (Skinner and Pavlik, 1994).

General Distribution:

Barstow woolly sunflower is endemic to the west-central Mojave Desert, and is generally known from within an area bound on the east by a point near the exit of Interstate 15 (I-15) at Camp Irwin Road (in the vicinity of Lead Mountain) west to Buckhorn Butte on Edwards Air Force Base, a distance of approximately 60 mi. (97 km), and from the north at a point near Almond Mountain south to the southeastern corner of Edwards Air Force Base, approximately 45 mi. (73 km) (Tetra Tech, 1995; Davis, 1998).

Distribution in the West Mojave Planning Area:

All known populations of Barstow woolly sunflower occur within the West Mojave Planning Area (WMPA). Populations are reported from near Lead Mountain (including the 1884 "Calico" record), Barstow (from which comes the type specimen), Stoddard's Well, Harper Dry Lake area, Kramer Junction, Boron, Fremont Peak, Almond Cove area, and Coolgardie Mesa. However, the majority of the populations occur in the Kramer Junction area. The most recently discovered population was found near Opal Mountain (MacKay, 1998).

Natural History:

Barstow woolly sunflower is a small woolly annual in the sunflower family (Asteraceae) which forms small tufts 0.5-1.5 in. (1-2.5 cm) high and 0.5-1.5 in. (1-3 cm) wide. Flower heads are sessile and very small, with only 3 or 4 light yellow flowers per head. Duration of flowering is typically limited to 2-3 weeks, from late March or April through May, depending on the year (Hickman, 1993). Following anthesis, Barstow woolly sunflower rapidly dries out and decomposes, becoming nearly impossible to detect by the end of May or beginning of June (Bagley, 1987).

Barstow woolly sunflower may be confused with a closely related species, bud woolly sunflower (*Eriophyllum pringlei*), as both species are small, tufted woolly annuals with sessile, discoid heads and yellow flowers. However, Barstow woolly sunflower is distinguished by sharp-pointed, usually 3-toothed leaf tips, and only 3-4 flowers per head, whereas bud woolly sunflower has rounded, lobed leaf tips and larger heads with 10-25 flowers (Hickman, 1993).

Only two known studies have reported data on population size and demographics. Tetra Tech (1995) conducted a study, addressing phenological stages over time for one population at Edwards Air Force Base. This study documented location and number of known populations (on or very near Edwards Air Force Base), and measured individual plant and population sizes.

André (1998) monitored a large population (2 ha; 0-4721 plants) located along the south side of Hwy 58, 20 mi. (?? km) west of Barstow, California, San Bernardino County at T.10N, R.4W, SE/4 of SE/4 of Section 30 for eight years (1991-1998). A total of 2432 plants were censussed in 1991, following above average spring precipitation. Little or no germination occurred during the three years with below average precipitation, indicating the "boom or bust" nature of this annual species. The following table summarizes results of this 8-year monitoring:

Year	Winter Precipitation	Number of Plants
1991	above average	2,432
1992	well above average	4,721
1993	above average	1,849
1994	below average	210
1995	average	1,210
1996	well below average	no plants
1997	below average	16
1998	well above average	3,407

These data indicate that spring emergence and growth is strongly correlated with amount of winter precipitation, and that clusters of plants tended to have high site-specific recurrence from year to year, suggesting short effective dispersal distances.

Critical biological information such as reproductive biology, pollination, population ecology and genetics (e.g., number of chromosomes), are still unknown for this species (Carlquist, 1956; Johnson, 1978; Mooring, 1997). There has even been some recent confusion about the species distribution, type locality, and taxonomic status, which led two researchers to assert that the species was "possibly extinct" (Johnson, 1978; Mooring, 1997).

Habitat Requirements:

Barstow woolly sunflower usually occurs in creosote bush scrub (sometimes adjacent to or with an overstory of Joshua trees), and in arid-phase saltbush scrub, with an elevation range of about 2,000 to 3,600 ft. (600 to 1100 m) (Rutherford and Bransfield, 1991a). It is most often associated with sparse occurrences of Mojave spineflower (*Chorizanthe spinosa*) and yellow peppergrass (*Lepidium flavum*), but has also been recorded less frequently with Fremont's phacelia (*Phacelia fremontii*), leafy tickseed (*Coreopsis calliopsida*), snake's head (*Malacothrix coulteri*), red-stemmed filaree (*Erodium cicutarium*) and desert dandelion (*Malacothrix glabrata*) (Henry, 1983b; Rutherford and Bransfield, 1991a; Tetra Tech, 1995; André, 1998). It has also been reported, rarely, to occur in association with carved-seed (*Glyptopleura marginata*) (Johnston, 1923; Rutherford and Bransfield, 1991b).

In general, this species requires open, flat, barren sites, and is most commonly found on the sandy margins of alkali depressions distributed among the more common creosote bush plant community. Hydrology in these areas is usually characterized by poor drainage, especially in shallow depressions showing evidence of ponding. Though it has been reported (Munz, 1974) that the species does not occur in rocky places or in washes, this is apparently not true for some of the populations which occur away from the Kramer Junction/Edwards Air Force Base area. In some cases, it has been found on gentle slopes or slight rises, or on ridges and terraces with firm sandy, clayey loam or sandy-silty soils, often with coarser sand or fine gravel on the surface (Bagley, 1987; Rutherford and Bransfield, 1991a; Tetra Tech, 1995). In a particularly odd account, Mary Spencer reported that the plant looked like "moss" or "mesa moss *on the rocks*" (emphasis added) (Spencer, 1922). Mary Spencer's letter to Johnston mentioned "going down a north slope [she found small patches of plants], but *at the base of the slope, where water had settled*..." (emphasis added) she found the plant growing "in abundance" with *Glyptopleura marginata* (Johnston, 1923). This implies a steeper slope than is the case with populations at Kramer Junction or Edwards Air Force Base areas (with the hillside population at Buckhorn Buttes population as the lone exception). The population at Coolgardie Mesa is reported to occur on a gravelly to cobbly surface (Rutherford and Bransfield, 1991a), and MacKay noted that the population at Opal Mountain occurred on a "gravelly soil with large rocks nearby" (MacKay, 1998). An historic collection from "Muroc Lake" (present day Rogers Dry Lake), made by Ralph Hoffman on May 19, 1930, was collected from a "stony hilltop" (Hoffman, 1930). The collection made by Jepson at Stoddard's Well on May 19, 1914, was collected in a "sandy wash" (Jepson, 1914). These exceptions seem to indicate that the species is capable of tolerating variable substrate surfaces, and that more detailed study is needed about its substrate tolerances.

One study, conducted by ERT in 1988, at Kramer Junction (Tetra Tech, 1995), compared soils supporting woolly sunflower to those that did not. Findings from this study indicated that soils supporting the species had more clay in the upper layers, higher alkalinity, more boron, and a harder consistency than adjacent soils without the species. One hypothesis is that the hardpan layer acts to exclude shrubs and thus creates the open spaces where Barstow woolly sunflower most commonly grows (Tetra Tech, 1995).

Population Status:

Mary Spencer and Fidella Woodcock collected Barstow woolly sunflower in 1922. Ms. Spencer's collection became the type specimen described by I.M. Johnston in 1923. Ms. Woodcock wrote Johnston that she found it on "Ord's Mountain," "on the high bench near the east bank of the Mohave River nearly opposite the Santa Fe passenger station in Barstow" (Johnston, 1923; Woodcock, 1922). Johnston apparently did not realize the contradiction in the location. However, Ms. Woodcock later wrote to Jepson, giving him the same information; Jepson caught the mistake and explained it to Ms. Woodcock, who then wrote back that the locality was "back of Mrs. Iverson's Ranch, about 2 miles out (west of Barstow) on the Hinkley Road" (Johnson, 1991). Jepson collected the plant on April 25, 1935 on "Iverson's Hill" (Jepson, 1935), which Johnson (1991) believes may be the type locality. Erroneously, Johnson reported both in his dissertation (1978) and in a later article (1991) that Iverson's Hill was located at 50 54'38"N, 117 2'33"W. This figure for latitude is clearly incorrect.

Jepson had already collected a specimen of *Eriophyllum mohavense* at Stoddard's Well wash in 1914, eight years before the type specimen was collected (Jepson, 1914). The present day Stoddard's Well is approximately 14.5 mi. (?? km) nearly due south of Barstow, making this location the southernmost known locality for the woolly sunflower. No recent surveys have searched for the plant in that area. This locality increases the reported range of the species significantly, yet to date there has been no discussion of it in the literature. The area around Stoddard's Well today is highly disturbed, and any populations from this area are likely to have been extirpated by ORV use, or possibly by construction.

The Ralph Hoffman collection of Barstow woolly sunflower from "Muroc Lake" was apparently the first record for Kern County. Mary Beal collected the plant at Waterman Ranch, on Waterman Mesa, Barstow, in 1937 (Beal, 1937). Between 1937 and 1982, there are no known collections. In 1982, Emery collected the species near Kramer Junction (Emery, 1982), and again in 1983 (Emery, 1983). No collections are reported during 1984, but since 1985, a series of development projects in the area requiring environmental regulatory studies have been constructed; numerous new populations were discovered as a result of the surveys, and many additional collections made. In 1991, Charlton and Beeler conducted a survey on Edwards Air Force Base, discovering two sites with numerous small populations or subpopulations on the Base. Charlton reported that this was the first record for Kern County (Charlton, 1993), unaware at that time of the prior Hoffman collection (Charlton, pers. comm., 1999). Also in 1991, Rutherford and Bransfield (1991a; 1991b) discovered a new population at Coolgardie Mesa, in atypical habitat. Elsewhere in 1991, during surveys associated with the Mojave Pipeline Project, approximately 18 populations of the woolly sunflower were recorded from Helendale Road, eight miles east of Kramer Junction, along Highway 58 to Boron, west of Kramer Junction (BioSystems Analysis, Inc., 1993).

In 1993, during a survey along a proposed transmission line from Adelanto north to Kramer Junction (and then eastward), 30 populations or subpopulations were discovered, with a total of approximately 8200 individuals, all located within the 200 ft. (??? m) wide corridor (Dames and Moore, 1993). Of these, about 1500 were found on sites where tower pads or their access roads were to be located, and are presumably destroyed. Twenty-nine of the 30 sites were found within about a mile of Kramer Junction, on the east side of Highway 395; one site was about a mile and a half south of Kramer Junction, on the west side of the highway (Dames and Moore, 1993).

In 1995, the populations at Edwards Air Force Base were again surveyed, and an attempt was made to locate additional populations (Tetra Tech, 1995). Out of 47 potential habitat sites, which had not been previously surveyed, 20 were found to support populations of the species, bringing the total estimated number of individuals on the Base in 1995 to 98,760. All of these new populations were within the earlier reported range of the species on the Base. Interestingly, the Hoffman site has not yet been relocated. As of December, 1995, many areas of the western portion of the Base had not been surveyed for new populations or potential habitat.

In 1998, a new population was discovered near Opal Mountain (MacKay, 1998). This record, although some distance from other reported populations, is still within the generally known range of the species.

Threats Analysis:

The vast majority of the range of the Barstow woolly sunflower lies within federal lands managed by the BLM or Department of Defense. Threats to the species to date have included military activities, livestock grazing and trampling, ORV activities, construction of utility corridors, such as roads, pipelines and power transmission lines, highway improvements such as the widening of Highway 58 and construction of the Highway 58/Interstate 15 interchange, construction of energy-related facilities such as the Luz Solar Energy Generating Facility at Harper Dry Lake, and urban sprawl near Barstow and along major highways.

Most of the area in which the Barstow woolly sunflower is found is open to sheep grazing, which occurs primarily in the spring during the flowering and seed-producing periods. Impacts from livestock (i.e., sheep) are probably due to trampling more than to grazing (Henry, 1983a). Livestock trampling and ORV activities not only cause direct mortality to individual plants, but also destroy cryptogamic crusts (Henry, 1983a), thus altering surface soil moisture, structure, and nutrient cycling regimes that are potentially important to short-lived annuals.

A portion of the range of the Barstow woolly sunflower is protected in a small, fence-enclosed Area of Critical Environmental Concern (ACEC; Emery and Rado, 1982). Within the fence, the plant is presumably protected. However, there are few regulatory mechanisms in place to protect areas outside the ACEC.

At least several known populations or portions of populations have been extirpated by the activities mentioned above. It is unknown whether ORV use and/or the building of the outlet shopping malls just southwest of Barstow have extirpated historic populations that were reported near this area; this is believed to be the case (Egan, pers. comm., 1999), but surveys are needed to confirm this.

Few restoration or enhancement studies have been conducted for the Barstow woolly sunflower. In 1991, just prior to construction of the Mojave Pipeline, a series of occurrences were documented along the south side of Highway 58 (BioSystems Analysis, 1993). A total of 3128 plants were censused in May 1991, with 943 of these occurring in the pipeline right-of-way. Recommended mitigation for the population was to collect seed and redistribute half of the seed on adjacent habitat, while redistributing the remaining seed back onto the graded pipeline right-of-way following construction. Whole plants with mature achenes were collected from all occurrences on the right-of-way and stored for one month during construction of the pipeline. The top two inches of soil were also removed, using shovels, a wheelbarrow and a small backhoe.

Following completion of construction in June, cached topsoil was redistributed and half of the collected seed was sown in the right-of-way. Every attempt was made to return the site to as close to pre-construction conditions as possible; but the fragile structure of the sandy alkali depressions on which the plants grow could not be recreated. Prior to seeding, the right-of-way was imprinted with 2-inch (?? cm) deep divots spaced 10 in. (?? cm) apart, and the sandy topsoil spread to form shallow depressions in an attempt to duplicate prior conditions. The remaining seed was cast and raked just off the pipeline corridor, on the borders of alkali depressions that, at the time of seeding, did not support Barstow woolly sunflower.

Follow-up monitoring in 1992 (André, 1995) indicated that indeed, some ponding had occurred in the artificially created alkali depressions, and scattered emergence of the species was evident. Recovery of that portion of the population occurring on the right-of-way was documented by comparing the total number of plants censused on and off the right-of-way. In May of 1992, a total of 47 individuals were located on the right-of-way, while 1532 were counted off the right-of-way. In May of 1995, a total of 123 plants were counted in the pipeline corridor, while 1709 were found off the right-of-way. Though slow recovery seems to be occurring on the right-of-way, much of the soil and hydrology there does not appear supportive of increased distribution of the species.

A total of 34 plants were counted in 1992, and 52 plants in 1995, in the area where seed was cast off the right-of-way. This site had no previous occurrence of Barstow woolly sunflower, though suitable habitat conditions seemed to exist there. The success of this outplanting of seed in an area adjacent to the large population suggests that dispersal is limited for this species. Initial observations indicate that overland flow of water is an important dispersal vector in this particular area. Any evaluation of impact to this species should, therefore, carefully evaluate hydrological effects.

In another survey (Bagley, 1987), a population of Barstow woolly sunflower was observed growing on a disturbed area (an old dump) which had previously been bladed, providing at least one example that the species may persist in highly disturbed soils.

Biological Standards:

The majority of known populations of Barstow woolly sunflower occur adjacent to or near rapidly growing urban areas, or along roads or utility corridors. Due to increasing disturbance throughout its range, the species may meet criteria for federal listing as threatened or endangered. Other than the management plan implemented at Edwards Air Force Base, an action plan to protect this species has yet to be developed. This should be a high priority by the managing agencies, and such plans should be implemented immediately to prevent further extirpation of populations, and possibly to preclude listing of the species.

Focused surveys should be conducted throughout the range of the species, with particular emphasis on those areas in immediate danger of impact, near sites of historic records, and in areas of potential habitat that have yet to be surveyed. It will be important to consider the apparent tolerance the species exhibits for variable substrates when deciding which areas to survey. Natural areas should be set aside in existing occupied habitat to insure long-term protection of viable populations.

Mitigation for construction projects should require in-situ restoration of sites where possible, and also acquisition of off-site protected areas where existing populations may be enhanced and expanded. Existing monitoring programs should be expanded, using recovering sites to assess recovery potentials following disturbance (e.g., André, 1998). Additional analysis of soil and hydrological conditions are needed, adding to those completed by ERT at Edwards Air Force Base (Tetra Tech, 1995), in order to better understand the species habitat requirements and to assist in developing comprehensive restoration protocols.

ORV use should be reduced or terminated in areas known to be populated by the Barstow woolly sunflower; this should be backed up with strong enforcement policies throughout the range of the species.

Basic information on life-history, reproductive biology, seedbank ecology, and genetics is needed, and such research should be encouraged with funding incentives.

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CHARLOTTE'S PHACELIA

Phacelia nashiana Jepson

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Management Status: Federal: None
California: G3; S3.2 (CDFG, 1998)
CNPS: List 1B; R-E-D code 1-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Charlotte's phacelia occurs in the high Sierra Nevada, its desert-facing foothills, and the adjacent El Paso Mountains, in Tulare, Inyo, and Kern Counties. Its elevation ranges from 2000-7200 ft. elevation (600-2200 m). Most occurrences are east of the Sierra Nevada crest, from the foothills above Fremont Valley, north through Red Rock Canyon State Park, to east-facing canyons above Indian Wells Valley. East of Red Rock Canyon, there are several occurrences along the southern slopes and canyons of the El Paso Mountains eastward to Iron Canyon. There also is one record from the northeastern slope of the El Paso Mountains. In the high Sierra Nevada, there are several occurrences along the Pacific Crest Trail in Inyo and Tulare Counties from Morris Peak to the head of Nine-mile Canyon. One record is from the Volcano Peak area, east of the Sierra Nevada, within the China Lake Naval Weapons Center. To the west, there are several occurrences in the headwaters of Canebreak Creek, in the Lake Isabella watershed. All known occurrences are on public land (Anon. 1989).

Distribution in the West Mojave Planning Area:

Most of *Phacelia nashiana's* range is within the WMPA; the only exceptions are the occurrences west of the Sierra Nevada crest. Within the WMPA, most documented populations are near roads or trails in the lower canyons and washes, or are in high-interest natural areas (e.g., Red Rock Canyon State Park). Several locations are associated with the Los Angeles Aqueduct and its various access roads. In view of the documented locations at the Sierra Nevada crest and on its lower slopes, it is likely that additional undocumented populations occur on the inaccessible mountain slopes above the foothills, washes, and lower canyons. Additional populations also are likely to occur within the China Lake Naval Air Weapons Center.

Natural History:

Charlotte's phacelia, a striking plant while in flower, is an annual, to about 7 in. (18 cm) tall, single or several-stemmed from base, short coarse hairs with black gland tips throughout much of the plant. Leaves are mostly basal, ovate or round to about 3 in. (7 cm) long, with irregularly toothed or lobed margins, on long petioles. Flowers are on pedicles about 0.2-0.4 in. (5-10 mm) long. Sepals are about 0.15 in. (4 mm), longer in fruit. Petals are fused at their bases in a widely open or bell shaped corolla to about 0.7 in (18 mm) long; they are bright blue with white spots at the bases of the petals and a white tube, dropping entirely from the flower before the fruit develops. The fruit is ovoid, and many seeded, about 0.3-0.6 in. (7-14 mm). Important characters for field identification are the annual habit, wide, crenate to weakly lobed leaves, large brightly colored deciduous corolla, toothed filament bases (the teeth glabrous), and many-seeded fruits (Jepson, 1943; Wilken et. al., 1993). The most similar species is Parry's phacelia *P. parryi* but the two do not overlap in geographic range and field identification need not distinguish them. (Charlotte's phacelia is treated with *P. parryi* in both the key and description by Abrams [1951]). Other similar species are sticky phacelia (*P. viscida*), wild Canterbury bells (*P. minor*), and long-stalked phacelia (*P. longipes*). These species also overlap little or not at all with Charlotte's phacelia.

Flowering has been reported from May to June (Munz, 1974), April to June (Anon., 1989) and March to June (Skinner and Pavlik, 1993). The earliest flowering specimen in the Rancho Santa Ana Botanic Garden collection (*Charlton 4767*) is dated 6 April and was collected at 2500 ft. elevation (760 m). The plant was in both flower and fruit, and was presumably flowering during late March. In the

SMASCH (Specimen Management System for California Herbaria) database, The Jepson Herbarium reports a specimen collected on 25 March at the same elevation (*Bacigalupi 6268*). Presumably, Charlotte's phacelia can be found in flower by late March, at least at lower elevations.

Several of the most similar species, including Parry's phacelia, large-flowered phacelia (*P. grandiflora*), sticky phacelia, and wild Canterbury bells are chaparral fire-followers whose seeds germinate in response to incubation with charred wood (Keeley, 1991). The close relationships among these species suggest that post-fire germination may have evolved in a common ancestor. However, given the high elevations and open sites where Charlotte's phacelia occurs, it seems unlikely that a fire-following life history would have an ecological benefit. There is no data on the dormancy mechanism (if any) of Charlotte's phacelia; it would be interesting to learn whether it shares the post-fire germination cue, perhaps as an evolutionary anachronism rather than an *in situ* adaptation.

No information is available on pollination vectors, self-compatibility, seed dispersal, mycorrhizal associates, or other aspects of Charlotte's phacelia's natural history. The plant's large and brightly colored flowers suggest a large investment in attracting pollinators. Its annual habit and occurrence on arid mountain slopes suggests that its numbers may vary widely with precipitation, and data cited below indicates wide population fluctuations; whether these are controlled by climatic variables or other factors is unknown.

Habitat Requirements:

At higher elevations, Charlotte's phacelia generally occurs in steep, coarse sand and talus in open pinyon woodland with single-leaf pinyon (*Pinus monophylla*) and green ephedra (*Ephedra viridis*). At lower elevations, it generally is in canyons and washes, in desert shrublands composed of widespread desert species including burrobush (*Ambrosia dumosa*), creosote bush (*Larrea tridentata*), box thorn (*Lycium cooperi*), beavertail cactus (*Opuntia basilaris*), smoke tree (*Psorothamnus fremontii*), and Joshua tree (*Yucca brevifolia*). Substrates generally are granitic, but the El Paso Mountains populations are on metamorphic rock (Twisselmann, 1967) and the Volcano Peak population is on dark volcanic material (CDFG, 1997b). Occasional waifs occur on the broader alluvial fans below desert canyons (Twisselmann, 1967). *P. nashiana* commonly occurs with other annual plants, including other *Phacelia* species, coreopsis (*Coreopsis bigelovii*), lupine (*Lupinus concinnus*), and chia (*Salvia columbariae*).

Phacelia nashiana is generally associated with naturally disturbed or unstable habitats such as loose sand, talus, and washes. Rowlands et. al. (1995) cite Glenn Harris observing *P. nashiana* "growing vigorously on disturbed soils." Based on these observations, it also is likely to occur on some human-disturbed sites such as road cuts and berms, especially where dirt roads cross alluvial fans and washes.

Population Status:

Charlotte's phacelia populations were censused at 28 locations in 1986 by Mary Ann Henry, and these data are reported in the California Natural Diversity DataBase (CDFG 1997b). Many of the locations had hundreds of plants that year. Some locations had only a few plants, and two locations could not be relocated (i.e., mapping information was inaccurate, or there were no plants present during the census). A few sites have been censused in several different years, and appear to fluctuate considerably from year to year. For example, NDDB location number 4 increased from fewer than 40 plants in 1982 to 92 in 1986, to 100-300 in 1987. The high numbers of individuals at many widespread locations suggest that Charlotte's phacelia is secure over most or all of its range.

Threats Analysis:

Most of the known populations are within grazing allotments and some observers (e.g., Anon., 1989) consider cattle grazing "the primary threat to Charlotte's phacelia." Grazing is mentioned repeatedly in CNDDB records, but there appears to be no documentation of population declines in response to grazing. Other potential threats are off-road vehicles and wildflower collecting (Anon. 1989). All of these potential threats are general in nature, and are likely to affect specific populations that are accessible to cattle, vehicles, and hikers. Given the wide distribution circumscribing large areas inaccessible to these effects, it is likely that many Charlotte's phacelia populations are secure from harm.

Biological Standards:

Due to the extensive and meticulous survey and census data prepared by Mary Ann Henry, far better Charlotte's phacelia population data is available than for the vast majority of other special-status plants. Even so, this data is largely from a single year, and constitutes a "snapshot" of populations but gives no indication of trends over multiple years. Land managers should encourage energetic plant enthusiasts to follow up on Henry's work (CDFG 1997b and unpublished files) to document population fluctuations in response to climate, grazing, or other factors. This plant is easily identified and inherently attractive; it provides an excellent opportunity for amateur botanists to make a significant contribution to broader understanding of population ecology in an annual desert species. No specific areas seem in need of new focused surveys, but any new locations should be documented by voucher specimens and reported to the CNDDB.

Range condition at significant Charlotte's phacelia sites should be evaluated. While the specific effects of grazing are unknown, it is likely that heavy grazing would result in cattle feeding on the plant and/or regularly disturbing its habitat. It is unknown whether seeds can pass through the bovine digestive tract or germinate from feces, or whether the season and nature of grazing disturbance is compatible with the plant's evident adaptation to regular soil disturbance.

Management actions planned within the species range should consider potential effects to Charlotte's phacelia populations and habitat suitability. Management conflicts should be minimal since the plant is associated with soil disturbance and its distribution is largely in poorly accessible areas. The species appears to be secure and not in need of active conservation efforts; instead, management should seek to retain populations and habitat in their present states.

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CRUCIFIXION THORN

Castela emoryi (Gray) Moran and Felger
[*Holacantha emoryi* Gray]

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Management Status: Federal: None
California: S2.2, G4 (CDFG, 1998)
CNPS: List 2, RED code 2-1-1 (Skinner and Pavlik, 1994)

General Distribution:

Crucifixion thorn is endemic to the Sonoran Desert and southern Mojave Desert, is widely scattered in southwestern Arizona (e.g., along Interstate 10) and reaches its western limits as a few populations in the deserts of southeastern California (Turner, et al, 1995). This species also occurs in northwestern Sonora, but is reported from only 4-5 sites there (Turner, et al., 1995), and in northern Baja California at one site immediately adjacent to the Crucifixion Thorn Natural Area (CTNA) population in Imperial County, California (Turner, et al., 1995). It is “nowhere abundant” (Wiggins, 1964), except , as we now know, at the CTNA. The Sonoran populations are so scarce that just 50 years ago the species was unknown from south of the United States border (e.g., Cronquist, 1944), though by 1951 it was known from a few localities (Shreve, 1964) as it still is today (Turner, et al., 1995). The plant occurs at so few locations in California that, as late as 1936, it was possible to report that only four locations were known in the state (Jepson, 1936) and in 1951 only six (Abrams, 1951). In California south of San Bernardino County there are still apparently only about five reported or documented populations. There are several populations in eastern San Bernardino County outside the WMPA, including sites along Chemehuevi wash; nearby in the Turtle Mountains; Ward Valley, 20 mi. (33 km) east of Essex; south of Needles and north of Goffs. The westernmost of these populations is just outside the WMPA at a point 5 mi. (8.3 km) east of Amboy (Munz and Johnston, 1922).

Distribution in the West Mojave Planning Area:

The crucifixion thorn barely reaches the WMPA as a few scattered populations and individuals: Amboy Crater quad. (Davidson, 1920; Skinner and Pavlik, 1994); Lavic, 8 miles (13 km) west of Ludlow, occurs for some distance along a sandy wash (Ferris, 1919; Munz and Johnston, 1922; Munz, 1974; Jepson, 1936; Tibor, 1997); east of Hector Mine Road in a wash, Sunshine Peak quad. (*Wear and Wade s.n.*, UCR, RSA; Skinner and Pavlik, 1994); lava beds 25 mi. (40 km) northeast of Daggett, Dunn quad. (*Greer s.n.*, SD; Jepson, 1936; Parish, 1921; Skinner and Pavlik, 1994); at the southeast edge of the area at Clark’s Pass east of Twentynine Palms (*Aulenbrock 127*, UCR), and at Dale Dry Lake (*D. Swinney s.n.*, UCR).

Natural History:

The type of this species was collected by George Thurber in July 1852 "on the desert between the Gila River and Tucson, Arizona" (Abrams, 1951; McMinn, 1939). The species is sufficiently common and conspicuous in Arizona that it was discovered and described very early in the exploration of that state (i.e., during the Mexican Boundary Survey of 1850-1854), rather than escaping detection into the 1980s, as several other rare plants of the WMPA did.

The plants are often 3-6 ft. (1-2 m) tall but are generally taller, to 12-19 ft. (4-6 m), in optimum frost-free areas (specifically, at the CTNA). Plants flower as early as April (Turner, et al., 1995) and late May (Jaeger, 1941), but apparently mainly in June and July (Munz, 1974). Fruits probably ripen at the arrival of the fall rains in about September, though fruit ripening has apparently never been studied. The fruits consist of about 7 (6-8) spreading carpels forming a wheel or star-like structure. Each individual carpel contains a single seed closely enclosed by the dried drupe-like carpel body. The plants are dioecious, that is, male and female flowers occur on separate plants. No indication is given of plant height on the labels of most specimens from the southern Mojave, but they are reported to be 3-4 ft. (1-1.3 m) tall (Munz and Johnston, 1922) in contrast to the 10-19 ft. (3-6 m) plants at the CTNA, where height is regularly noted by collectors. Stems are rigid and have rather stout spine-tipped twigs that are covered with a short dense pubescence. The branches are light green. The flowers are inconspicuous and greenish-yellow, but are produced in abundance and must produce copious nectar, based on the numerous insects that visit (J. Wear, pers. comm., 1998). This species is not easily confused with any other member of the California flora.

Crucifixion thorn is leafless shrub or small tree of washes and other sites where water accumulates. It is particularly characteristic of non-saline dry lakes. The plants are long-lived and thorny and thus not much subject to grazing damage. It is mostly restricted to outwash plains and reported not to occur on rocky slopes (Shreve, 1964; Turner, et al., 1995), but there is a recent (obs. in Nov. 1994) unconfirmed report of this from talus slopes in the Cady Mountains (CNPS, 1998). Plants occur as scattered colonies of fairly small size that never extend far across the landscape (Shreve, 1964). It has been suggested that these populations may be partially clonal in origin (Shreve, 1964), but this is unconfirmed and appears unlikely. In many areas there are large areas of unoccupied, but apparently suitable, habitat between colonies (Shreve, 1964), though in most of California this is less obviously the case. The largest known population (about 1000 individuals) is at the CTNA in the Imperial Valley just north of the Mexican border (Turner et al., 1995). Jaeger (1941) reports that it is "locally abundant" along washes east of the Chocolate Mountains, but no one else seems to have noticed this, though it has been collected (once only?) in the area described. Perhaps Jaeger knew the location of a population now lost.

In California, the fruits seem to persist on the plant for a long time, and this observation is supported by the literature where it is reported that the fruit typically remains on the plant for 5-7 years after it matures (Shreve, 1964) or at least "sometimes persisting several years" (McClintock, 1993). In addition to the long persistence on the plant, germination is further inhibited by a need for scarification of the thick carpel wall surrounding the seed (Shreve, 1964). Shreve also reports that seeds germinate readily in cultivation after the hard seed coat has been opened by filing through it. It is claimed that there is "no mechanism for the release of the seeds" (Shreve, 1964) but this is probably not strictly true. Shreve seems to have thought that the fruits normally remain on the plant until the twigs break due to weathering or other causes and that there is no other dispersal mechanism. This idea makes little biological sense. It is true that the pedicels do eventually weaken due to weathering, thus permitting the seeds to fall to the ground, but it is not in the interest of the plant to hold its seeds in a position where they cannot germinate, and where they are exposed to extreme heat and potential desiccation, unless there is some evolutionary "reward" for doing so. The fact that the fruits are held for a long time in large clusters at the ends of branches suggests that they are being "presented" for dispersal by vertebrate herbivores. This supposition is supported by the thick seedcoat which would be necessary to assure that the seeds can pass undamaged through the gut of a large herbivore, such as a camel, horse or sloth. A seed, which is not normally subject to such abrasion, would not need such a seed coat. That this species is normally dispersed by large herbivores is supported by the observation that donkeys and goats readily eat the fruits, but do not to touch the branches (Jaeger, 1941). Whether cattle consume the fruits is unknown. Seed dispersal mechanisms are not discussed in the literature, but it seems likely that the seeds are distributed (or were) by large herbivores. It may be that this plant was formerly dispersed by the now extinct Pleistocene megafauna, as has been demonstrated for some plant species in other regions (Janzen and Martin, 1982). It is noteworthy that the closely related *Castela polyandra*, perhaps similar to the ancestor of crucifixion thorn, has fleshy fruits ("drupes") that are promptly deciduous (Moran and Felger, 1968). It appears that the persisting fruits of crucifixion thorn are a derived characteristic and are the result of some specific selective factor. Fruit dispersal by large herbivores appears the most likely candidate for such a factor. It would be interesting to test the fruits of this plant to see if germination is facilitated by scarification in passing through an herbivores gut. Fruits do eventually fall to the ground, and the seed coat eventually weathers away permitting germination, but this is probably not the historically normal seed release mechanism. Cultivated plants at Rancho Santa Ana Botanical Garden (RSABG) do have a moderate number of seedlings around them, which is evidence that the simple dropping and weathering of seeds can result in the production of new individuals (pers. obs., 1998). Wild populations at some sites (i.e., Hayfield Lake on the Colorado Desert) do contain plants of various sizes including leafy seedlings, young plants less than 1 m tall, and mature fruiting individuals (B. Pitzer, pers. comm.). Reproduction is thus definitely occurring under modern conditions.

The plants have no developed leaves, except in seedlings (Cronquist, 1944) and thus the stems are, of necessity, photosynthetic. The leaves on seedlings are reported to be both deeply divided (Shreve, 1964) and simple (Turner et al., 1995), so this point could use some clarification. Recent observations at RSABG revealed that seedling plants can have both simple leaves and leaves with two deep lateral lobes (pers. obs., 1998). Mature plants do sometimes produce small deciduous scale-like leaves (Moran and Felger, 1968), but developed leaves never appear on mature plants, even on new growth or "sucker" shoots. The plants are presumably leafless because this is an adaptation that results in reduced water loss due to the thin cuticle of leaves, versus the thicker cuticle of stems, and also avoids the problem of leaf wilt and resultant tissue damage. The cost of being leafless, and thus reducing transpiration loss, is that the mature plants are not very fast growing (Turner et al, 1995) and hence are perhaps not very competitive with other large shrubs and trees. This could account for its scattered and apparently "refugee" distribution. The species may be restricted to a few unusual spots that have sufficient water, but are dry enough to reduce competition from larger and faster growing plants. The hard stems and spiny branch tips are doubtless responses to large herbivore attacks in the past, though such threats are not now apparent. This is the only native member of the tropical family Simaroubaceae that exists in California.

It may be that the dioecious habit works against this species in areas like the southern Mojave where populations are often small and scattered. Some individuals may not be sufficiently close to other plants for effective pollination. This supposition is supported by the fact that none of the four collections of this species at UCR from the southern Mojave Desert have fruit, whereas six of seven from the Colorado Desert, where populations are larger, are fruiting. Given that the fruits may persist for 5-7 years on the plant (Shreve, 1964) it is expected that fruits will be present whenever a collector gathers material of this species, if the population collected is producing fruit at all regularly. The frequent absence of fruits in the northern part of the range suggests a problem in fruit production. It is, of course, expected that 50% of any population in a dioecious species will never be able to bear fruit. In a sizable population, there will always be at least a few fruit-bearing females present for collection, whereas a solitary individual has a 50% chance of being fruitless even if the species were autogamous. There are, or were, some substantial populations on the southern Mojave Desert, based on herbarium specimens at Rancho Santa Ana and on field notes. The population 8 miles west of Ludlow [= near Lavic] was reported to occur "for several miles" along a sandy wash (Munz and Johnston, 1922). Specimens taken from this population bear fruit. This population, or part of it, was rediscovered in 1997 and was found to consist of 52 individuals scattered along about 1 mile of wash (Tibor, 1997).

Pollinators are unreported in the literature, but J. Wear (pers. comm., 1998) reports that the small population north of the Hector Mine was being heavily visited by numerous insects, especially various wasps, including the large tarantula hawks (*Pepsis*) and numerous small metallic-colored species. Since the plants are reported not to begin flowering until quite old (Turner et al, 1995) and frequently occur in small populations, as at Hector, the pollinators are presumably generalists.

Germination requirements are unknown, except that the species probably relies on summer rainfall for seedling establishment, based on its distribution and relationships. It is reported that the seedlings rapidly develop a deep tap root and that they grow relatively rapidly if sufficient moisture is available (Shreve, 1964). Many of the seedlings present near the cultivated plants at RSABG are growing in the shade of their parents or of other shrubs and trees. A single young seedling at Hayfield Lake was likewise growing in shade under mesquite (B. Pitzer, pers. comm.). Full sun is evidently not required for seedling establishment, and a possible preference for a "nurse plant" should be investigated.

The extent of insect predation on the plants is unknown, but insect damage is not extensive on available herbarium specimens. It is reported that moth larvae (*Atteva exquisita* Busck.) eat this species (presumably the flowers, bark and young twigs) in California, as well as the flowers, bark and leaves of the related *Castela polyandra* in Baja

California (Moran and Felger, 1968). This insect may attack young fruits as well. There are compounds in the stems that have insecticidal properties (Turner et al., 1995) and these may also contribute to the reported distaste for the foliage by goats and burros (Jaeger, 1941). However, it is obvious that the insecticidal compounds are not effective against the moth *Atteva*. In addition, one specimen examined had a number of twigs clipped off, apparently by a jack rabbit (*Lepus californicus*).

Habitat Requirements:

Crucifixion thorn occupies low, 350-2100 ft. (115-640 m), seasonally moist sites where water accumulates, but which are not saline. Plants occur along washes, at non-saline playas (e.g., Clark's Pass, Hayfield, CTNA) and often in drainage ways around basalt flows, at least in the southern Mojave. Crucifixion thorn occurs on fine-textured soil of plains and alluvial bottomlands (not even on upper alluvial slopes) and has been reported on dunes (Turner, et al., 1995). Basalt flows probably generate large amounts of water runoff into adjacent washes, and may hold heat due to their dark color. Washes among basalt flows may thus be both relatively warm and moist sites. This species occurs entirely in low hot areas (e.g., Jaeger, 1941; Turner et al., 1995), perhaps because of a lack of tolerance for severe frost, or a need to escape certain competitors. Examination of a range map of the species (e.g., Elias, 1980; Turner, et al., 1995) reveals that it is distributed through the hottest and driest parts of the southwestern deserts, but examination of the microsites occupied reveals that within the larger habitat it is specialized to relatively moist sites. The species is most common in areas where summer rainfall is common or predominant, but extends sparsely into areas of the western Mojave where winter rainfall is the dominant mode (Turner et al., 1995) and summer rainfall is infrequent. Areas occupied are characterized by high summer temperatures and rare frost (Turner et al., 1995).

It may be that climatic change has driven this species into a narrower range of habitat types than it formerly occupied. In the Kofa Mountains of Arizona, a seed of this plant was found in a 9750 year old packrat midden on rocky slopes (Van Devender, 1990). Since packrats gather the material for their nests/middens over relatively small areas around the sites occupied, this implies that crucifixion thorn formerly occurred on rocky hillsides. In addition, there is a recent unconfirmed report that this species occurs on a talus slope in the Cady Mountains.

Population Status:

Populations in the WMPA are often small and hence precarious, and the species is only very locally common anywhere in California. Populations are few and highly scattered. There appear to have been few attempts to count individuals of this species. Most records are based on specimens where the locality is recorded, and often nothing more. At Clark's Pass the species is recorded on a specimen label as "scarce", and near Hector Mine there were four individuals (J. Wear, pers. comm., 1998). Only the report from near Lavic seems to represent a substantial population, but recent survey work in exactly that area for *Penstemon albomarginatus* did not reveal crucifixion thorn. The plant is certainly not common anywhere in the WMPA, and it may be that most records are based on single individuals or very small populations. It appears that the southern

Mojave Desert populations are having trouble reproducing due to lack of opportunity for cross pollination, poor seed dispersal or marginal environmental conditions.

Threats Analysis:

Currently, no significant human threats are known to exist, and the few threats that have impacted the species in the past have not significantly reduced its populations, except perhaps at Hayfield Dry Lake. Some populations are, or were, somewhat impacted by off highway vehicle (OHV) recreation, but the mature plants are large and stout enough that they are generally avoided. Seedlings could be damaged or destroyed by OHV activity.

Jaeger reported a "large aggregation" at Hayfield Dry Lake (outside the WMPA), but implied that this was largely destroyed when the pumping plant for the Colorado River aqueduct was constructed, though he actually says that the plants occupied an area "now covered by the waters of the Hayfields Reservoir" (Jaeger, 1941). Since there is no such reservoir today, this is puzzling. Perhaps there was a temporary reservoir that has since been eliminated. This is the only population in California reported to have been heavily damaged by human activity, but even here plants persisted and these still appear healthy and numerous. Besides Jaeger, other authors say that in the 1920s this population consisted of "hundreds" of plants (Munz and Keck, 1922) or that they were "numerous" (Parish, 1921). If this population was damaged, it has since substantially recovered because today there are at least 300 individuals present (B. Pitzer, pers. comm.). Many of the plants present today are tall 6-10 ft. (2-3 m) and mature and in places they form thickets so dense that they are difficult to walk through (B. Pitzer, pers. comm.).

As noted above, there may be a problem with pollination and hence seed set in some populations. Populations that consist only of a few large old individuals that are not setting seed are subject to elimination as those plants age and die. There may also be problems with seed dispersal and germination, if this species requires, or is greatly aided by, large herbivores that consume the fruits.

The largest population in California and the world, that at the CTNA, is protected by the BLM.

Biological Standards:

The few populations (or scattered individuals) in the WMPA are probably not crucial to the species' survival, even just within California. However, it would be highly desirable to conduct extensive surveys of likely habitat areas to confirm that there are no large populations in the area. In particular, the population eight miles west of Ludlow that was collected by Munz and associates in 1920 should be located and monitored. This is the only significant population ever reported in the WMPA.

The possible requirement for seed scarification should be investigated. It is possible that the fencing of the CTNA stand to protect it from OHVs also has the effect of keeping out livestock, and other large animals such as deer or bighorn sheep, that could serve to enhance germination. It may be that allowing cattle to roam in the fenced population at the CTNA at certain times of the year (perhaps late summer/fall in years when higher than normal summer rainfall is expected) would aid population recruitment. At least, this potential management tool should be investigated.

Once the biology of this species is better understood, rational measures can be taken to protect the most important populations.

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CUSHENBURY BUCKWHEAT

Eriogonum ovalifolium Nutt. var. *vineum* (Stokes) Jepson

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Management Status: Federal: Endangered
California: S1.1, G5T1 (CDFG, 1998)
CNPS: List 1B, RED code 3-3-3 (Skinner and Pavlik, 1994)

General Distribution:

Cushenbury buckwheat is endemic to California and is restricted to dry calcareous (primarily limestone) slopes of the northern San Bernardino Mountains (Reveal, 1993). Most populations are on lands within the boundary of the San Bernardino National Forest, but the taxon does extend slightly onto BLM and private lands along the southern edge of the WMPA. The overall range of this plant extends from White Mountain southeast to Mineral Mountain on the north side of Rattlesnake Canyon.

There is a recent report of what is possibly this plant from the southern Sierra Nevada Mountains, but the identification has not yet been confirmed. This discovery is discussed in greater detail in the Natural History section, below.

Distribution in the West Mojave Planning Area:

This species seems to barely extend into the WMPA in a narrow band from North Peak in the west to Round Mountain and the Partin Bros. Mine, east of Cushenbury Canyon. The distribution in the WMPA is restricted to scattered populations at the north foot of the San Bernardino Mountains along the southern margin of the WMPA, adjacent to the San Bernardino National Forest. Specific localities include: Arctic Canyon, 5200-5400 ft. (1585-1645 m), T.3N R.1E Sec 16; NE of Monarch Flat, 4800 ft. (1450 m), T.1E R.3N Sec 12; 1/8 mi. (0.2 km) north of North Peak, T.3N R.1W Sec 6; and Cushenbury Canyon.

Natural History:

Cushenbury buckwheat (Polygonaceae) was originally described as a distinct species, *Eriogonum vineum*, by Small (1898) from plants collected near Rose Mine by S.B. Parish (#3170) in 1894. At that time Small confused it with plants from farther north and cited a specimen from Oregon as representing this taxon also. It is now believed that this plant is endemic to the San Bernardino Mountains, with the possible exception of a small population in the southern Sierra Nevada.

Cushenbury buckwheat is a long-lived prostrate to mound-forming shrub that typically occurs on rocky slopes, often in cracks on bedrock or on otherwise stable slopes, but is also known from deeper soils derived from decomposed carbonates. It is typically not found in disturbed areas (either naturally or by man), nor is it usually found along washes or on canyon bottoms, unlike Parish's daisy (*Erigeron parishii)*, another limestone endemic that often occurs nearby. But, it has occasionally been found colonizing abandoned haul roads, as at Furnace Canyon (pers. obs., 1998). It is the only variety of *Eriogonum ovalifolium* found in the San

Bernardino Mountains, though other varieties occur elsewhere on similar substrates. It has never been found away from carbonate substrates and appears to be more common on the higher value limestones than it is on the economically unimportant dolomites. It is thus, based on information from a survey done for a consortium of mining companies in 1992 (Tierra Madre, 1992), particularly vulnerable to destruction by limestone mining (Sanders, 1992).

Cushenbury buckwheat plants are very compact with short woody stems spreading a few centimeters over the ground. They have been described as “forming large silver mats” resembling “boulders of the limestone it occurs on” (T. Krantz, label notes, UCR). The foliage mounds seldom rise more than 4 in. (10 cm) above the surrounding rocks or soil. However, when the plants begin flowering, they send up inflorescences 1-5 in. (2-12 cm) above the foliage. The several to many short woody stems spread and ascend over a very small patch of ground from a thick woody base above a deep and well-developed woody taproot. The short branches hold many small round-obovate leaves with blades 0.16-0.5 in. (4-12 mm) long and slightly narrower. The petioles are distinct and ca. 0.12-0.24 in. (3-6 mm) long. The foliage is densely covered with tangled, white, rather felty, hairs on both surfaces. The leaves densely cover the upper parts of the stems and are densely grouped so that the ground is generally not visible through the plant. This overall plant density is partly caused by the dried leaves which do not fall from the plant but simply turn a dark brown color and cling to the older parts of the stem. This presumably provides insulation for the plant as well as added protection from water loss through the stems.

Cushenbury buckwheat seems to share many general ecological characteristics with the other varieties of *E. ovalifolium.* It is a perennial of open areas and appears intolerant of extensive shading, preferring full sunlight, and typically occurs between shrubs rather than under them (White, 1997). *Eriogonum ovalifolium* is not a species well adapted to competing for light, but it is very competitive on sites where tall and fast growing species are excluded by moisture deficiencies, wind, winter cold, or nutrient deficiencies. The compact “cushion” habit probably serves to reduce moisture loss on windy ridges as is true for other species of similar life form (Walter, 1973). The short annual growth intervals and consequent low stature makes all races of *E. ovalifolium* poor competitors on sites that are capable of supporting tall or dense vegetation. However, sites where moisture stress is combined with high insolation are highly favorable for plants such as this one. The nutrient deficiencies of limestone soil, exacerbated by the high pH which interferes with mineral uptake, doubtless serve to further reduce competition by fast growing species.

Winter cold is another major ecological factor that affects interior and montane species in the temperate zone. Cushenbury buckwheat, and other low growing cushion species, may be regularly covered by snow during the period of the year when soil moisture is unavailable because the ground is frozen, and when, in arid areas, the humidity of the air may still be very low. When covered with snow, Cushenbury buckwheat is subjected to even less moisture stress than it would be if exposed to the dry air. Under snow, the relative humidity is at virtually 100% and wind effects are excluded. Even when exposed, the low dense form of the plant shelters much of it from direct wind effects. The dense covering of wool on the leaves is evidence that moisture and not light is a major controlling factor for this species. Such a woolly covering will greatly reduce the amount of light striking the chloroplasts in the leaf tissue, but this tomentum also forms a layer of dead air at the leaf surface and may reduce water loss due to wind.

The inflorescence consists of a leafless peduncle (flowering stem) that supports a group of involucres that form a single head-like unbel of cream-white to reddish flowers, with green to reddish midribs, at the tip. The flowers are perfect (possess both male and female parts). Cushenbury buckwheat is distinguished from other mat-forming buckwheats in the San Bernardino Mountains by its compact cushion-form habit, large solitary heads of cream-white to maroon flowers, and round-obovate leaves. There are two similar buckwheat species in the general region. Perhaps the most grossly similar species in the area is southern mountain buckwheat (*Eriogonum kennedyi* var. *austromontanum)*, which occurs in a different habitat (pebble plains) and which has narrower leaves and smaller heads. Its general lifeform is very similar to Cushenbury buckwheat. Skree buckwheat (*Eriogonum saxatile*) is also quite similar, and occurs in the same general areas, but has a more open form and occurs primarily on loose granitic soils on slides and along washes. It is also less long-lived and is seldom conspicuously woody. Its leaf morphology is very similar, but its open cymose inflorescence is quite different from the compact head of Cushenbury buckwheat.

Based on a relatively small sample of herbarium specimens, it appears that Cushenbury buckwheat fruits ripen primarily in about July following the main May-June flowering period, but must ripen later for later flowerings (see below). This would make the seeds ready for germination at the time of any summer rains in August/September, assuming the seeds do not remain dormant for a lengthy period following dispersal. It appears that the relatively large perianth may dry around the fruit, with the achenes remaining attached to the receptacle, and that this whole unit is involved in dispersal, with the dried tepals acting as wings. Wind is thus probably important for local dispersal. Wind is not, however, very effective over long distances. Seed dispersal has not been studied in this species (or variety), but Stokes (1936) thought that birds may play a role in the dispersal of all *Eriogonum* seeds based on various observations of birds and their behaviors. She thought that seeds stored in the crop of a bird killed by a predator might serve to establish new populations in areas distant from existing populations. She also mentioned wind, rain and streams as dispersal agents, but presented no data to support these ideas. Given the extremely restricted distribution of Cushenbury buckwheat, it is not clear that long-distance dispersal has ever occurred and it certainly does not appear to be a common phenomenon. The rest of the varieties of *E. ovalifolium* occur north of the Mojave Desert, such as in the Inyo-White Mtns. and Sierra Nevada (Reveal, 1968) as well as through the Great Basin (e.g., Kartesz, 1988; Welsh et al, 1987; Reveal, 1968). It thus does appear that long distance dispersal occurred at some point, unless there was formerly suitable habitat across the Mojave Desert. There are scattered limestone outcrops on the Mojave Desert that would have supported pinyon woodland when, during the Pleistocene, this more mesic vegetation occupied what are now desert flats (Raven and Axelrod, 1978). These limestone hills could perhaps have served as stepping stones across the desert for populations of *Eriogonum ovalifolium*. It should also be noted that *Eriogonum ovalifolium* in general is not restricted to limestone. Other varieties of the species commonly occur on granite or general alluvium in sagebrush scrub (Reveal, 1968; Welsh et al., 1987). Thus it is possible that this taxon entered the range on other substrates, but then became restricted to limestone by competitive exclusion and subsequent refinement of existing adaptations.

The flowers are relatively large and are clustered into conspicuous head-like umbels. The flowers fade to pink or red at maturity (i.e., probably after pollination) and primarily bloom in May and June. There can be later flowering, for example in September (e.g., Derby and Krantz, s.n., UCR), but the extent of such late flowering or its environmental triggers are unknown. The flowers often dry to a yellowish color in herbarium specimens, but whether this may reflect the original color of some populations is unknown and unlikely. Few collectors of this species appear to bother recording flower color. White (#4012, UCR) has recorded the color of young flowers as "dull white w/reddish vein at centers of "petals" and reddish anthers". Maile Neel (pers. comm.) reports that there is flower color variation within populations and that fresh flowers vary from creamy white to yellowish and that some are pinkish to maroon even when newly opened. She also reports that not all individuals have flowers that turn reddish in age. Clearly, there is need for further study of the trends in flower color in this plant.

Pollination of this plant has only recently been studied, and small insects are almost certainly its pollinators (S. Morita, pers. comm., 1998). The flower color changes to red suggest that the pollinator may be a bee, but such have rarely been observed on the species and Morita (pers. comm., 1998) thinks the pollinators may be generalist flower visitors, rather than a specialist such as a bee. In the summer of 1998 Morita observed nearly 100 insect species visiting this plant, including potential pollinators, plant feeders and others. She noted that because it is relatively late flowering, it is one of the few nectar sources available in its habitat at the time it flowers and so may be heavily visited for that reason. The generalists that are potentially pollinators included many flies, particularly tachinids and bee-flies (Bombylidae), but also many smaller species, such as chloropids. A small species of bee-fly was locally common on the flowers. Two species of small solitary bees (Andrenidae and Halictidae) were also seen visiting, but these were very few (Morita, pers. comm., 1998). Exactly which species serve as effective pollinators has not yet been determined.

Among the plant feeders present were a leaf beetle (Chrysomelidae) which was seen eating the flowers, soft-winged flower beetles (Dasytidae) which were present in the flowers, and various hemipterans, including the small milkweed bug (*Lygaeus*), various plant bugs (Miridae), and stink bugs (Pentatomidae). Grasshoppers (Acrididae) and their nymphs were also present and probably feed on the foliage of the Cushenbury buckwheat.

Habitat Requirements:

This taxon is apparently restricted to carbonate slopes on the north side of the San Bernardino Mountains. As noted above, it seems to display a preference for limestone rather than dolomite, but this needs confirmation. It also seems to prefer stable slopes with bedrock outcropping, and is rarely found on unstable slopes or along active washes. It can be locally common where it is found, but more commonly is present as scattered individuals. Cushenbury buckwheat occurs primarily in pinyon-juniper woodland but also descends into Joshua tree woodland, mixed desert and blackbrush scrub and extends upward into Jeffrey pine-western juniper woodland (Munz, 1974; Skinner and Pavlik, 1994; Gonella and Neel, 1995). Among its typical associates are: single-needled pinyon (*Pinus monophylla*), big-berried manzanita (*Arctostaphylos glauca*), curl-leaf mountain-mahogany (*Cercocarpus ledifolius*), Shockley's rock cress (*Arabis shockleyi)*, rose sage (*Salvia pachyphylla*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush (*C. nauseosus*), big sagebrush (*Artemisia tridentata*), pine needlegrass (*Stipa pinetorum*), canyon live-oak (*Quercus chrysolepis*), nevada forsellesia (*Forsellesia nevadensis*), green Mormon tea (*Ephedra viridis*), blackbrush (*Coleogyne ramosissima*), Coville's dwarf abronia (*Abronia nana covillei*), yellow cryptantha (*Cryptantha confertiflora*), Utah juniper (*Juniperus osteosperma*), small-cup buckwheat (*Eriogonum microthecum*), and Parish's daisy (*Erigeron parishii*).

Based on specimens at UCR, populations occur at elevations between 4800 and 6500 ft. (1450 and 1982 m), though Munz (1974) reports "ca. 5000-5500 ft." (1500-1675 m) and Reveal (1993) reports 1500-2100 m (5000-7000 ft.). Recent plot-based sampling has found it between 4680 and 7840 ft. (M. Neel, pers. comm.), and Melody Lardner (pers. comm.) reports that the Forest Service has the species mapped up to 8100 ft. elevation.

Dana York, a biologist with CalTrans, has collected plants in the Kings River Canyon near Boyden Cave, Fresno County, that Steve Boyd believes are Cushenbury buckwheat (Boyd, pers. comm., 1997). The plants form mats on N-facing carbonate (marble) slopes at 6,000 ft. elevation (York, pers. comm., 1998), which is a habitat very similar to that of *E. ovalifolium* var. *vineum*. York has received different identifications of these plants from virtually everyone he's sent them to, including a determination of *E. o.* var. *nivale* by James Reveal, the foremost expert on *Eriogonum*. York is convinced, however, that the plants are not *E. o.* var. *nivale* because their morphology and habitat are quite different. He has not yet decided exactly what they are, though seems to feel that *E. o. vineum* is a strong possibility (York, pers. comm., 1998). Whatever the ultimate determination about the identity of the Boyden Cave plants, the taxon will still be very rare as the Fresno County population consists of only about 30 plants at one site.

Population Status:

Cushenbury buckwheat is naturally very restricted in its distribution, but has additionally suffered a large but unquantified population decline due to limestone mining (Krantz, 1988; Gonella and Neel, 1995). There are no populations that are secure from mining activity and most are within areas subject to massive disturbance within the next few decades.

Populations of this long-lived plant appear stable in areas where they are undisturbed (pers. obs.), but its habitat has been heavily disturbed and many plants destroyed by mines, haul roads, waste dumps and other mining related activities in recent decades (Krantz, 1988).

Threats Analysis:

The major and only significant threat to this species is the mining of limestone along the north face of the San Bernardino Mountains. It is estimated that over 1600 acres of potential habitat for the various carbonate endemics has been lost to mining (Gonella and Neel, 1995). Because of the steep rocky slopes it occupies, off highway vehicles and urbanization are not significant threats. Likewise, cattle grazing has never been a significant activity in the areas this species occupies. The topography combined with the arid and highly seasonal climate, makes the habitat of Cushenbury buckwheat unsuitable for all these activities. The profitability of limestone mining has made feasible destructive activities on a scale that dwarfs the problems that threaten rare species in other habitats.

Because of their difficult nutrient regime (e.g., Gonella and Neel, 1995), the carbonate slopes are not heavily invaded by alien weeds (pers. obs.), most of which depend on high levels of nitrogen and other nutrients. There are certainly places where weeds are common, but overall it appears that the weed problem is much less severe than it is on granitic soils on the coastal slope of the mountains. It appears that native plant densities on limestone have not generally been adversely affected by weed invasion, as they have been in some other areas.

There has historically been rather weak conservation planning for this species by the relevant agencies (Krantz, 1988), and the mining companies have not taken any proactive steps to assure the continued existence of this plant. In the past 10 years or so, the U.S. Forest Service has been actively trying to design an adequate reserve program, but so far nothing has been formally established. As a result, there has been a continuous incremental loss of both habitat and population by this taxon.

Biological Standards:

The most important issue in the protection of this species is clearly the need for the establishment of a series of reserves protected from limestone mining that support adequately large (and that still needs definition) populations of this species, over a range of the environmental conditions it occupies. There appear to be no populations that are currently in protected status of any sort. Many populations are on public lands, but these are almost all under claim for limestone mining by one company or another (USFWS, 1997). Any reserve design must take into account the need for populations to adjust geographically (shift) in response to long-term climatic change. Reserves must thus include a range of elevations and adequate linkage between zones.

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CUSHENBURY MILKVETCH
Astragalus albens Greene

Author: Pamela J. MacKay, Department of Biology, Victor Valley College, 18422 Bear Valley Road, Victorville, CA 92392

Management Status: Federal: Endangered
California: S1.1, G1 (CDGF, 1998)
CNPS: List 1B, R-E-D code 3-3-3 (Skinner and Pavlik, 1994)

General Distribution:

Cushenbury milk-vetch is found in the northeast end of the San Bernardino Mountain range in San Bernardino County, California. With rare exceptions, it is restricted to carbonate and carbonate-related soils and outcrops from 4000-6600 ft. (1300-2000 m). Its range extends from a ridgetop just east of Dry Canyon to the southeast through Lone Valley, east of Baldwin Lake, to upper Burns Canyon. An unverified population at Box 'S' Springs, two to three miles northwest of Cushenbury at 3600 ft. (1100 m), is its northernmost and lowest reported location.

Distribution in the West Mojave Planning Area:

Cushenbury milk-vetch primarily occurs on U.S. Forest Service lands just outside the WMPA, but extends northward and downslope onto private or BLM lands in Furnace, Bousic, Marble, and Cushenbury Canyons, below Monach Flat and Blackhawk Mountain, at Round Mountain, and at Terrace Springs.

Natural History:

Cushenbury milk-vetch is an herbaceous member of the pea family (Fabaceae), and was first collected by Parish and Parish (Greene, 1885). Several prostrate stems, each 2-12 in. (0.5-3 cm) long, emerge from the base. The leaves and stem have appressed silvery-white hairs, giving the plant a smooth, sleek, gray appearance. The pinnately-compound leaves have 5-9 leaflets which are elliptic to oval-shaped, have obtuse tips, and are each 0.2-0.4 in. (5-10 mm) long. Flowers occur in racemes on 0.8-2.0 in. (2-5 cm) long peduncles. The calyces are about 0.16 in. (4 mm) long, and also bear the silky silvery-white hairs. The papillionaceous corolla is pink to purplish, with both banner and keel 0.3-0.4 in. (7-10) mm in length, exceeding the wing length. The sessile fruits have two locules, are about 0.4-0.7 in. (10-18 mm) long, crescent-shaped, three-sided, and densely strigose (Hickman, 1993; Munz, 1974; Barneby, 1964). This fruit shape helps to distinguish the Cushenbury milkvetch from Bear Valley milk-vetch (*A. leucolobus)* which may also grow sympatrically on carbonate soils (USFWS 1997). It also resembles Mojave milk-vetch (*A. mohavensis)* from the northern Mojave Desert, but Mojave milk-vetch is not pubescent, as is the Cushenbury milk-vetch (Isely, 1984).

Cushenbury milk-vetch has been described both as an annual and as a short-lived perennial herb (Barneby, 1964; Greene, 1885; Hickman, 1993; Munz, 1974; Skinner and Pavlik, 1994). Little is known of its life history. Greene reported that a "good proportion" of the plants flower precociously and are monocarpic, especially in years of low rainfall (Greene, 1885). However, it is not known whether the plants typically flower and fruit the first year, how long they live, or what conditions might cause them to act as annuals in some cases or perennials in other cases.

Flowering occurs from late March to mid-June. Pods ripen at least as early as May, and become stiff and papery with long hairs as they mature.

Pollen vectors are most likely small bees, given the flower shape and color (Faegri and Van der Pijl, 1978). It is not known if this species is self-compatible. Most Cushenbury milk-vetch reproduction presumably occurs by seed, and seeds have been found to have high viability (Tierra Madre Consultants, 1996). Vegetative reproduction has never been reported. Seeds require scarification, and greenhouse experiments have shown that seedlings are susceptible to damping off when grown in pots (Tierra Madre Consultants, 1996). It has long been known that seeds remain dormant in the soil during drought years (Greene, 1885), but the numbers of viable seeds present in the soil and the length of time they can remain viable is unknown. The extent of seed predation, the numbers and kinds of seed predators, and seed dispersal mechanisms are also unknown.

Habitat Requirements:

Generally Cushenbury milk-vetch is restricted to carbonate soils (Gonella and Neel, 1995; Tierra Madre Consultants, 1992), but one account reported populations from non-carbonate soils. Subsequent surveys have not supported this finding (Tierra Madre Consultants, 1992), and it is likely that these plants were on carbonate alluvium that had been deposited over granite bedrock, as is often the case in populations below 5000 ft. (1600 m) elevations (USFWS, 1997). More recently, Cushenbury milk-vetch plants have been found on granitic soil (Psomas and Associates, 1996), but it is likely that these plants fell into the site, along with some carbonate substrate, during a debris slide. It is expected that, as larger species move into the disturbed area, the Cushenbury milk-vetch plants will be eliminated (Psomas and Associates, 1996). It often occupies areas with an open canopy, less litter accumulation (2.3%), higher per cent calcium (average 21.3%), and shallower slope angles (average 12.1) than other carbonate sites that do not support these plants (Gonella and Neel, 1995; USFWS, 1994).

Cushenbury milk-vetch has been reported from Joshua tree woodland and blackbush scrub communities, but is most commonly found in pinon-juniper woodland. It has been reported growing with dominant species Utah juniper *(Juniperus osteosperma)*, joint fir *(Ephedra viridis),* paper bag plant *(Salazaria mexicana),* mountain mahogany *(Cercocarpus ledifolius),* Mojave yucca *(Yucca schidigera*), manzanita *(Arctostaphylos glauca)*, flannel bush *(Fremontodendron californicum),* Great Basin sagebrush *(Artemisia tridentata),* and needlegrass (*Stipa coronata)* (CDFG 1997; Gonella and Neel, 1995).

Population Status:

It has been estimated that there are between 5000-10,000 Cushenbury milk-vetch plants throughout the entire range (USFWS, 1997), and the total number probably varies annually depending on rainfall (Barneby, 1964; USFWS, 1997). Estimates from previous surveys in 1988 indicated a total of just over 2000 plants (Barrows, 1988), but more detailed surveying in subsequent years with greater rainfall led to the increase in estimated number of plants. The population center with the most dense population is most likely in Lone Valley, with 3172 Cushenbury milk-vetch plants found at the proposed Right Star mine site in 1991 (USFS, 1992). However, the variation due to environmental conditions, coupled with the unknown nature of the soil seed population and inability to survey all potential habitat, make it very difficult to develop any reliable estimate of population size.

In general, occurrences of Cushenbury milk-vetch within the WMPA are at the lower elevational edge of the range of this species, and are less dense than those at higher elevations. However, very large areas within the WMPA may support these plants, thus total numbers of plants may be as great as or greater than those found at higher elevations. Reliable estimates for numbers of plants within each general occurrence area in the WMPA are not available, and many areas of potential habitat within the WMPA have not been adequately surveyed. Some data are available from counts taken within general occurrence areas in different years. The following table summarizes available data:

General WMPA area	**No. plants**	**Sources of information**
Furnace Canyon	100[a,c]	Barrows, 1988; CNDDB, 1997
Bousic Canyon	50[a]	Barrows, 1988; USFS, 1995
Cushenbury Canyon	100[b]	USFS, 1995; Henderson, 1998
N. of Monarch Flat	198[b,c]	Barrows, 1988; Henderson, 1995; USFS, 1995
N. of Blackhawk Mt.	78[b]	USFS, 1995; Leverett, 1995
Round Mountain	130[b]	Egan, 1993; Rutherford, 1993; USFS, 1995
Terrace Spring	219[b,c]	Barrows, 1988; Rutherford, 1993; Egan, 1993; USFS, 1995

[a] Highest number of plants found when counts were made at same location in different years.
[b] Sum of highest counts made from different sites within same general area in same year or different years.
[c] Occurrence only partially in WMPA.

Threats Analysis:

Mining. There are at least three multinational companies that currently mine carbonate products within the range of the Cushenbury milk-vetch. The actual amount of product material removed by the mining companies is much lower than the amount of earth that is disturbed during the removal process. Habitat may be destroyed from mining activities such as construction of quarries, access and haul roads, staging areas, processing plants, and dumping of overburden piles on occupied habitat (USFWS, 1997). By 1992, at least 1600 acres (648 hectares) of carbonate soil habitat had been destroyed (USFS, 1992). About 70% of the claims (over 400 acres) have easy access and high resource value, and have current and planned mining (URCEM, 1996).

Other threats. OHV activity, recreational shooting, and competition from exotic species also have impacted Cushenbury milk-vetch habitat, at least in USFS land (USFS, 1992), but these impacts are much less severe than those from mining (USFS, 1992).

Summary. Most of the populations within the WMPA are potentially threatened by human activities. The following table summarizes existing and potential threats to Cushenbury milk-vetch in each general area of occurrence within the WMPA:

General WMPA area	Existing and potential threats	Sources of information
Furnace Canyon	Mining, currently no plans to use quarry Proposed hydroelectric project	CDFG, 1997; USFS, 1992
Bousic Canyon	Mining, population along old road bed	CDFG, 1997
Cushenbury Canyon	Mining, possibly extirpated from type	USFWS, 1997; CDFG,

	locality by cement dust; new powerline proposed along existing right of way; illegal trash dumping; shooting	1997
N. of Monarch Flat	roads provide OHV access	Henderson, 1995
N. of Blackhawk Mt.	roads provide OHV access	USFWS, 1997
Round Mountain	Grazing, mining potential is being investigated; roads provide OHV access	USFWS, 1997
Terrace Spring	Mining, quarry currently closed, but interest in use of tailings.	USFWS, 1997

Constraints to Recovery and Restoration

Natural Recolonization. There appears to be some potential for natural recolonization of slightly disturbed sites by Cushenbury milk-vetch (Barrows, 1988; Tierra Madre Consultants, 1992; USFWS, 1997). This species has been observed on little used roads and on two small quarries that have been abandoned for 20 to 25 years (USFS, 1992). There is no indication that they can tolerate continuous disturbance or high levels of disturbance, such as active quarrying or continual usage of roads (Sanders 1992; Tierra Madre Consultants, 1992). That this species can tolerate a degree of disturbance does not mean that disturbed sites are preferred. At Right Star mine site in Lone Valley, there were significantly fewer Cushenbury milkvetch plants per acre in previously disturbed areas than in adjacent undisturbed areas. A greater proportion of juvenile plants were found in undisturbed areas, possibly indicating more recruitment when there is less disturbance (USFS, 1992).

Propagation. It is uncertain whether Cushenbury milkvetch plants could be propagated in a greenhouse for purposeful revegetation. Although an attempt to germinate seeds was successful as long as seeds were scarified, the necessity to keep soil moist for seedling establishment encouraged the growth of the root rot fungus, *Pythium*, which probably caused death of all of the seedlings in the study (Tierra Madre Consultants, 1996). In a trial revegetation program at Gordon Quarry, Cushenbury milk-vetch plants were salvaged, potted, and kept in a greenhouse prior to relocation and transplant to a field site, but all plants died in the greenhouse. However, plants were observed later in the Gordon Quarry, evidently recolonizing naturally (Tierra Madre Consultants, 1992).

Genetic Characteristics. Cushenbury milk-vetch populations experience extreme fluctuations due to amounts of annual precipitation (Barneby, 1964; USFWS, 1994). This could possibly lead to genetic bottlenecks, which could result in loss of genetic diversity (Barrett and Cohn, 1991). However, recent isozyme research has shown a surprisingly high degree of heterozygosity for an endemic species (Neel, 1999). The maintenance of genetic diversity through years with low populations is likely due to the soil seed bank. Although there are currently no seedbank data, Cushenbury milk-vetch population increases following rainy seasons indicate that seeds must persist in the soil for at least several years.

Human disturbances, such as road building and quarry excavation, cause habitat fragmentation which might eventually restrict gene flow and also lead to loss of genetic diversity and long term population viability (Beeby, 1993).

Biological Standards:

After extensive surveys in Forest Service and WMPA lands, the USFS identified areas suitable for establishment of a series of reserves to protect plant habitats, create buffer zones and corridors to connect protected areas, and provide long-term management and monitoring. Cushenbury milk-vetch occurs within three of these designated areas in the WMPA, including Partin Mine area at Terrace Springs, an area north of Monarch Flat, and an area southeast of the Specialty Minerals headquarters in Bousic Canyon.

The Bureau of Land Management staff have proposed the creation of two areas of critical environmental concern that lie within the WMPA and that include known Cushenbury milk-vetch populations, as well as other carbonate endemic species (Egan, 1993). One of these areas includes Round Mountain and Terrace Spring, and the other is an area north of Monarch Flat.

The U.S. Fish and Wildlife Service recently produced a draft recovery plan for carbonate endemic plants of the San Bernardino Mountains, including Cushenbury milk-vetch. The goals of the plan are to protect sufficient habitat for species persistence by establishment of a reserve system on federally owned lands with buffer zones around the reserves, to monitor populations, and to maintain or perhaps even expand existing populations through reintroductions of plants. Although there have been several criticisms of the draft recovery plan, especially that it lacks detail (White, 1997; USFS, 1998), the USFWS believes that the plan should simply serve as a guide for the other agencies that will actually carry out more specific management plans. The USFWS final recovery plan is currently being developed, and should be published in 1999.

Cooperation among agencies, private land owners, and mining companies will be necessary to develop and carry out an integrated plan to ensure the long term conservation of Cushenbury milk-vetch. An integrated network of reserves, rather than numerous, small, isolated protected areas are necessary to maintain long term viability of Cushenbury milk-vetch populations (Neel, 1997). Building a reserve system may entail trading of lands between agencies and private land owners, establishment of mitigation banks, acquisition of lands, and establishing a minerals withdrawal, so that relinquished claims are not subject to being reclaimed. Without cooperation of all parties, it will be difficult to ensure that reserves will be large enough (USFS, 1998) and contiguous enough to be effective in the conservation of this species.

Research Needs:

Reserve Location and Design. Further research is needed to obtain information necessary for appropriate selection of reserve sites as well as for management of Cushenbury milk-vetch. The specific areas already designated may turn out to be the best locations for recovery plan reserves, and it would be a good strategy to secure these lands as temporary reserves as soon as possible before any more habitat is destroyed. However, just because these areas have the highest number of carbonate endemic species, establishment of reserves in these locations does not ensure long-term population viability of any or all of the carbonate endemic taxa involved. Establishing a reserve for all carbonate endemics does not take into account habitat preferences for each species to be protected (Gonella and Neel, 1995). In addition, these areas may not represent the genetic diversity present within this taxon, and may not represent the ecological range of the taxon, both of which are important criteria in establishing effective reserves (Neel, 1999).

It is recommended that reserves should be set up at a variety of elevations and geographic locations, so that random events, such as fires or flash floods, would not impact all reserves at one time (White, 1997; Neel, 1995), and that each reserve site should include unoccupied habitat into which the species can move in the future (White, 1997).

Life History Research Needs. If data were available on recruitment and reproductive success in various areas within its range, efforts could be directed toward establishing reserves in those sites where the Cushenbury milk-vetch gets established and produces viable seed most readily. Research is needed to determine if the plants always flower and fruit the first year, how long they live, and what conditions influence their life history strategy. This information would be useful in conservation management by helping to predict future reproductive effort and population fluctuations.

If seed bank information were available (such as seed bank population size, numbers and kinds of seed predators, and the extent of seed predation) the genetic repercussions of random population variation due to climate could be more predictable, potential rates of recolonization of disturbed areas might also be determined with more accuracy, and there would be greater precision in determining how large preserves and buffers must be to maintain population viability. If seed dispersal mechanisms were known, there would be a better understanding of potential for natural recolonization.

Research on Habitat Requirements. It would be helpful to obtain information about mycorrhizal associations (White, 1997), and to use available information about soil mineral nutrient content and texture preferences for this species (Gonella and Neel, 1995); reserves could be established and revegetation efforts could be directed only in areas which meet those requirements. To understand data gleaned from monitoring population fluctuations, it is imperative to know how rainfall affects population size from year to year, so these effects can be separated from those from human activities.

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CUSHENBURY OXYTHECA

Oxytheca parishii var. goodmaniana

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Management Status: Federal: Endangered
California: S1.1, G4?T1 (CDFG, 1998)
CNPS: List 1B RED code 3-3-3 (Skinner and Pavlik, 1994)

General Distribution:

Cushenbury oxytheca is endemic to the San Bernardino Mountains of southern California and is restricted to the dry carbonate slopes on the north side of the range. It has never been found outside of this limited area.

Distribution in the West Mojave Planning Area:

Barely entering the WMPA along the north foot of the San Bernardino Mountains on limestone and other carbonate slopes, Cushenbury oxytheca is one of the most geographically restricted plant species of the WMPA, but most of its populations are on the San Bernardino National Forest, above the WMPA margin. As a result of surveys in 1998, it is now known to occur in at least 50 locations from near Terrace Spring west to White Mountain (V. Sosa, pers. comm.), but as recently as 1992 only four locations were known for this plant (Tierra Madre, 1992).

Natural History:

Cushenbury oxytheca is an annual herb of the buckwheat family (Polygonaceae). It is poorly known and was almost unknown before it began to be studied as a result of the realization that most of its limited habitat was subject to elimination by limestone mining. Little has been published on the natural history of the plant and much of what follows is based on personal observation and the study of a limited number of herbarium specimens. It occurs on dry open slopes, mostly in loose scree and talus derived from limestone (Hickman, 1993; pers. obs.).

Oxytheca plants germinate in the fall following the first rains and exist as a vegetative rosette through the winter months. The basal rosette consists of relatively broad, oblong-obovate, green leaves, which are followed in the spring by a slender leafless inflorescence. As the inflorescence matures the leaves wither and dry, so that by the time of late flowering or fruit ripening the plant typically has no living leaves at all. All late season photosynthesis is presumably carried on by the green stems and the involucral bracts. The flowers are white with a reddish midrib, and are apparently insect pollinated. Specific pollinators, germination requirements, seed longevity, and most other aspects of the biology of this species are largely unknown, but there are some recent observations on the insect associates of this plant.

Based on limited observations in the summer of 1998, it appears that the insect pollinators of this species are generalists, such as various flies and possibly small beetles (S. Morita, pers. comm.), rather than highly specialized pollinators tied closely to this species. Small gray beetles of the family Dasitidae were found visiting the flowers (S. Morita, pers. comm.). At least two plant feeding insects have been identified attacking this species, including the bordered plant bug (Largidae: *Largus cinctus californicus*), which is a generalist sap feeder, and an otherwise unidentified leaf beetle (Chrysomelidae) which was observed eating the flowers (S. Morita, pers. comm.). In addition to the above, a number of big-eyed bugs (Lygaeidae: *Geocoris*) were found on the plants (S. Morita, pers, comm.), but these were probably predators on other insects rather than plant feeders (G. Ballmer, pers. comm.).

The taxonomy of Cushenbury oxytheca is in need of clarification, with respect to the distinctiveness of this taxon relative to the other two varieties of *Oxytheca parishii* in the San Bernardino Mountains, var. *parishii* and var. *cienegensis*. Cushenbury oxytheca is most readily separated from the other two San Bernardino Mountains varieties by its possession of only four (or rarely 5) involucral awns (Reveal, 1989). These awns are also shorter (ca. 2-3 mm) and more slender and inconspicuous than those in the other two varieties. Parish's oxytheca (var. *parishii*) is the most widespread and distinctive variety with its numerous (10-36) long (ca. 4-4.5 mm) awns on the involucral lobes. These awns are thicker and much more conspicuous than those in the other varieties. It is also the most widespread variety, due to its habitat preferences -- openings on granitic slopes in yellow pine forest. It is widespread from Big Bear, west through the Crestline/Arrowhead area, and then continuing through the San Gabriel Mountains to the mountains of Ventura County (Reveal, 1989). Variety *cienegensis* is the most poorly known of the three varieties and the one most similar to variety *goodmaniana*. It is intermediate in involucral awn number (7-10) and length (3-4 mm) between the other two varieties. Variety *cienegensis* occurs on various substrates from Tip-Top Mountain to Cienega Seca near Onyx Peak, and plants near Tip-Top Mountain are on limestone and appear to be morphologically transitional toward var. *goodmaniana*. Being recently described (Ertter, 1980), and not being in an area of high environmental impact, this variety has received much less attention from botanists and environmental consultants than has Cushenbury oxytheca. All three varieties are illustrated in the Jepson Manual (Hickman, 1993).

<u>Habitat Requirements</u>:

Cushenbury oxytheca occurs only on carbonate slopes, usually steep ones, and almost always on loose scree or talus. This preference is revealed in the data from the only published results from plot-based population sampling of limestone endemics in the San Bernardino Mountains (Gonella and Neel, 1995). Cushenbury oxytheca was never (0 of 30 plots) found on sample plots centered on Cushenbury milkvetch (*Astragalus albens*) plants but was fairly regularly found on plots lacking this species (Gonella and Neel, 1995). Cushenbury milkvetch is a species typical of stable, often bedrock, slopes. Likewise, Cushenbury oxytheca appears to be negatively correlated with the presence of Cushenbury buckwheat (*Eriogonum ovalifolium* var. *vineum*), another species which prefers stable slopes (Gonella and Neel, 1995). However, recent surveys conducted by Rancho Santa Ana Botanic Garden for the U.S. Forest Service did find Cushenbury oxytheca growing with *Astragalus albens* and *Eriogonum ovalifolium* var. *vineum* in some areas (V. Sosa, pers. comm.).

Populations occur at elevations between 4000 and 7800 ft. (1200-2380 m) in the pinyon-juniper woodland (Reveal, 1989) and Jeffrey pine-western juniper (M. Neel, pers. comm.) vegetation zones which, of course, occurs on the desert-facing slope of the mountains. In this zone air movement is primarily descending and hence often removes moisture from vegetation, rather than depositing moisture as rain as it does on the coastal slope. The resulting lack of rainfall and consequent substrate aridity makes it important that plants be either early flowering or deep rooted, so that they can take advantage of the limited water supply. Cushenbury oxytheca is late flowering (May-June), but has a relatively long straight taproot and presumably is able to tap into supplies of soil moisture below the surface where low atmospheric humidity results in moisture being removed from the soil.

The loose gravel and rock substrate preferred by Cushenbury oxytheca has several important ecological characteristics that may favor this species. The first and most obvious is that, because the slopes are unstable, it is difficult or impossible for larger, potentially competing, trees and shrubs to become established. This leaves the habitat open for smaller annuals like Cushenbury oxytheca to occupy. A second noteworthy characteristic is the coarse and well-aerated character of the substrate, which permits rapid infiltration of rainfall and thus less moisture loss to runoff than would otherwise be expected. It is probable, also, that soil moisture in occupied talus is supplemented by runoff from rocky slopes, cliffs and bedrock outcrops above, where those are present. The loose character of the soil also permits the easy penetration of roots and the coarse surface material serves as a "ock mulch" to retard the loss of soil moisture to the atmosphere. These characteristics permit plant growth after the soil surface has dried.

Population Status:

Cushenbury oxytheca was found at nine of 88 sites sampled on carbonate substrates in the San Bernardino Mountains in 1992 and 1993 (Gonella and Neel, 1995), which clearly indicates that it is more widespread than formerly known though still uncommon. A total of at least 50 populations were known as of 1998 (V. Sosa, pers. comm.), which is a substantial increase from the four known in 1992 (Tierra Madre, 1992), or the 15 reported more recently (USFWS, 1997). It is apparent that a clear understanding of the abundance and distribution of this plant within its narrow range is still developing.

Populations of Cushenbury oxytheca do not appear to exhibit a general downward trend, given the population fluctuations that are normal in an annual plant, at sites where it is not being directly impacted by mining (pers. obs.). Populations are highly variable (White, 1997) at any given site, but plants can be locally common after particularly favorable years. Populations vary in response to rainfall and other climatic conditions, so that at a given site where there was a substantial population one year there may be few to none the next. Even in years when no plants are present, a living seed bank remains. However, large parts of its range are under heavy pressure by mining interests and so overall Cushenbury oxytheca has certainly declined significantly over recent decades. It has been estimated that over 1600 acres of potential habitat for the various carbonate endemics had been lost to mining by 1993 (Gonella and Neel, 1995). Unfortunately, because this plant was little collected and never censused prior to the 1980s, the historical pattern of its population sizes and distribution is unknown, except by inference. At best, we can infer former distributions based on habitat type and general range. Sites that are now mined down to bedrock, but which are in areas which were formerly suitable habitat, must be presumed to have formerly supported this plant. A quantitative survey of the abundance and distribution of this species has recently been completed and this has revealed that the species is more widespread than formerly known (V. Sosa, pers. comm.), though it is still seen to be very restricted in its distribution.

Cushenbury oxytheca is a naturally restricted endemic, but populations have apparently been further reduced by mining activity within its range, based on the widespread disturbance of carbonate habitats (Gonella and Neel, 1995).

Threats Analysis:

Limestone mining is the only significant threat to this species and in the absence of mining, this would not be an endangered species because no other significant threats exist in the area (pers. obs.). This impression is confirmed by the Fish and Wildlife Service (USFWS, 1997) which says that mining is the "imminent and primary threat" to all the San Bernardino Mountains carbonate endemics. The extremely steep rocky slopes, and more particularly oxytheca's preference for unstable sites on those slopes, are powerful barriers to most of the "normal" sorts of destructive activities. The steep slopes it occupies are almost inaccessible by vehicles and even hikers have a difficult time entering its habitat in many areas (pers. obs.). Urban expansion and OHV recreation are generally not feasible in the areas occupied. Grazing does not occur within its habitat. The extent of any threat from introduced weeds is unknown, but appears not to be great. In general, few such plants occur in the habitats occupied (pers. obs.). Because of their difficult nutrient regime (e.g., Gonella and Neel, 1995), the carbonate slopes are not as heavily invaded by alien weeds (pers. obs.) as other substrates. Most of the locally troublesome weeds, especially the grasses, depend on high levels of nitrogen and other nutrients. There are localized areas where weed invasion appears to be a problem, and this is an issue that needs further investigation.

Biological Standards:

Like the other carbonate endemics, the major need for the conservation of this species is preservation of significant areas of undisturbed carbonate that is not subject to mining disturbance. It is critically important to find areas with large populations of this plant that can be protected from disturbance. Such preserve areas should incorporate as wide a range of the environmental conditions occupied by the species as possible. It is also important that as much of the geographical range of the species as possible be protected. Protection of only one or two areas is an inherently risky strategy.

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DEDECKER'S CLOVER
Trifolium dedeckerae J. M. Gillett

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Management Status: Federal: BLM Sensitive
California: S2.3 (CDFG, 1998)
CNPS: List: 1B, R-E-D Code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Dedecker's clover is a California endemic known from scattered localities on the rugged, arid, eastern crest of the Sierra Nevada Mountains from Tulare and Inyo Counties, south to the Spanish Needle area in Kern County. Populations of Dedecker's clover are also found in the White Mountains of Mono and Inyo Counties.

Distribution in the West Mojave Planning Area:

The one West Mojave Planning Area population of Dedecker's clover occurs in the Owens Peak Wilderness Area on the eastern side of Spanish Needle at approximately 2300 m elevation (Shevock, 1997b).

Natural History:

Dedecker's clover was described as a new species by Dr. John M. Gillett (1972). Since this initial paper, little scientific attention has been paid to Dedecker's clover. There appear to have been no studies of any aspect of its ecology or natural history. The interest that has been shown in the species has been strictly taxonomic. There is much confusion concerning the evolutionary relationships and distinctness of the plant, and consequently about the correct Latin name assigned to it (Vincent, 1997). Isely (1993) and Barneby (1989) both treated Dedecker's clover has been treated as a variety of *Trifolium macilentum*. Others have thought that its relationships are with *Trifolium kingii* and have treated it as a subspecies of that plant, *T. kingii* ssp. *dedeckerae* (Zohary and Heller, 1984). In this account both these names are treated as synonyms of *Trifolium dedeckerae* and it is treated as a distinct species, though I agree with the placement of it nearer to *T. kingii*.

Dedecker's clover is a small, glabrous, rhizomatous perennial herb in the pea family (Fabaceae). The leaves, with three very narrow leaflets, are mainly basal with 2-3 leaves being found on the stem (Gillett, 1972). Pink to pale violet flowers are produced from June to early July on short stalked pedicels which quickly elongate and reflex the flower downward (Isely, 1993). Several characters separate Dedecker's clover from other *Trifolium* species of the southern and central Sierra Nevada Mountains with which it could be confused. Dedecker's clover differs from carpet clover (*T. monanthum* var. *monanthum)* and cast clover (*T. wormskioldi)* in lacking a wheel-like cluster of fused bracts at the base of the inflorescence (Isely, 1993). The glabrous, entire lobes of the calyx separate Dedecker's clover from long-stalked clover (*T. longipes* var. *nevadense)* and Beatley's clover (*T. andersonii* var. *beatleyae)*, both of which have ciliate or puberulent calyx lobes (Isely, 1993). Dedecker's clover seems to be most closely allied with Shasta clover (*T.* kingii var. *productum*), which occurs as far south as Sonora

Pass in Tulare County, but differs by narrower leaflets, larger calyx (with slender lobes) and a broad standard (upper petal of the flower).

Pollination requirements are not known for this species, but like most similar legumes it is presumably bee pollinated.

Habitat Requirements:

Dedecker's clover occurs in dry, rocky crevices and on gravely slopes and canyon floors derived from granitic and metamorphic substrates (Shevock, 1997b). Dedecker's clover is found in a wide variety of vegetation types throughout its range, but lacks a single indicator habitat in which it is most often found (Shevock, 1997b). Associated species include single-leaf pinyon (*Pinus monophylla*), sierra juniper (*Juniperus occidentalis* ssp. *australis*) and Jeffrey pine (*Pinus jeffreyii*) and occur between 2100 m and 2600 m elevation. Other species with which Dedecker's clover can be associated include Sagebrush (*Artemisia* spp.), Rabbitbrush (*Chrysothamnus* spp.), linanthus *(Linanthus* ssp.), Snowberry (*Symphoricarpos* ssp.), Gooseberry (*Ribes* ssp.) and Morman Tea (*Ephedra* ssp.).

Population Status:

A peculiar trend has been noted for Dedecker's clover populations occurring on the highest peaks within its range. These populations tend to be very depauperate in the number of individuals present (Shevock, 1997b). This may be the result of the sparse seed-set (1-2 seeds per fruit) by Dedecker's clover (Isely, 1993) or rather the small size of the seeds (Shevock, 1997b). It may also simply reflect more difficult environmental conditions at the highest elevations.

Threat Analysis:

The wide range of Dedecker's clover, its occurrences on federal lands (National Forest land and wilderness areas), and the relative inaccessibility of most populations contribute to a low threat to the species (Shevock, 1997b). Various activities such as trail maintenance, fire prevention strategies and issuance of permits for mining and timber operations could potentially impact certain low elevation sites. Grazing and OHV traffic do not represent a great threat as population localities make these land uses impractical. The rugged terrain in which Dedecker's clover grows should also help protect it from logging and grazing pressures on steep sites with lean soils within non-wilderness lands. The remoteness of Dedecker's clover populations and the ruggedness of the habitat should also greatly reduce the possibility of habitat destruction by off-trail human activity.

Biological Standards:

All known populations of Dedecker's clover occur on federal lands, with most on National Forest parcels. This fact should make conservation management decisions easier since the species' habitat is entirely under federal management. Public lands management should concentrate on known Dedecker's clover populations and survey potential habitat before management decisions are made, especially in relation to the small high peak populations. The existence of high peak populations may be an important link to the taxon's historical range and may provide insights into potential future surveying localities. These small isolated populations may also have distinct genetic identities that make them potentially important for future conservation efforts. Within the wilderness areas, management decisions such as trail maintenance, future trail expansion, and fire prevention strategies, especially along the Pacific Crest Trail in the Owens Peak Wilderness, the only access Spanish Needle Peak (Shevock, 1997a), should focus on known Dedecker's clover populations to reduce the risk of habitat alteration or destruction.

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DESERT CYMOPTERUS

Cymopterus deserticola Brandegee

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S2.2, G2 (CDFG, 1998)
CNPS: List 1B, RED code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

The entire known range of desert cymopterus occurs in the western Mojave Desert within the WMPA.

Distribution in the West Mojave Planning Area:

Desert cymopterus has been reported in widely scattered, generally highly dispersed and small populations in the WMPA. This species ranges from Apple Valley, San Bernardino County, northward approximately 55 mi. (89 km) to the Cuddeback Lake basin, San Bernardino County, and westward approximately 45 mi. (73 km) to the Rogers and Buckhorn lake basins on Edwards Air Force Base, Kern and Los Angeles counties (Bagley, 1995; BLM, 1977; CDFG, 1997; Dames and Moore, 1993). However, the Apple Valley sites are disjunct by at least 28 mi. (45 km) from the nearest known sites and they are known only from historic collections made in 1915, 1920 and 1941. More recent attempts to locate desert cymopterus in areas of the historic Apple Valley collections have been unsuccessful and it appears likely that these sites may have been lost to urban development and off-highway vehicle (OHV) use (Moe, 1988). The known extant portion of the range, not including Apple Valley, occurs in three adjacent areas: the Rogers Lake basin (including the small Buckhorn Lake area to the west and the Kramer Hills to the east), the Harper Lake basin, and the Cuddeback Lake basin. This extant portion of the range extends approximately 40 mi. (65 km) east-west and 35 mi. (56 km) north-south.

The largest of these areas is in the Rogers Dry Lake basin. Desert cymopterus occurs in this area, in sometimes widely separated populations, extending approximately 30 mi. (48 km) east-west, from the Kramer Hills to Buckhorn Lake, and about 19 mi. (30 km) north-south, from Peerless Valley to just south of Rogers Lake. Most of the known desert cymopterus sites in this portion of its range occur on Edwards AFB, in scattered sites near Rogers Lake and Buckhorn Lake, eastward across the Base to the Kramer Hills, including a site in the upper portion of Buckthorn Canyon which drains southeast to the Mojave River. One site occurs east of the Base in the Kramer Hills and five sites occur just north of the Base and south of the Santa Fe Railroad line, in the vicinity of Kramer and Boron. Kramer (the old Kramer Railroad Station located about 2.5 mi. (4 km) west of Kramer Junction) is the type locality for this species, first collected there in 1913 by Mrs. K. Brandegee (Brandegee, 1915). One other known site in the Rogers Lake basin occurs about 6 miles north of Edwards AFB in Peerless Valley (Bagley 1991, 1997; BLM, 1997; CDFG, 1997). Up to 130 plants have been reported from the Peerless Valley site, but fewer than 60 plants from the other six desert cymopterus sites that occur off of Edwards AFB in this area.

Prior to extensive surveys conducted in 1995, desert cymopterus had been reported from 29 sites on Edwards AFB, some of which were poorly documented as to location or source and some which were quite close together (Bagley, 1995). The 1995 surveys relocated 19 of these previously known sites and discovered 57 new locations on Base. This large number of new sites was no doubt due partly to the extensive effort made to search for them, but also partly to the wet winter and spring weather which produced an exceptionally abundant year for Mojave desert wildflowers, including desert cympoterus. Fewer than 1700 plants had previously been reported for the 19 known sites on Base, with one site accounting for 1000 plants and two others together accounting for about 300 plants. In 1995, 10,402 plants were counted at these 19 sites; one site with over 3200 plants, four other sites with over 1000 plants each, and two additional sites with over 500 plants each. In all, 76 desert cymopterus sites were observed on Base in 1995, and there were 14,362 plants counted. Unfortunately, no surveys for desert cymopterus appear to have been conducted off of Edwards AFB in 1995.

Desert cymopterus was first discovered in the Harper Lake basin by Mark Bagley in 1989 (ENSR, 1989). There are now seven reported sites, all within 4.5 mi. (7 km) of the Harper Lake playa. Six of these sites are along an east-west utility corridor that lies about one mile south of the playa. The seventh site lies about one mile to the north of the playa. Approximately 160 plants have been reported from these seven sites (CDFG, 1997; Dames and Moore, 1993). Approximately 7.5 mi. (12 km) separates the westernmost desert cymopterus site in the Harper Lake basin from the nearest Rogers Lake basin site in the Kramer Hills.

In the Cuddeback Lake basin, just north of the Harper Lake basin and northeast of the Rogers Lake basin, desert cymopterus populations are known from three sites. These sites all lie to the northeast, within 1.25- 2.5 mi. (2-4 km) of the playa. These were first discovered by Mary Ann Henry in 1988 (CDFG, 1997). A total of about 25 plants has been reported at these sites. Approximately 17 mi. (27 km) separates the Cuddeback Lake sites from the nearest Harper Lake site, and about 25 mi. (40 km) separates them from the nearest Rogers Lake basin site at Kramer.

Natural History:

Desert cymopterus is an early-spring flowering herbaceous perennial in the carrot family (Apiaceae). A detailed description of this species is found in Mathias (1930), and subsequent descriptions in floras appear to be based on this work. Desert cymopterus is an acaulescent plant, generally to about 6 in. (15 cm) high. It has long, slender, deep, tap roots with one or more leaves arising below ground from a short combined stem-root crown. Typically, there are one to several leaves per plant (pers. obs.; Charlton 1993; Smithsonian Institution, 1978). Petioles are about as long or longer than the leaf blades, but typically much of the petiole is hidden underground. Leaf blades are oblong-ovate in outline, highly dissected, grayish-green, and hairless. Purple flowers are clustered in a compact globe at the end of each leafless peduncle that rises above the leaves.

Mathias (1930) reports petole length as 1.5-3.9 in. (4-10 cm), leaf blade length as 0.8-2.6 in. (2-6.5 cm), and blade width as 1-3.5 in. (2-9 cm). A slightly longer blade length, 1.5-3.2 in. (4-8 cm), was reported in a 1977 study on Edwards AFB (Smithsonian Institution, 1978). However, in a 1995 Edwards AFB study during an exceptionally wet year, desert cymopterus plants were much larger and more vigorous than these descriptions indicate (Bagley, 1995). In that study, where the largest leaf was measured on more than 1,000 plants in three separate populations, the mean petole length (above ground only) was 2 in. (5.0 cm), with a maximum of 6 in. (15.2 cm); mean leaf blade length was 2.5 in. (6.3 cm), with a maximum of 4.2 in. (10.7 cm); and mean blade width was 2.4 in. (6.0 cm), with a maximum of 4.4 in. (11.1 cm). Instead of the one to several leaves per plant usually observed, or the mean of 2.6 and maximum of 14 leaves per plant reported in a 1992 study at the same sites (Charlton, 1993), the 1995 study plants had a mean of 5.2 and maximum of 28 leaves per plant.

Desert parsley *(Lomatium mohavense)* is the only other member of the carrot family within the range of desert cymopterus that might be confused with it. This species has similar highly dissected leaves in a basal cluster, but is readily distinguished from desert cymopterus by the dense, short covering of fine hairs on the leaves and by the flowers arranged in distinct compound umbels. Good illustrations and descriptions of desert cymopterus are found in Abrams (1951), Constance (1993), Jaeger (1941), and Smithsonian Institution (1978).

Desert cymopterus is a long-lived perennial geophyte, with perennating buds located underground at the top of the root crown (Charlton 1993; Smithsonian Institution, 1978). This species typically grows in the cool, moist conditions of winter and spring. The rainy season normally ends by early spring and plants quickly dry out and go dormant with the onset of hot weather, usually in April or May (pers. obs). Thus, there is a long period of dormancy when the plants are not visible above ground.

Limited data are available on population fluctuations in desert cymopterus. In dry years, it appears that some plants in a population may produce one or a few small leaves, but many plants (or possibly all plants in a very dry year) stay dormant throughout the normal growing season (pers. obs; Bagley, 1995). Like desert annuals, observable population numbers appear to fluctuate widely from year to year, apparently in response to the amount and timing of winter and spring rainfall (Bagley, 1995; Charlton, 1993; CDFG, 1997). This makes it very difficult to determine population trends. Nothing is known of the physiology of dormancy in this species or how long a dormant period plants can endure.

The highly dispersed, low density nature of many desert cymopterus populations may indicate that establishment of new individuals in a population is infrequent (Constance, 1979; Smithsonian Institution, 1978). The actual populations may also be larger than have been observed, due to high dormancy in drier years, as suggested by the results of the 1995 surveys on Edwards AFB. Very little is known about reproduction and recruitment in this species and nothing is known about pollination. Flowering occurs from March to early May, depending on the year (pers. obs.; Bagley, 1995; Constance, 1979; Moe 1988). If establishment is infrequent, poor seed production or seed survival may be a factor. Little or no seed production has been observed in several different years at a number of sites (pers. obs.; Charlton, 1993; Moe 1988). Moe found desert cymopterus at five sites in 1988 and at all sites reported that the inflorescences dried up and aborted before setting fruit. In a 1992 study at three sites on Edwards AFB, Charlton reported that only a small portion of the plants flowered and that only 37 inflorescences out of a total of 424 produced were observed to successfully produce seed (n=1084 plants). However, in the exceptional year for desert cymopterus in 1995, observations at the same sites on Edwards AFB showed that most plants (95%) produced inflorescences during the growing season, with an average of 1.8 inflorescences per plant and a maximum of 19 (Bagley, 1995). Near the end of the growing season 51.3% of the plants had set fruit (n=1129 plants). Seed viability, longevity in the soil, and predation on the rather large seeds has never been studied.

Successful reproduction is critical to the long-term survival of any population. Because of the annual variability in rainfall, the underground parts of herbaceous desert perennials, including desert cymopterus, must be able to survive prolonged periods of low soil moisture and entire years without above-ground photosynthetic activity. These plants must also have the ability to maintain their populations over time with frequent years of reproductive failure (Beatley 1976). In dry years they may grow a few leaves, but not produce flowers or fruit. In very dry years they may endure drought by remaining dormant underground during the usual growing season. And, in very wet years they may produce flowers and fruits abundantly. The 1995 observations clearly demonstrated that desert cymopterus on Edwards AFB survived the 1988-1994 drought in large numbers and with great vigor and reproductive potential. It is most likely that populations of desert cymopterus are maintained by periodic recruitment only after these years of exceptionally favorable conditions.

Habitat Requirements:

Desert cymopterus is known to occur in deep, loose, well drained, fine to coarse sandy soils of alluvial fans and basins, often in swales or stabilized low sand dune areas and occasionally on sandy slopes. The known elevation range of this species is 2060-3060 ft (692-933 m), although Constance (1993) erroneously reports it at ± 4875 ft. (1,00 m) (Bagley, 1995; CDFG, 1997). It occurs in Mojave creosote bush scrub, desert saltbush scrub, and Joshua tree woodland with creosote bush scrub or desert saltbush scrub understory (Holland 1986). Common perennial associates growing with desert cymopterus include creosote bush *(Larrea tridentata)*, Joshua tree *(Yucca brevifolia)*, saltbush (*Atriplex polycarpa, A. canescens, A. spinifera, A. confertifolia)*, burro bush *(Ambrosia dumosa)*, goldenhead *(Acamptopappus sphaerocephalus)*, winter fat *(Krascheninnikovia lanata)*, peachthorn *(Lycium cooperi)*, cheesebush *(Hymenoclea salsola)*, desert croton *(Croton californicus* var. *mohavensis)*, and Indian rice-grass *(Oryzopsis hymenoides)*. The latter four species, in particular, are indicators of sandy habitats. A few sites occur in areas lacking creosote bush or saltbush as common species (Bagley, 1995); these areas are dominated by cheesebush and peachthorn with goldenhead and spiny hopsage (*Grayia spinosa*) and may fit better in the Mojave mixed woody scrub community type (Holland 1986). Desert cymopterus plants typically are widely scattered, usually growing in openings between shrubs. A diversity of annual species typically also occurs in these sandy habitats.

Population Status:

Desert cymopterus was formerly a federal Category 1 candidate for listing. It was removed from candidate status in February of 1996 by the U.S. Fish and Wildlife Service solely on the basis that it "occurs within the area being addressed by the West Mojave Coordinated Management Plan, which will function as a multi-species habitat conservation plan and this action will alleviate many of the threats to the species" (USFWS, 1996).

Until 1977 desert cymopterus was known from fewer than a dozen herbarium collections that probably represented no more than seven populations located near Kramer, Rogers Lake (formerly Muroc Dry Lake), Peerless Valley, and Apple Valley (CDFG, 1997). Observations since 1977 have substantially increased the number of known sites in the Rogers Lake basin and adjacent Kramer Hills. And, in the late 1980's, populations were discovered in Cuddeback and Harper Lake basins, extending the known range about 25 mi. (40 km) to the north and 10 mi. (16 km) east.

Historic Apple Valley collections, last made in 1941, were probably all from near Highway 18. This area is all private land and heavily developed now. Desert cymopterus was searched for, but not seen, in this area in 1986 and 1988; it was reported that little suitable habitat remains due to commercial and residential development and ORV use (CDFG, 1997; Moe, 1988). The Natural Diversity Data Base considers this occurrence to be "possibly extirpated" (CDFG, 1997). Other surveys for this species in the Victorville-Apple Valley area have not been reported and surveys conducted in a wet year are needed to determine the status of desert cymopterus in this area.

With a number of sites very close together, and similar habitats connecting these to each other, it appears likely that desert cymopterus on Edwards AFB forms one highly dispersed population, with several areas of very favorable habitat where population densities are relatively high (Bagley, 1995). The five sites just north of the base near Boron and Kramer, on private land, and the Kramer Hills site, on BLM land, would be part of this dispersed population. The desert cymopterus site in Peerless Valley, on private land, appears to be an outlier to the north separated by several miles of unfavorable habitat. In this Rogers Lake basin-Kramer Hills area, approximately 14,300 desert cymopterus have been reported on Edwards AFB, about 180 plants on private land, and two plants on BLM land.

The distribution of this species on private versus BLM land in the Harper Lake basin in not known because of the patchwork of BLM and private land and the fact that the precise locations of some of the sites are not well documented. However, at least three of the seven reported sites in this area are on BLM land (one only partially) and these account for 104 of the approximately 160 desert cymopterus reported in this basin.

In the Cuddeback Lake basin, two of the three known sites occur on BLM land, the other is private. Only one of the approximately 25 desert cymopterus plants reported in this basin occurred on private land.

Over all, approximately 97% of the reported desert cymopterus plants are known to occur on Edwards AFB, about 2% on private land, and 1% on BLM land. This distribution is likely due in part to the fact that extensive efforts have been made to inventory this species on Edwards AFB and that similar efforts have not been made off Base. It also reflects the fact that extraordinarily large numbers of desert cymopterus were found on Base in 1995, an exceptionally wet year when apparently no surveys were conducted for this species off Base. There are many sandy sites outside of Edwards AFB that may provide suitable habitat for this species on both public and private lands within the Rogers, Harper and Cuddeback lake basins and surrounding areas (pers. obs.). Surveys in these areas, and in the intervening areas south to the historic sites in Apple Valley, need to be conducted in order to improve our understanding of the distribution and abundance of desert cymopterus. Given the lack of past efforts to search for this species outside of Edwards AFB, the amount of potentially suitable habitat within its known range, its relatively short season of growth and disappearance underground during its dormant periods, and the apparent population fluctuations between wet and dry years, it seems quite possible that desert cymopterus could be more widespread and abundant than we now know.

Threats Analysis:

Current threats to desert cymopterus are not obvious. The California Native Plant Society indicates that this species is threatened by sheep grazing, vehicles, and urbanization (Skinner and Pavlik, 1994). In addition, the Cuddeback Lake sites are located within the BLM Pilot Knob grazing allotment and cattle grazing has been reported as a threat to these populations (CDFG, 1997), however the Pilot Knob allotment is being retired from grazing.

There is no hard evidence about the affects of sheep or cattle grazing on desert cymopterus populations. Sheep grazing in sandy Mojave Desert soils typically results in extensive trampling and disturbance of the top several inches of the soil and the removal of the above ground parts of almost all herbaceous plants in the area grazed (pers. obs.). However, at the current time livestock grazing is not a factor over most of the range of desert cymopterus. Sheep grazing has been eliminated from BLM lands east of Highway 395 because of its impacts to the listed desert tortoise (Glen Harris, BLM Ridgecrest, pers. com.). Grazing is not permitted on Edwards AFB, although some sheep trespass has occurred on some desert cymopterus habitat on base. Additionally, cattle grazing is not currently occurring on the Pilot Knob allotment. The Desert Tortoise Preserve Committee and the Wildlands Conservancy have purchased the core property for that allotment and requested a permanent reservation from grazing which could be granted through the West Mojave Plan. The desert cymopterus populations on private land in the vicinity of Boron and Kramer Junction may be subject to sheep grazing and the site in Peerless Valley was grazed and trampled by sheep at least in 1991 and 1996 (pers. obs.). As long as grazing is not permitted on Edwards AFB, the Pilot Knob allotment, and east of Highway 395, grazing will potentially impact only a small portion of the known range of desert cymopterus.

In addition to potential grazing impacts, high levels of leaf predation in desert cymopterus have been observed in two studies on Edwards AFB in areas not grazed by livestock (Bagley, 1995; Charlton, 1993). More limited observations of high predation have been recorded off Base (pers. obs.; CDFG, 1997). This predation is presumably by native mammals (such as rabbits, hares, ground squirrels, mice, and kangaroo rats), insects (caterpillars and beetles), and desert tortoise. This predation may limit the reproductive potential and vigor of the plants, and contribute to the low density, dispersed nature of most of the reported desert cymopterus populations.

A number of roads go through desert cymopterus populations and no doubt the creation of these reduced the habitat for this species to a small extent. In the Apple Valley, where this species may be extirpated, OHV use has been cited as seriously impacting potential desert cymopterus habitat (Moe, 1988). In all other reported sites, vehicle use has been confined for the most part to existing roads (pers. obs.; M.A. Henry, pers. com.). Vehicle use therefore does not appear to be a current threat to this species.

Urbanization has apparently extirpated this species from the Apple Valley, although additional searches should be made to confirm this. Recent development pressures in the extant portion of the range of desert cymopterus have not been extensive; they include development along several existing utility right-of-way corridors, some expansion of facilities at Edwards AFB, and in the late 1980's and early 1990's development of solar power plants in the Harper Lake and Kramer Junction areas. There is the potential for further development, including increased facility expansion at Edwards AFB, additional utility and solar power development, and urbanization, particularly in the Peerless Valley, North Edwards, Boron, and Kramer Junction areas. If this species does not receive some protection, the urbanization of the Mojave Desert which is occurring to the south (as in the Antelope Valley, Apple Valley, Victorville, and Adelanto areas) could spread northward over the next 20-50 years and have very significant impacts to desert cymopterus. Protections for the desert tortoise may provide some protection for desert cymopterus. Although desert cymopterus may be more abundant than previously thought, its known range occupies a very restricted portion of the western Mojave Desert, that portion which is adjacent to a very fast growing part of California.

Biological Standards:

Currently, the known areas where desert cymopterus are most dense occur on Edwards AFB just south of Rogers Lake, west of Leuhman Ridge, and south of Leuhman Ridge. At a minimum, significant portions of these areas should be protected to maintain these populations. Protection of habitat corridors between these populations may also be essential for their long term viability. However, our knowledge of the distribution and abundance of desert cymopterus off of Edwards AFB is too poor for proposal of protective efforts off Base. Focused surveys for this plant should be conducted outside of Edwards AFB to determine if high density sites exist and how any such areas could be protected.

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ERTTER'S OR WALKER PASS MILKVETCH

Astragalus ertterae

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S1.3, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Ertter's milkvetch is a narrowly distributed endemic with three known populations, all occurring on Federal lands. Its distribution is limited to the Walker Pass area in the southern Sierra Nevada Mountains, Kern County, California, with all known populations occurring along the Pacific Crest Trail (PCT; Barneby and Shevock, 1987). One population is located at the first saddle southwest of Walker Pass, a second population occurs approximately 1.5 mi. (2.5 km) southwest of the pass, and a third population is about 1.5 mi. (2.4 km) north of the pass. The two southern populations occur in the Sequoia National Forest (SNF; outside the planning area), while the third (northern most) population occurs within the BLM Caliente Resource Area (just outside the planning area). According to the most recent reports in the California Natural Diversity Data Base (CNDDB), it is estimated that there are about 700 plants between the two occurrences on Forest Service managed land and approximately 50 plants in the occurrence on BLM managed land (CNDDB, 1997).

Distribution in the West Mojave Planning Area:

None of the known populations occur within the WMPA, the northern population which is approximately 1.5 mi. (2.5 km) north of Walker Pass is just outside the planning area. Barneby and Shevock (1987) and J. Shevock (pers. comm., 1997) reported that there is additional habitat along the western slope of the crest of the southern Sierra Nevada (away from the PCT) that appears to be suitable for Ertter's milkvetch, however, only these three populations are known to exist.

Natural History:

Ertter's milkvetch is a low growing to procumbent herbaceous perennial in the pea family (Fabaceae, tribe Papilionoideae). It was first described in 1987 from a collection made in 1982 along a newly constructed section of the PCT (Barneby and Shevock, 1987). The entire aerial portion of the plant, except the petals and fruit, is covered with fine hairs. It has a woody tap root, a short buried caudex, and typically has about half of the stem length underground. The stems (2-6 per plant) can attain lengths to 4 in. (10 cm) with the four to five leaves and one to three peduncles all crowded on the upper part of the stem. The leaflets (9-13) are oblanceolate with blunt to narrowly notched tips and have a greenish-cinereous appearance. The crowded and ascending inflorescences have seven to seventeen flowers with cream colored petals that bloom from April to May. The swollen glabrous pods are pendulous, triangular in cross section, and dehisce apically (Spellenberg, 1993).

The distinct features of the pod (as described in Barneby and Shevock, 1987) readily distinguish it from the other *Astragalus* species reported in the area by Twisselmann (1967). Its closest relative appears to be crested milkvetch (*A. bicristatus* , sect. Bicristati; Barneby, 1964), a localized species in the San Gabriel and San Bernardino Mountains (Barneby and Shevock, 1987; Munz, 1974). Ertter's milkvetch differs from crested milkvetch in geographic range and in having a plump triangular pod, dwarf stature, smaller flowers, and fewer ovules (Barneby and Shevock, 1987). Other less closely related and similar species are Webber's milkvetch (*A. webberi*), Beckwith's milkvetch (*A. beckwithii*), and Cima milkvetch (*A. cimae*; Barneby and Shevock, 1987).

The biology of Ertter's milkvetch appears to have escaped study. There is no mention in the literature of the extent of fruit or seed set for this plant. The existence of predation on the seeds, as is common with other *Astragalus*, is also not known. Likewise, there appears to be no information available on pollination, seed dispersal, or germination requirements of this species.

Habitat Requirements:

This taxon is highly restricted and only occurs in openings within pinyon-juniper woodland. It grows in the sandy-loamy to granitic soils associated with pinyon pines and canyon live oaks. It is primarily found on west-facing slopes from 5600-6200 ft. (1705-1890 m). Other major plant associates include sulfur-flowered buckwheat (*Eriogonum umbellatum)*, heliotrope (*Phacelia* spp.), big sagebrush (*Artemisia tridentata*), and mountain-pennyroyal (*Monardella odoratissima*). Although it has been reported that suitable habitat appears to be common in pinyon-juniper woodlands on the west slope of the crest in the southern Sierra Nevada, only three populations have been documented (Barneby and Shevock, 1987). This species' highly restricted and endemic nature may indicate that 1) there are precise habitat requirements that have yet to be identified; 2) this plant is a fire follower, as is common with other *Astragalus*, and possibly exists as a dormant seed bank in suitable habitat; or 3) all suitable areas have yet to be searched. Botanical collecting and documentation in the southeastern Sierra Nevada has been sparse to date, due to its remote location, limited access, lack of potable water, and the rugged conditions. In the past 15 years, a number of new species have been described from this area, including Ertter's milkvetch. Further exploration of this area may yield more Ertter's milkvetch populations as well as additional new species (Shevock, 1987).

Population Status:

Ertter's milkvetch has three known populations, all of which occur in the Walker Pass area in the southern Sierra Nevada, Kern County, along the PCT. The largest population, at the first saddle southwest of Walker Pass (SNF), consists of approximately 500 individuals. The other two populations, approximately about 1.5 mi. (2.5 km) southwest of the pass (SNF) and 1.5 mi. (2.5 km) north of the pass (BLM), consist of about 200 and about 50 individuals, respectively, according to the CNDDB (CDFG, 1997).

Threats Analysis:

Threats to this species have not been well documented, and in fact none are listed by the CNDDB (CDFG, 1997). Potential threats include grazing, trampling, trail maintenance, over collection, and stochastic events.

Cattle grazing could severely threaten this species, however, according to Shevock (pers. comm., 1997) this is unlikely due to the isolated location of the populations and the lack of water for cattle in the area. Despite the fact that cattle grazing permits are issued for the area by the Sequoia National Forest (Shevock, pers. comm., 1997), threats from cattle grazing are here considered potential, but minimal.

There is a possible threat from foot trampling due to the proximity of the PCT, which bisects two of the populations (Shevock, pers. comm., 1997). Construction and maintenance of the PCT is also a threat that has already caused the destruction of part of two populations (Shevock, pers. comm., 1997). Presumably most hikers remain on the trail, so the extent of the trampling threat is not likely to be great, and presumably there will be little further trail construction occurring, thus leaving only maintenance as a continuing threat. Perhaps the PCT could be rerouted in the future to avoid these occurrences altogether.

Human collection may be a threat to this species (G. Harris, pers. comm., 1997), but this appears very unlikely to be significant according to J. Shevock (pers. comm., 1997). There is no known collecting of this species except, rarely, for scientific purposes. The isolated location and lack of scientific plant collectors makes a significant impact from this activity appear very unlikely (A. Sanders, pers. comm., 1997). Scientific collectors are more likely to document additional populations than they are to eradicate known ones. The collecting threat is obviously greater for smaller populations, such as that population of 50 plants on BLM land, than it is for larger stands. The removal of five plants from a population of 50 would obviously be a larger impact than the removal of a similar number from a larger population. Casual flower pickers are not likely to completely destroy a plant in picking, but rather are likely to "top snatch" a few plants. Digging up the roots is more work than most casual collectors are likely to attempt.

This plant may be vulnerable to stochastic extinction events due to its highly restricted distribution, the limited number of populations, and the small number of individuals per population (CDFG, 1997).

There is no known threat to the habitat or range by urban or private development or road maintenance since all three populations occur on remote federal lands. The ruggedness of the terrain reduces the potential threats from off road vehicles. Threats from mineral exploration and development and water developments and impoundments are unknown. There is no known threat from disease or predation, but no information as well as the species has never been studied in this respect.

It should be noted that the plants extremely limited distribution and small population sizes magnify any threat affecting this species.

There are currently no existing regulatory mechanisms protecting Ertter's milkvetch. It is not afforded protection under state or federal laws, though all of the known populations are on federal lands, which does offer some protection.

Biological Standards:

Until the distribution and ecology of this species are better understood, effective management is not possible. There is considerable habitat that appears to be suitable for this species in pinyon juniper woodlands on the west slopes of the crest of the southern Sierra Nevada. The highest immediate priority for this species must be the initiation of comprehensive surveys of this potential habitat to determine the precise status of this plant. Until its status has been clarified by further surveys, the most important aspect of maintaining the long term viability and evolutionary potential of Ertter's milkvetch is to protect the few known population sites from disturbances that would depress or eliminate populations. If this plant truly is as rare as presently believed, it is crucial that all existing populations be protected. All potential habitat areas should be considered in all land management decisions by Sequoia National Forest and the BLM Caliente Resource Area, and careful surveys should be required before any actions are permitted which could potentially damage populations of Ertter's milkvetch, either known or yet to be discovered.

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HALL'S DAISY
Erigeron aequifolius H. M. Hall

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Management status: Federal: BLM Sensitive
California: S2.3, G2 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Hall's daisy is endemic to the southern Sierra Nevada Mountains and is known from fewer than 20 sites (Skinner and Pavlik, 1994). The northernmost known populations occur at Wren Peak in eastern Fresno County and from there the species extends south along the high ridges of the Sierra Nevada in Tulare County to Owens Peak in Kern County. Most populations occur on National Forest or National Park Service lands. The species is known only from the three counties just mentioned (Skinner and Pavlik, 1994).

Distribution in the West Mojave Planning Area:

A single population of Hall's daisy occurs in the WMPA at approximately 8000 ft. (2440 m) on the northeastern slope of Owens Peak, Owens Peak Wilderness Area. There seems to be some confusion about the location of this population in the CNDDB records. These records (CNDDB, 1997) indicate the population occurs at T.21S, R.37E in the northeast quarter of section 21, which would place the population in Talus Canyon, just west of the towns of Talus and Dunmovin. This is some 25 mi. (40 km) north of the location specified by the verbal description. Doubtless a typographical error was made either on the original label, or in entering the information into the database. The correct legal description of the Owens Peak population of Hall's daisy is: T.25S, R.37E northeast quarter of section 21.

Natural History:

Hall's daisy was described by H.M. Hall based on his collection made in 1908 at Trout Meadows, California (Hall, 1915). Cronquist (1947) states that botanical collections of Hall's daisy are very rare, being known from only two localities. Recent botanical work in the southern Sierra Nevada (post-1947) has discovered a number of additional locations (Nesom, 1992), thus providing the present distribution limits of the species.

Hall's daisy is a small, branched, rhizomatous perennial herb in the Daisy Family (Asteraceae), which grows from a rather deep-seated root crown. The stems range from 4-8 in. (10-20 dm) tall and are densely covered by glandular hairs (Munz, 1959). Lavender or light blue ray and yellow disk flowers are produced in short stalked heads from July through August. The glandularity of the stem separates Hall's daisy from other *Erigeron* species found in the southern and central Sierra Nevada Mountains (Brewer's daisy [*E. breweri* var. *breweri*], Elmer's daisy [*E. elmeri*], and fleabane [*E. foliosus* var. *foliosus*]) with which it may be confused (Nesom, 1993). Hall's daisy differs from unadorned daisy (*E. inornatus* var. *inornatus*) and its variant Keil's daisy

(*E. inornatus* var. *keilii*), another glandular-stemmed species found in the southern Sierra Nevada, by the presence of ray flowers, which *E. inornatus* lacks (Nesom, 1993).

The pollination requirements of Hall's daisy are not known, but many other Asteraceae are insect (bee, fly or butterfly) pollinated (Faegri and van Der Pijl, 1979, Sanders, pers. com.). Flowering occurs in July and August (Skinner and Pavlik, 1994). Seeds are presumably produced in August and September, with dispersal probably being primarily by the wind carrying the seeds away via their soft pappus. It may be that, like most rhizomatous perennials, much reproduction occurs by the vegetative spread of rhizomes rather than by seeds, at least within established colonies.

Habitat Requirements:

Hall's daisy occurs on dry, rocky ledges and vertical outcrops derived from granitic substrates (Shevock, pers. com., 1997). It is found in a wide variety of vegetation types throughout its range, including broad-leaved upland forest, upper and lower montane coniferous forest, and pinyon - juniper woodlands. The plant has been reported to occur between 4600 ft. (1400 m) and 8000 ft. (2440 m) in elevation. The population on Owens Peak is found in openings of a park-like coniferous forest that includes Jeffrey pine (*Pinus jeffreyi*), limber pine (*P. flexilis*), singleleaf pinyon (*P. monophylla*), sugar pine (*P. lambertiana*), white fir (*Abies concolor*) and Sierra juniper (*Juniperus occidentalis* ssp. *australis*). This habitat type is described as a "mixed conifer series" (Sawyer and Keeler-Wolf, 1995) or as "mixed conifer forest" (Holland and Keil, 1995). Associated species with the Owens Peak population include several sensitive taxa such as Needles buckwheat (*Eriogonum breedlovei* var. *shevockii*), sweet-smelling monardella (*Monardella beneolens*), Owens Peak lomatium (*Lomatium shevockii*) and Muir's raillardella (*Raillardiopsis muirii*).

Population Status:

Populations appear to be relatively low, but stable. There is no evidence of significant declines during historic times, but the available evidence on the abundance and distribution of this species is scant.

Threat Analysis:

The wide range of Hall's daisy, its occurrences on federal lands (primarily Wilderness Areas), and the relative inaccessibility of most populations contribute to a low threat to the species (Shevock, pers. com.). Those populations occurring outside of designated Wilderness Area face potential threats such as logging, and grazing pressures, as well as trail expansion and fire control activities.

Biological Standards:

All known populations of Hall's daisy occur on federal lands with most occurring in designated Wilderness Areas. The rugged terrain in which Hall's daisy grows should help protect this species from logging and grazing pressures on non-Wilderness Area lands. The remoteness of Hall's daisy populations and the ruggedness of the occupied terrain should also greatly reduce the possibility of habitat destruction by humans. Public land management should consider known Hall's daisy populations and potential habitat before management decisions are made. Within the Wilderness Areas, management decisions such as trail maintenance (especially the Pacific Crest

Trail in the Owens Peak Wilderness Area), future trail expansions or fire prevention strategies should focus on known Hall's daisy populations to reduce the risk of habitat alteration or destruction.

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INYO HULSEA

Hulsea vestita ssp. *inyoensis* (Keck) Wilken

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Management Status: Federal: None
California: G5T2T3, S1.2 (CDFG, 1998)
CNPS: List 2, RED 2-2-1 (Skinner and Pavlik, 1994)

General Distribution:

Inyo hulsea occurs in eastern California (Inyo and Mono Counties) and southwestern Nevada (Nye County). The only verified California locations are in the Coso, Panamint, and Inyo Mountains (Inyo County) and Lower Rock Creek Canyon (Mono County). It also occurs (CNDDB occurrence 6, based on M. French Gilman specimen 1821, US National Herbarium) in the Grapevine Mountains of Death Valley National Monument, though this location is near the Nevada border and may actually be in Nye County, Nevada. The Mono County report (CNDDB occurrence no. 1, California Dept. of Fish and Game, 1997b) had been unverified until recently, but has been confirmed in the field and is supported by a specimen (*Ingram s.n.* SBBG; Dieter Wilken, pers. comm.). Another Mono County report, CNDDB occurrence no. 7, is based on a misidentified specimen (*G. Helmkamp s.n.* UCR). California locations are generally from sites that are inaccessible and poorly collected due to harsh climate and topography, few roads or trails, and administrative prohibitions against access and / or collecting (e.g., China Lake Naval Weapons Center and Death Valley National Park). In Nevada, Inyo hulsea occurs from the North and Central Belted Ranges to the Eleanor Range (Kartesz, 1987). Elevation ranges from 4600 - 7300 ft. (1400 - 2230 m) (Bagley, 1985); both these extremes are for Nevada locations.

Distribution in the West Mojave Planning Area:

The only known Inyo hulsea record within the WMPA is based on a Coso Mountains specimen collected by Frederick V. Coville and Funston (*935*, US National Herbarium) and reported by Coville (1893). Wilken (1975) cited the specimen as "representative" of the subspecies. California Dept. of Fish and Game (1997b; CNDDB occurrence 5) reports the location as Crystal Spring at 5640 ft. elevation, citing the herbarium label. Coville's published report (1893: p. 254) includes the remark that it was collected "in the cañon next south of Crystal Spring" and indicates its elevation as 6070 ft. (1850 m).

This site is the southwesternmost known Inyo hulsea occurrence. The plant is likely to occur elsewhere in mountains of the northernmost part of the WMPA, particularly within China Lake Naval Air Weapons Station.

Natural History:

Inyo hulsea has been treated as a full species (*H. inyoensis*); a subspecies of San Diego sunflower (*H. californica* ssp. *inyoensis*); and as a synonym of *H. vestita* ssp. *callicarpha.* Munz (1968) explained its distinction from *H. californica,* and Wilken (1975) explained its placement in *H. vestita.* Cronquist (1994) felt that it was indistinguishable from *H. vestita* ssp. *callicarpha,* endemic to the San Jacinto and Palomar Mountains in southern California, some 170 miles (270 km) distant from the southernmost Inyo hulsea location. While Wilken (1975) found that it hybridized more readily with *H. vestita* ssp. *callicarpha* than with other *H. vestita* subspecies, the distinction between the two taxa is unambiguous, at least for specimens housed at Rancho Santa Ana Botanic Garden. Wilken (1975; 1993) and Kartesz (1987) have described characters readily distinguishing it from this and other *H. vestita* subspecies. The conspicuous and numerous ray flowers are the most distinctive characters.

Inyo hulsea is an herbaceous perennial with one to several erect stems, generally about 15 in. (0.4 m) but up to about 27 in. (0.7 m) tall. Its leaves are green, on long petioles, occurring in a basal group and part way up the stem; the basal leaves are lobed. Bracts are, at most, only slightly woolly. Flower heads are generally two to several per stem. The disc and ray flowers are yellow. There are generally

18 or more rays, each one about 0.5-0.8 in. (12-18 mm) long. The fruit is an achene about 0.3 in. (7.5 mm) long. Commonly lower stature, generally leafless stem, densely woolly bracts, and fewer and shorter ray flowers distinguish the related H. vestita ssp. vestita, which may overlap in the western part of its range. Inyo hulsea's ray flowers are longer (0.5-0.8 in. [12-18 mm]) and sometimes more numerous (18-32) and than those of *H. vestita* ssp. *callicarpha* (0.2-0.4 in. [6-10 mm];16-25). Ranges of the two subspecies as treated by Wilken (1975) do not overlap, though Cronquist (1994) treated the two as synonyms, under *H. vestita* var. *callicarpha*.

Skinner and Pavlik (1994) report Inyo hulsea flowering from April through June. Nevada references (Kartesz, 1987; Cronquist, 1994) report it flowering from May through October. Beatley (1976) reported it flowering May through July and, in some years, to September and October. Based on these dates, it seems to be primarily a spring-flowering species, but evidently also responds to late season thundershowers.

Little additional information is available. All *Hulsea* species are self-incompatible (Wilken 1975). Flower morphology suggests a generalist insect pollinator. Seed dispersal, mycorrhizal associates, population fluctuations over time, and other aspects of Inyo hulsea natural history are unknown.

Habitat Requirements:

Inyo hulsea occurs primarily on steep, unstable sandy or rocky slopes and sometimes washes in high desert shrublands and pinyon woodlands. Associated species include big sagebrush (*Artemisia tridentata),* saltbush *(Atriplex* spp.), rabbitbrush *(Chrysothamnus nauseosus),* single-needle pinyon *(Pinus monophylla),* and antelope brush (*Purshia tridentata).* Some occurrences are on road cuts or other disturbed sites and it "appears to thrive on disturbed soil" (Mozingo and Williams, 1980). Its occurrence on open, unstable sites suggests that Inyo hulsea may be intolerant of shade, or may compete poorly for water or other soil resources. It generally occurs on "white tuff bedrock" (Beatley, 1976) but has been collected on a variety of substrates (Bagley, 1985), suggesting that it has no specialized edaphic requirements. This and other *Hulsea vestita* subspecies often occur on nutrient-poor soils, including coarse granitic sand, pumice, and limestone. Occurrence in these soils suggest either low nutrient requirements or very effective nutrient-acquisition mechanisms.

Population Status:

Inyo hulsea populations are uncommon and widely scattered, but the plants may be numerous or even common at any one site. For example, Mary DeDecker reported it "plentiful in immediate area" on the label of her Panamint Mountains specimen (*2492* RSA). Kartesz (1987) described it as "restricted but locally common" and "rare" but "probably more common than reported in Nevada." Its occurrence on steep, inaccessible mountain slopes suggests that many populations are yet to be discovered, particularly where access is limited by land management agencies.

Efforts by Mark Bagley to relocate the Coso Mountains site, the only known occurrence within the WMPA, have been unsuccessful, perhaps due to poor rainfall during the years when he searched for it (Mark Bagley, pers. comm.).

Threats Analysis:

The type locality was reportedly degraded by highway maintenance work in 1989 (Skinner and Pavlik 1994), but there are no known threats affecting Inyo hulsea over wide portions of its range. It is tolerant and even thrives with certain human disturbances that evidently create soil conditions similar to its natural habitat. This tolerance does not suggest that it is invariably disturbance-tolerant. There is a wide range of human-associated soil disturbances, and the specific disturbance characteristics favoring Inyo hulsea are unknown.

Biological Standards:

The Coso Mountains location is the only known report within the WMPA, but the taxon evidently has not been seen or collected at the site since 1891. Regular visits to the Coso Mountains should be made to search for the plant at the historic location and in suitable habitat in the surrounding area.

Potential effects to Inyo hulsea should be considered for any project site in the northern part of the WMPA above about 4600 ft. (1400 m) elevation. Project sites should be surveyed in advance of soil disturbance, following recommendations and methods described by Nelson (1994). In particular, surveys should be completed during spring, and should be "floristic in nature." Careful surveys in suitable habitat would likely lead to the discovery of new Inyo hulsea populations. New populations should be vouchered and reported to the CNDDB to assure that permanent, verifiable records are available. Collectors should be certain to include sufficient representative material so that ray flower number and length can be compared with descriptions of Inyo hulsea and *H. vestita* ssp. *callicarpha.*

No management standards for Inyo hulsea within the WMPA can be recommended without confirmation that the historic Coso Mountains population is still extant, and new data (e.g., either new occurrences or negative results from carefully conducted surveys of suitable habitat within its geographic and elevational ranges). Management conflicts should be minimal since it occurs primarily on poorly accessible high mountain slopes.

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KELSO CREEK MONKEYFLOWER
Mimulus shevockii

Author: Mark Elvin, 3143 Avenida Olmeda, Carlsbad, CA 92009

Management Status: Federal: None
California: S1.2, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

The distribution of the Kelso Creek monkeyflower is limited to the southern Sierra Nevada within the Kern River drainage in the Isabella Lake area. All ten known occurrences are in Kern County. The center of distribution for this plant is in the southwest region of Isabella Lake with nine occurrences in the Kelso Creek and Cortez Canyon area, all within an area 5 mi. (8 km) in diameter. One disjunct occurrence was located in 1983 in the Cyrus Canyon area, 13.5 mi. (22 km) northwest of the other populations.

Distribution in the West Mojave Planning Area:

Of the ten occurrences, nine are located within the planning area and are wholly or partially on BLM managed lands. Five of the nine populations in the planning area occur entirely on BLM managed lands. Two of these populations consist of thousands of plants, two consist of hundreds of plants, and one has an undetermined number of plants. The other four of the populations in the planning area are partially on private lands. Two of these consist of thousands of plants and two consist of hundreds of plants. Only one population is completely outside of the planning area and it is entirely on private lands and consists of thousands of plants.

Natural History:

The Kelso Creek monkeyflower (n=16) is a small annual herb (up to 4.75 in., 12 cm, tall) of the snapdragon family (Scrophulariaceae, sect. *Paradanthus*) and is covered with minute glandular-puberulent hairs. The lanceolate to ovate leaves (1-10 pairs) clasp the stem. They are somewhat fleshy with a purplish underside. The flowers are auxiliary from the nodes ascending to declinate with upturned apices on pedicels up to 0.8 in. (20 mm) long. The calyx is vase shaped with either reddish spots or is solid red. The corolla's tube, throat, and four upper lobes are maroon-purple. The slightly larger lower, bilobed lip is yellow and notched. The flowers appear in April and May (Thompson, 1993). The 0.25 in. (5-6 mm) capsule, with greater than 100 seeds, is dehiscent at the apex and along both sutures (Heckard and Bacigalupi, 1986; Thompson, 1993). Small bees may be responsible for pollination. It is not known whether this plant is self-sterile or self-fertile. Since the plant occurs in washes, water is one of the most likely seed dispersal mechanisms, but no observations have apparently been made at this point.

The Kelso Creek monkeyflower is similar in vegetative and pollen morphology to several other local *Mimulus* in the *M. rubellus* and *M. palmeri* groups (Grant, 1924;

Argue, 1980, 1985); such as Tehachapi monkeyflower (*M. androsaceus)*, bearded monkeyflower (*M. barbatus* [=*M. montioides*]; Thompson, 1993), slender-stalked monkeyflower (*M. gracilipes)*, and purple monkeyflower (*M. purpureus)*. The Kelso Creek monkeyflower is easily distinguished from these species by its unusual corolla features (Heckard and Bacigalupi, 1986). *M. barbatus* is most similar in corolla color and has been confused with *M. shevockii* on herbarium specimens. However, corolla lobing between these two monkey flowers is quite different. It also grows in close proximity to *M. shevockii*, but it grows in meadow borders at higher elevations on the Kern plateau.

The Kelso Creek monkeyflower was not described until 1986. The type was a collection made in 1983 at Kelso Creek near Cortez Canyon. Subsequent searches of *Mimulus* collections in herbaria yielded unidentified/misidentified material dating back to 1932 that had been collected from the known locations (Heckard and Bacigalupi, 1986).

Habitat Requirements:

Kelso Creek monkeyflower predominantly occurs in the loamy, coarse sands of alluvial fans, dry streamlets, and deposits of granitic origin that are found in Joshua tree woodlands, pinyon-juniper woodlands, or their transition in the southern Sierra Nevada in the Kelso Creek drainage within the Kern River drainage (Heckard and Bacigalupi, 1986; CDFG, 1997). One disjunct population, however, occurs in finer soils developed from meta-sedimentary rocks (Heckard and Bacigalupi, 1986; CDFG, 1997). This plant is found at elevations from 2800-4300 ft. (860-1325 m) (Heckard and Bacigalupi, 1986; Thompson, 1993; CDFG, 1997). Major associates of this plant include pygmy poppy (*Canbya candida)*, silver cholla (*Opuntia echinocarpa)*, purple sage (*Salvia dorrii)*, golden gilia (*Linanthus aureus)*, Tehachapi monkeyflower *(Mimulus androsaceus)*, Fremont's monkeyflower (*M. fremontii)*, and cheesebush (*Hymenoclea salsola*; Heckard and Bacigalupi, 1986).

Population Status:

The Kelso Creek monkeyflower has ten known occurrences, nine that occur within an area of 5 mi. (8 km) in diameter and one disjunct population 13.75 mi. (22 km) to the NW. It occurs in a fairly restricted habitat, primarily in the loamy, coarse sands of alluvial fans, dry streamlets, and deposits of granitic origin associated with the washes in the Kelso Creek drainage in the Isabella Lake area. The creation of Isabella Lake caused the possible extirpation of at least one occurrence (CDFG, 1997).

Threats Analysis:

The Kelso Creek monkeyflower has probably always been a rare species with a very narrow distribution. Large scale human modification of the landscape has now begun to threaten its limited natural habitat. This includes mobile home development, grading of habitat, introduction of non-native plant species, and conversion of habitat to orchards.

The area it occupies is undergoing considerable development at the present time (CDFG, 1997). Of the ten occurrences nine are wholly or partially on BLM Ridgecrest Resource Area lands, four are partially on private lands, and one is entirely on private lands. While the occurrences on BLM lands are afforded a measure of protection, there are still documented threats to these populations (CDFG, 1997). Multiple threats have been documented for eight of the ten occurrences. The main threat to this species is the present or threatened destruction, modification, or curtailment of its habitat or range. These threats place this plant in immediate danger of becoming extinct throughout a major portion of its range (USFWS, 1994). The extremely limited distribution of this plant also puts it at risk of stochastic extinction events.

Mobile home and subdivision developments either presently threaten or have already impacted seven of the ten occurrences. All of the populations on private land are at risk due to this threat. Populations located on BLM lands adjacent to private property are also affected by this treat. Highway and road maintenance affect populations on or adjacent to private property since an increase in development has resulted from improved access, and the resulting added traffic has created pressure to add or widen roads. At least one population has been bisected by one of these roads. Off highway vehicle (OHV) use directly impacts or threatens five of the ten occurrences. Threats from mineral exploration and development are unknown. Cattle grazing or trampling, or other agricultural activities, affect four sites with one occurring within a grazing allotment on BLM property. Water developments and impoundments are potential threats.

Biological Standards:

The most important aspect of maintaining the long term viability and evolutionary potential of Kelso Creek monkeyflower is to protect the known population sites from development and surface disturbance. It is also important to continue exploring other potential habitat in an attempt to identify additional populations. There is a significant amount of development occurring in the limited area that this plant occupies. This threat needs to be addressed immediately by determining what populations (if any) are on public lands in locations safe from disturbance by adjacent development activities. A significant portion of the range of the Kelso Creek monkeyflower could be lost in the not too distant future to development and this will further imperil the species. All of the populations could eventually be impacted by fragmentation of the habitat due to this development. There is an immediate need to secure the largest possible block of protected and completely undisturbed land. Additional surveys should also be conducted for the Kern River Valley Cemetery occurrence (EO #8; CDFG, 1997), which was last seen in 1932 in the area that is now Isabella Lake.

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KERN BUCKWHEAT

Eriogonum kennedyi var. *pinicola*

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Management Status: Federal: USFWS Species of Concern
California: S1.1; G4T1 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 3-3-3 (Skinner and Pavlik, 1994)

General Distribution:

All records for the Kern buckwheat come from Kern County, California. There are between four and six documented populations of this plant in the Tehachapi Mountains from Cache Peak south to Middle Knob, but most location descriptions are such that we can't tell exactly which reports pertain to which populations. Rutherford (1998) specifies that there are four populations, but other sources seem to indicate that there may be at least six. Two additional occurrences were reported by George Lawrence in 1984 and 1985 (CNDDB, 1997). One was north of Pajuela Peak (Tehachapi NE quad) and the other was south of Highway 58 (Monolith quad) but the variety identification was never verified. Sandy Hare (1995) commented that her site observations indicate the habitat at these locations is not suitable for Kern Buckwheat and that Lawrence's description of the plants seen, based on a conversation they had in 1995, does not match that of Kern Buckwheat. Whatever the identity of these two occurrences, they were both eliminated by wind energy development in the late 1980s (Hare, 1995).

Distribution in West Mojave Planning Area:

All known populations are in the WMPA. There are two to four populations on public land and one or two on private land. All are located either: west of Middle Knob and south of Pine Tree Canyon, or on Sweet Ridge. On private land, there are two populations on Sweet Ridge, but all others are on BLM managed land.

Rutherford (1998) discusses four populations along Mananga Road, east of Sand Canyon, and implies that these are all that is known. These locations are not identified by coordinates or other standard map features, but can be described as follows:

Population A – "Near" Zond Windfarms transmitting Station; a 2-5 acre site in a basin below the station.

Population B – On Zond property; a 1 acre site, bisected by the road.

Population C – On BLM managed land ca. 1/2 mile south of population B; a 2-3 acre site, bisected by the road.

Population D – On BLM managed land about 3 miles south of population C; perhaps 4 to 5 acres.

Natural History:

This cushion-form shrub in the buckwheat family (Polygonaceae) was originally described by Reveal (1968) from plants collected at Sweet Ridge, south of Cache Peak by E.C. Twisselmann in 1966. Kern buckwheat grows as a low dense cushion or mat, but when flowering sends up inflorescences 2-5 in. (5-13 cm) high. The plant spreads over a small circle of ground from a woody base above a stout taproot. The short branches hold many small leaves**,** 0.12-0.2 in. (3-5 mm) long**,** which are densely grayish to rusty-white felty on both sides and which densely cover the stems. The inflorescence consists of a leafless peduncle (flowering stem) that supports a single head of white to reddish flowers, with green to reddish midribs, at the tip. The flowers are perfect (have both male and female parts). Kern buckwheat is distinguished from most other mat-forming buckwheat species within its range (except var. *purpusii*) by its solitary heads of white flowers. Kern buckwheat has gray to rusty leaves while *Eriogonum kennedyi* var. *purpusii* has white leaves (Hickman, 1993). Kern buckwheat is only found in white clay soils of pebble plains (Hare, 1995).

Fruit ripens and is dispersed in about July. Seed dispersal does not appear to have been studied, but Stokes (1936) thought that birds may play a role in the dispersal of all *Eriogonum* seeds based on various observations of birds and their behaviors. She thought that seeds stored in the crop of a bird killed by a predator might serve to establish new populations in areas distant from existing populations. She also mentioned wind, rain and streams as dispersal agents, but there appears to have been little data available to support these ideas. Given the extremely restricted distribution of Kern buckwheat, it is not clear that long-distance dispersal has ever occurred and it certainly does not appear to be a common phenomenon.

Pollination of this plant has not been studied, but small silvery-white, iridescent butterflies (Lycaenidae?) have been observed visiting the flowers (Hare, 1995), and may be its pollinators. It is certainly probable that Kern buckwheat is insect pollinated, but whether the butterflies observed are effective pollinators is unknown. The flowers fade to pink or rose at maturity (probably after pollination) and bloom from May through June. The flower color change to shades of red suggests that the pollinator may be a bee -- pure red is invisible to bees and shades (to us) of red appear as very different colors to bees (Barth, 1985). Many bee pollinated species have flowers that change to red after pollination. For example, many lupines develop a red spot on the banner after pollination (e.g., Faegri and van der Pijl, 1979). This change can make flowers invisible to the bees, or at least make them appear very different, thus signaling the lack of nectar or pollen and thus preventing potential damage to developing ovules by useless flower visitors. It is suspected that such color changes may also be seen by other potential insect pollinators, but such has apparently not been demonstrated (Barth, 1985). In any event, the color change very strongly suggests that some insect is involved in pollination.

Habitat Requirements:

Kern buckwheat is found in poorly draining depressions in white bentonite clay soils thought to be from volcanic ash (Uli and Schiffman, 1984). These depressions have pebbles, gravel and rock cemented into the soil surface. These exposed "pebble plains" are found on ridge tops and saddles between knolls. Kern buckwheat is associated *Layia glandulosa*, *Mimulus androsaceous*, *Calochortus kennedyi* and *Allium cratericola*. Species found at the edges of the pebble plain include Jeffrey pine (*Pinus jeffreyi*) and single-leaf pinyon (*Pinus monophylla*). All plant species that grow on or within 30 feet of the pebble plains are smaller than average. Kern buckwheat is never found on red or dark brown soil and never in loamy soils. While Reveal (1989) reported an elevational range of 4900-5600 ft (1500-1700 m), the existing documented populations occur from 5400-6200 ft (1600-1900 m) elevation (CNDDB, 1997).

Kern buckwheat seems to share many general ecological characteristics with the other varieties of *E. kennedyi*. It is a perennial herb of open areas that appears intolerant of extensive shading, preferring full sunlight. It is not a species well adapted to competing for light, but it is very competitive on sites where tall and fast growing species are excluded by moisture deficiencies, wind, and winter cold. The compact "cushion" habit probably serves to reduce moisture loss on the windy ridges as is true for other species of similar life form (Walter, 1973). The short annual growth intervals and consequent low stature makes all races of *E. kennedyi* poor competitors on sites that are capable of supporting tall or dense vegetation. However, sites where moisture stress is combined with high insulation are highly favorable for plants such as this one.

Another major ecological factor is the winter climate. Low growing cushion species, such as Kern buckwheat, are likely to be covered by snow during the period of the year when soil moisture is unavailable because the ground is frozen, and when, in arid areas, the humidity of the air may still be very low. When covered with snow, Kern buckwheat is subjected to less moisture stress than it would be if exposed to the dry air -- relative humidity is probably at virtually 100% and wind effects are excluded. That moisture and not light is probably a controlling factor for this species is evidenced by the fact that the foliage is densely covered with tomentum (wool). Dense pubescence is commoner on mature foliage in drier environments and can greatly reduce the amount of light striking the leaf tissue (Johnson, 1975). This pubescence may affect photosynthesis, but it also forms a layer of dead air at the leaf surface, which can reduce water loss due to wind, though the magnitude of this effect apparently varies greatly with the species being considered and appears not to have been studied under conditions of air movement (e.g., Johnson, 1975). Detailed studies of the ecophysiology of this species would be very valuable.

Population Status:

Only four to six populations of this plant are known to exist, all in the Tehachapi Mountains. Hare (1995) estimated 400 plants total based on observations in the early 1990s, but based on surveys in 1998 Rutherford (1998) estimated the total population as about 10,000 individuals distributed among four populations. Much of the occupied area is rugged and poorly explored, so it must be considered possible that additional populations could exist on unexplored ridge tops in the area.

Rutherford noted (1998) that the populations contained individuals of various age classes, and that it appeared the populations were reproductively healthy. Some individuals were seen to be over 2-4 ft (1 m) in diameter and were surmised to be very old.

Threats Analysis:

This species is currently threatened by maintenance of wind energy facilities, off highway vehicle (OHV) use, and possible future construction (Hare, 1995; Rutherford, 1998). The northeast portion of the one acre population on private land on Sweet Ridge was destroyed by the construction of wind energy facilities (Hare, 1995; Rutherford, 1998). Approximately half the population, 50 plants (Hare, 1995) to 500 or more (Rutherford, 1998), was destroyed by this construction. Additional habitat was destroyed, along with some plants, during construction of access roads to newly subdivided lots and construction of a ramp to a proposed camp site for the

Pacific Crest Trail (Hare, 1995). Illegal grading at Rutherford's population D has resulted in a continuing erosion problem that threatens part of one population (Rutherford, 1998). There is a rumor that BLM has plans to build a campsite on the Pacific Crest Trail that would destroy the population at the southern end of Sweet Ridge. While there is no current known cattle grazing around the populations, the area has been used for cattle grazing in the past. Future cattle grazing, construction, logging or mining could potentially threaten the remaining populations (Skinner and Pavlik, 1994).

Observations by Sandy Hare indicate Kern buckwheat has been unable to recolonize disturbed areas (Hare 1995). Due to a restricted distribution and small number of remaining plants, this species is vulnerable to stochastic extinction.

Biological Standards:

The number, extent and condition of populations needs to be determined as soon as possible. Careful extensive survey of all apparently suitable habitat areas is needed immediately. With portions of populations already destroyed by Wind Park development and road construction, the need for careful range and habitat assessment is obvious. Listing as threatened or endangered may discourage future development on BLM land, but may do little for populations on private land. Consideration should be given to notifying private landowners of the existence of this rare species, where it is, and how to prevent future disturbance. Soil disturbance could be reduced by restricting vehicle access to roads and trails through the habitat, or by preventing vehicles from leaving the road by physical barriers. At least, jeep trails should be closed when they are wet. If the rumor that BLM intends to construct a campsite at the site of one of the populations is accurate, this plant should either be abandoned or the proposed location altered to a less sensitive site. Perhaps the populations on public lands can be protected by the fact that each population occurs on a recorded archaeological site (Robinson, 1982; Uli and Schiffman, 1984; Whitley, 1991). Due to the proximity to the Pacific Crest Trail, it is recommended that BLM put up signs asking hikers to stay off the pebble plains because they are a rare habitat.

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LANE MOUNTAIN MILKVETCH

Astragalus jaegerianus Munz

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Management Status: Federal: Endangered (listed October 6, 1998)
California: S1.1, G1 (CDFG, 1998)
CNPS: List 1B, RED code 3-3-3 (Skinner and Pavlik, 1994)

General Distribution:

The entire known range of Lane Mountain milkvetch occurs in the western Mojave Desert within the WMPA.

Distribution in the West Mojave Planning Area:

Lane Mountain milkvetch is a very rare and highly localized species. Only about 200 plants have ever been reported, including observations in the same area at different times that may have reported the same plant more than once (CDFG, 1997; BLM, 1997; Brandt et al., 1997). The entire known range of this species lies between Barstow and Goldstone, San Bernardino County, in a area no more than 13 mi. (21 km) in diameter. There are two population areas where this species is known to occur. The largest is to the north and northwest of the Paradise Range, northeast of Lane Mountain. This area extends approximately 5 mi. (8 km) east-west and 4 mi. (6.5 km) north-south. However, plants are known only at scattered sites here, covering a total of fewer than 875 acres (350 hectares). Most of the known sites occur within half a mile (1 km) of a road. Extensive surveys in this area have not been reported, except at a few sites adjacent to roads (USFWS, 1991) and in the eastern portion of the area on U.S. Army Fort Irwin National Training Center (NTC) and some adjacent BLM lands (Brandt et al., 1997). Potentially suitable habitat does occur beyond the areas surveyed at the known sites (Bagley, 1989; Lee and Ro Consulting Engineers, 1986). The second Lane Mountain milkvetch population area is located approximately 6 mi. (10 km) to the southwest, west of Lane Mountain on Coolgardie Mesa. Only one small site, less than 10 acres (4 hectares), is known to occur here. Two earlier herbarium records, both from 1941, may have been from this site or from another area on Coolgardie Mesa (CDFG, 1997) within a few miles distance.

Natural History:

Lane Mountain milkvetch is a spring flowering perennial in the pea family (Fabaceae). It is a slender, diffuse plant, 12-27.5 in. (3-7 dm) tall, with straggling, freely branched stems that arise from a buried root-crown (Barneby, 1964). The weak sparsely leafy stems are nearly always growing up through and entangled in low shrubs. Munz (1941), Barneby (1964) and Spellenberg (1993) describe this species as a perennial herb, and Munz notes that it is somewhat woody at the base. Bagley (1989) has noted that stems are persistent and that even in a dry year plants are noticeable due to the remains of previous years' growth. Additionally, at least some stems do not appear to die back to the root-crown annually; stems one to several years old have been observed to produce new growth in the canopy of the host shrub (pers. obs., 5 May 1985). This persistence and regrowth of stems, and the woodiness at the base noted by Munz, should be confirmed by additional field observations.

Herbage is light-gray or greenish, strigulose with short, fine, straight hairs. Leaves are 0.8-2.35 in. (2-6 cm) long, divaricate or reflexed, relatively short in relation to the internodes, and with 7-15 narrow, widely spaced leaflets. Leaflets are pubescent on both sides, but more so above. The inflorescence is loosely 5-15 flowered, divaricate and ascending. Flowers are at first ascending, then reflexed and secund in age. Petals are a dull yellowish-white or lavender-rose with darker veins. Pods are pendulous, stipitate, bilocular, and not inflated; the body is narrow and straight, 0.64-1 in. (16-25 mm) long, 0.12-0.2 in. (3-5 mm) wide, laterally compressed when dry, keeled at the two sutures, abruptly contracted into a mucronate beak, glabrous, and leathery or stiffly papery when mature. A detailed description of Lane Mountain milkvetch is found in Barneby (1964) and keys and brief descriptions in Munz (1974) and Spellenberg (1993). Illustrations are found in Jaeger (1941) and Spellenberg (1993).

Barneby (1964) places this species in its own monotypic section of the genus, indicating its distinctness from other species of milkvetch (*Astragalus*). It may be related to *A. pachypus* or *A. atratus* var. *mensanus*, the only other American species with fruit which is stipitate, laterally compressed, keeled at the two sutures, and bilocular. Barneby also suggests a possible relationship with *A. bernardinus*, with which it shares the same small flowers and a straggling growth habit, nearly always entangled in the canopy of low desert shrubs. No milkvetch species that occur in the vicinity of Lane Mountain milkvetch would be easily confused with it.

Little has been reported on the growing season of Lane Mountain milkvetch. It is known to grow in the spring and bloom in April and May. Presumably it is similar to other Mojavean perennials; in years with sufficient soil moisture it would be expected to begin growth sometime in the late fall or winter, going dormant sometime in the late spring or summer when the soil moisture has been depleted in its rooting zone. It is unknown when annual growth begins, or what combination of temperature and moisture conditions trigger it, and whether or not this species responds to summer rains. Bagley (1989) reported that in a very dry year Lane Mountain milkvetch appeared to have a very short growing period in which little new growth and no flowers or fruit were produced. This is not surprising as many desert perennials and shrubs are known to endure dry years by remaining dormant throughout the entire period of drought (Beatley, 1976).

Nothing is known of the physiology of dormancy in this species or how long a dormant period plants can endure. With so few observations of Lane Mountain milkvetch, limited data is available on population fluctuations. Rutherford and Bransfield (USFWS, 1991) observed one plant in 1991 where 30 had been observed in 1989 (Bagley, 1989, population A5). Brandt et al. (1997) found no plants in 1992 where 14 had been observed in 1989 (Bagley, 1989, eastern site in population A5). Brandt et al. observed only a few plants in 1992 at a site where Rutherford and Bransfield reported two in 1991 and where 87 had been reported in 1985 (Lee and Ro Consulting Engineers, 1986). These reductions in observed populations may indicate a real population reduction that occurred during the extended drought conditions through 1990. It seems unlikely that plants which survived the drought would remain dormant in 1991 and 1992 since rainfall in those years appeared adequate based on growth of other species; although the first significant rains in both years were unusually late (March and February). However, this species is quite cryptic. Its habit of growing within the canopy of shrubs, along with its rarity and the relatively dull color of the herbage and flowers, makes Lane Mountain milkvetch very difficult to locate as has been commented on by all recent workers (Lee and Ro Consulting Engineers, 1985; Bagley, 1989; USFWS, 1991; Brandt et al., 1997; A. Gibson, pers. comm.; B. Prigge, pers. comm.). Without marking individual plants and monitoring them over time, little can be concluded about population fluctuations and dormancy in this species. C. Rutherford of USFWS has started such a study at two locations, but no results of this work are currently available (Rutherford, pers. comm.).

Nothing is known of the reproductive biology of Lane Mountain milkvetch. Factors in pollination, seed production and dispersal, seed viability and longevity, seed germination, seedling establishment, and predation are all unknown.

Habitat Requirements:

Lane Mountain milkvetch is known to occur at elevations of approximately 3150-3850 ft (960-1173 m). The type locality was reported by Munz (1941) as 3000 ft (ca. 900 m), but this has not been relocated since 1941. This species appears to be confined to granitic substrates in Mojave creosote bush scrub with a few widely scattered Joshua trees. It occurs on rocky, very low ridges, only a foot or two higher than the main bajada slope, and rocky low hills, 10-20 feet high, where bedrock is exposed at or probably near the surface (Lee and Ro Consulting Engineers, 1986). Soils are shallow, rocky and coarse sandy decomposed granite (Bagley, 1989; Lee and Ro Consulting Engineers, 1986; Brandt et al., 1997). At the largest reported population, only 4 out of 87 plants were observed on the adjacent gently sloping flats with finer soils (Lee and Ro Consulting Engineers, 1986). Bagley (1989) reported that all Lane Mountain milkvetch were observed in areas with a whitish granite parent material that broke down into a light gray coarse-grained sand. They were not observed in nearby areas where the parent material was a pinkish granite that formed a more fine-textured soil, or in a less common dark gray granite. However, at the site observed by Rutherford and Bransfield (USFWS, 1991) the whitish decomposed granite surface layer was underlain with a finer-textured pinkish soil. Brandt et al. (1997) reported no difference in soil hue among sites with and without Lane Mountain milkvetch. There were, though, differences between sites in color value and chromicity. Contrary to their stated conclusion, their data showed that soils under the milkvetch were lighter and less intensely colored.

The scrub community at Lane Mountain milkvetch sites is typically a diverse mix of shrub species including California buckwheat (*Eriogonum fasciculatum* ssp. *polifolium),* Nevada Mormon tea *(Ephedra nevadensis),* Cooper goldenbush *(Ericameria cooperi)*, turpentine-broom *(Thamnosma montana),* paper-bag bush *(Salazaria mexicana),* Mojave aster *(Xylorhiza tortifolia),* hop-sage *(Grayia spinosa),* Anderson box-thorn *(Lycium andersonii),* creosote bush *(Larrea tridentata)* and burro bush (*Ambrosia dumosa*). Twenty-four perennial species were recorded in the vicinity of Lane Mountain milkvetch at one population site on Fort Irwin (Lee and Ro Consulting Engineers, 1986). A diversity of annual species may also occur in years with adequate moisture. *Larrea* and *Ambrosia* are dominant on the surrounding sandy bajada slopes, but are not dominant on the thin soils where Lane Mountain milkvetch occurs (Bagley, 1989; Brandt et al., 1997). Brandt et al. characterized milkvetch sites as areas with Nevada Mormon tea and Cooper goldenbush dominant and where the shrub density is greater than in surrounding areas.

Lane Mountain milkvetch typically grows under and entangled within the canopy of low shrubs. Few plants have been observed in the open, not associated with a host or nurse shrub. In studies where this has been recorded, only 9 of 127 plants (7%) were in the open (Table 1). A total of 17 different host species has been identified. Most of the host species are intricately branched low shrubs, but a few of the observed hosts were bunch grasses (*Stipa* sp.) and subshrubs (Mojave aster and wishbone bush, *Mirabilis bigelovii*). Host plants were usually living, although a few hosts observed (6 out of 118) have been dead shrubs.

Table 1. Summary of reported Lane Mountain milkvetch host species associations (n=127; data from Lee and Ro Consulting Engineers, 1986; USFWS, 1991; Rutherford and Bransfield, 1992; Brandt et al., 1997).

Host Species	Number of Lane Mountain milkvetch
None	9
Ambrosia dumosa (4 dead)	47
Eriogonum fasciculatum ssp. *polifolium*	18
Ephedra nevadensis	11
Ericameria cooperi (1 dead)	9
Thamnosma montana	8
Salazaria mexicana	3
Stipa sp.	3
Xylorhiza tortifolia	3
Echinocactus polycephalus	2
Encelia actoni	2
Grayia spinosa	2
Hymenoclea salsola	2
Lycium andersonii	2
Krameria parvifolia	1
Larrea tridentata (1 dead)	1
Mirabilis bigelovii	1
Opuntia ramosissima	1
Ambrosia dumosa/Ericameria cooperi (mixed clump)	1
Thamnosa montana/Salazaria mexicana (mixed clump)	1

Although Brandt et al. (1997) state that their sample size is too small to allow statistical comparisons of association between Lane Mountain milkvetch and host shrubs, they go on to assert that this species "does not occur in association with a particular shrub species, but may be found in an apparently random subset of the shrubs in the habitat" (p. 10). Brandt el al. have done the only study where they compared the host species to the relative abundance of the host in the surrounding scrub; but they had a sample of only 18 Lane Mountain milkvetch plants and looked only at the three shrubs nearest the milkvetch, including the host plant. Of 118 Lane Mountain milkvetch plants where the host species has been recorded, 47 (40%) were in burrobush (*Ambrosia dumosa*) and only one plant (<1%) was in creosote bush (*Larrea tridentata*), and that host shrub was dead (Table 1). Burrobush and creosote bush are fairly common in and near sites where these Lane Mountain milkvetch plants occurred, but burrobush probably represents significantly less than 40% and creosote bush much more than 1% of the shrub density or cover (Bagley, pers. obs.). These observations suggest something other than random association with the shrubs that occur in the habitat. Brandt et al. (1977) suggest that the open, tall growth form of creosote bush may provide insufficient support for the milkvetch. Alternatively, the open growth may provide insufficient protection from herbivores or the creosote bush may inhibit milkvetch growth through allelopathic chemicals. Studies of host shrub occurrence and shrub composition in Lane Mountain milkvetch habitats need to be conducted in order to determine if this species has any positive or negative associations with particular shrub species.

Gibson et al. (1998) have observed that leaflets of Lane Mountain milkvetch have the anatomy typical of full-sun desert leaves and that stems are important photosynthetic organs. Additionally, their studies showed this species achieves maximum photosynthetic rates at relatively high light intensities (photon flux densities of 1400-1500 mol m^{-2} s^{-1}) and, therefore, is probably not benefiting from the shade of its host shrub. The host shrub likely provides the milkvetch with protection from herbivores. Gibson et al. also determined that Lane Mountain milkvetch is a nitrogen fixer and speculated that the host shrub may benefit from higher soil nitrogen when it grows with this species, making the herb-shrub association mutualistic.

Population Status:

This species was first collected by E.C. Jaeger in April 1939, at sites 6 and 10 mi. (3.7 and 16 km) northwest of Paradise Rocks (Barneby, 1964). Jaeger (1941) reported these collections as "from the vicinity of Goldstone." In 1941, two additional collections were made by P.A. Munz and one by H.D. Ripley and R.C. Barneby (Munz, 1941; Barneby, 1964). In his original description of the species, Munz (1941) indicated that his type locality ("2 miles south of Jay Mine, about 12 miles south of Goldstone and 30 miles northeast of Yermo" at about 3000 feet) was "at about the same place" as Jaeger's collections. It is not known precisely where these locations were; Paradise Rocks presumably refers to the Paradise Range and Goldstone to the old mining site by that name, but the Jay Mine is not on the 1948 Lane Mountain or Goldstone Lake USGS 15' series quadrangles nor on more recent maps. Munz's reference to the site as northeast of Yermo, which is not on his collection label [*Munz 16580* (DS 324889)], must be in error, as Goldstone is about 30 miles from Yermo, but at about 10 degrees west of north. These three collections apparently came from sites northwest of the Paradise Range and south of Goldstone. Munz's second collection, made on the same day (April 26, 1941), was from "15 miles north of Barstow on the road to Superior Dry Lake" (Munz, 1941). Ripley and Barneby's collection, made about a week later (May 2, 1941), was from 13 miles north of Barstow [*Ripley and Barneby 3297* (RSA)] on Coolgardie Mesa (Barneby, 1964). These two collections no doubt came from the same general area west of Lane Mountain, on Coolgardie Mesa. No indication of population size was given in these early reports, except that Barneby (1964) noted this species is "very local but forming colonies."

Until 1985, Lane Mountain milkvetch was known only from these five collections, apparently taken from only two general locations (Munz, 1959). The first reported sighting since 1941 was made by M. Bagley, M. DeDecker and J. Chesnut on Fort Irwin NTC in 1985 (Lee and

Ro Consulting Engineers, 1986). This population was located near the western boundary of the NTC on the north side of the Paradise Range, possibly a few miles east of Jaeger's and Munz's collections from the vicinity of Goldstone. A total of 87 plants were counted in three groups at this population in 1985; however the full extent of the population was not determined due to time constraints. Fewer plants have been reported subsequently in this same area, (USFWS, 1991; Brandt et al., 1997; Gibson et al., 1998). Brandt et al. (1997) did extend the known area of one group found in 1985, adding about 10 plants. They found an additional group of 9 plants just southwest and extending about 0.5 mi. (1 km) westward across the Fort Irwin boundary onto BLM land. Six of these plants occurred on BLM land, three on Fort Irwin. They also found another site on Fort Irwin, with only four plants, located about 1.2 mi. (2 km) to the south of the first site.

Additional sites, primarily on BLM lands, have been located northwest and west of these Fort Irwin sites. These additional sites occur north and northwest of the Paradise Range, some probably in the near vicinity of Jaeger's and Munz's earlier collection sites. North of the Paradise Range, approximately 40 plants have been observed at several small sites scattered approximately 0.5-3 mi. (1-5 km) northwest to west-northwest of the first Fort Irwin site (Bagley, 1989; Brandt et al., 1997; USFWS, 1991). Approximately five of these plants occurred on Fort Irwin, the remaining 35 on BLM land. Most of these sites have not been intensively surveyed. Northwest of the Paradise Range, and about two mi. (3.5 km) from the sites to the north, 12 plants have been observed at six sites over a 1.5 mi. (2.5 km) long area; no site was extensively searched (Bagley, 1989). Five of these sites and 11 of the 12 plants occurred on BLM land. The sixth site was mapped on private land, but within 265 ft. (80 m) of the section line separating BLM from private land. Given the low relief in the area and the relatively crude map and compass technique for locating this site about 1 mi. (1.6 km) from a road, it is quite possible that the site was actually on BLM land. Additional surveys in 1991 did not locate any Lane Mountain milkvetch in this area (USFWS, 1991).

In 1992, C. Rutherford and R. Bransfield located a small population of Lane Mountain milkvetch on Coolgardie Mesa, approximately 15 mi. (24 km) north of Barstow. This is no doubt in the vicinity of the earlier collections by Munz, and Ripley and Barneby. Seven plants were observed here in 1992, on BLM land. This is the only known recent site on Coolgardie Mesa.

Lane Mountain milkvetch occurs in two population areas, separated by Lane Mountain and the smaller peaks that lie northward. Since 1985, a total of approximately 173 plants have been reported at different times from all known sites (not taking into account possible population declines). The Coolgardie Mesa population, west of Lane Mountain, has a single known site on BLM land. This site had 7 plants or 4% of the total number of plants reported from all sites and covered less than 10 acres (4 hectares). The population north and northwest of the Paradise Range, northeast of Lane Mountain, had a number of known sites scattered over several miles of BLM and Fort Irwin lands, and possibly one site on private land. A total of 166 plants have been reported here. Within this population, approximately 68% of the reported plants occurred on Army land, 31% on BLM, and 1% on private land.

Threats Analysis:

Fewer than 200 plants of Lane Mountain milkvetch have ever been reported. With such a small population and small range it is particularly vulnerable to stochastic extinction (USFWS, 1992). It is potentially threatened by ongoing military activities at the Fort Irwin National Training Center and by proposed expansion of Fort Irwin onto adjacent BLM lands (USFWS, 1992). The largest population occurs on Fort Irwin, in an area thus far not used for training. Except for the small population on Coolgardie Mesa, the remainder of the plants occur within one of the proposed alternative sites for Fort Irwin expansion (BLM, 1996). If the Army expands into this area it would no doubt cause increased use in the area where Lane Mountain milkvetch occurs on base and new military uses in the expansion area. This species occurs on low hills and very low ridges on the upper and middle bajada slopes, just the kind of terrain that would likely become heavily impacted if these areas were used for tank maneuvers or as staging and bivouac areas. The primary threat to the species is from off-road-vehicle travel that is an integral part of the Army's training at Fort Irwin, particularly from heavy trucks and tracked vehicles. Without strong protections, Army use in these areas is a significant potential threat to the survival of this rare milkvetch.

Sheep grazing, a minor threat noted by USFWS (1992), has been alleviated by closure of the grazing allotments within the range of the plant due to conflicts with the listed desert tortoise. Mineral claims on BLM land could also potentially pose a threat to this species.

Biological Standards:

To protect Lane Mountain milkvetch on Army land, known and potential habitat areas should be placed off-limits to all off-road travel and protected from any new surface disturbances. Such areas should have a buffer zone established around them and be strictly enforced. An education program for military personnel and contractors should be established to teach the importance of these areas and to make personnel aware of the location of the restricted areas.

On BLM land, the species could be protected by eliminating known and potential habitat areas from the proposed Fort Irwin expansion and by providing further protection from mining by withdrawal of these areas from mineral claims.

The distribution and abundance of Lane Mountain milkvetch is not well known, particularly on Coolgardie Mesa where only one small population has been mapped. This species is known to occupy only a small portion of the potential habitat within its reported range. Further surveys for this species on both Army and BLM lands are needed to determine the population size and extent, and monitoring studies should be undertaken to look at natural population fluctuations.

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LITTLE SAN BERNARDINO MOUNTAINS GILIA

Gilia maculata Parish
[*Linanthus maculatus* (Parish) Mlkn.]

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S1.1, G1 (CDFG, 1998)
CNPS: List 1B, RED code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Little San Bernardino Mountains gilia is endemic to southern California. It is restricted to dry canyons and alluvial fans in the Little San Bernardino Mountains, near the mouth of Dry Morongo Canyon and near Desert Hot Springs at the head of the Coachella Valley, in Whitewater Canyon in the eastern San Bernardino Mountains, and from Whitewater to Palm Springs (the type locality). It is also known from a very recently discovered locality at the mouth of Rattlesnake Canyon on the north side of the San Bernardino Mountains (Sanders, in press).

The populations in Palm Springs, Whitewater Canyon, along the Whitewater River and elsewhere around the head of the Coachella Valley (e.g., mouth of Dry Morongo Canyon) are not within the WMPA.

Distribution in the West Mojave Planning Area:

The most extensive populations of this species are along washes at the northern edge of Joshua Tree National Park in the Little San Bernardino Mountains, within the WMPA. These populations are near the cities of Yucca Valley, Joshua Tree, and Twentynine Palms, with most reported in the vicinity of Yucca Valley and Joshua Tree. The other population of the species that is definitely within the WMPA is at Rattlesnake Canyon. It is probable that there are additional populations waiting to be discovered along washes somewhere in the 22 mi. (35 km) of hilly country at the east end of the San Bernardino Mountains between Yucca Valley and Rattlesnake Canyon.

Natural History:

Gilia maculata was described by S.B. Parish in 1892 from a collection made by W. G. Wright at "Agua Caliente" (=Palm Springs) in 1889 (Parish, 1892). Jepson (1943) says that the type collection bears "no exact station", but S.B.Parish (1907) says that Wright collected it just west of the hot springs at Palm Springs. In April 1907 Parish visited the exact site in the company of Wright in an unsuccessful attempt to recollect this elusive species which had not been seen in 18 years. While Parish and Wright were unsuccessful at the type locality, just a few days earlier the species had been found in abundance, and the second collection of the species made, along the Whitewater River (Jepson, 1943) about half way between Whitewater Station and Palm Springs by Charlotte Wilder (Parish, 1907). It then disappeared for another 17 years until it was collected at

Coyote Holes (now in city of Joshua Tree) in the Little San Bernardino Mountains by P. A. Munz in 1924 (Munz, 1925). Since 1924 it has been very elusive and little collected. The specimens in herbaria have been so few that its study has been difficult (Patterson, 1989). Since the publication of Patterson's paper, the exact habitat of the species has finally been identified and a number of new populations have been discovered. For example, G. Helmkamp had been looking for this species for about ten years before he finally found it in 1992, after the correct habitat was identified (G. Helmkamp, pers. comm.). It is undoubtedly true that more plants of this species have been found and collected in the past decade than were found in the previous century.

In addition to its elusive character, this is a species that has been the source of some taxomomic controversy and appears to have no unambiguously close relatives. Its closest relatives may be Inyo gilia (*Gilia inyoensis*) and bell-flowered gilia (*G. campanulata*), which occur 180 mi. (300 km) to the north (Patterson, 1989). Its physical isolation and morphological dissimilarity from its closest apparent relatives suggest that this may be a rather old species. It was first described in *Gilia*, because at the time that was a large and variable genus encompasing a variety of plants. Later it was removed to *Linanthus* because it had no obvious close relatives in Gilia and seemed to share some similarities (mostly overall aspect, probably) with certain *Linanthus* species, notably desert linanthus (*L. demissus)*. A review of the status of the plant by Patterson (1989) revealed that it is not closely related to any species of *Linanthus* and seems best accommodated in the still variable genus *Gilia* in which it was originally described. The more closely one examines this plant, the less it resembles any other species. The genus *Gilia* is still highly variable, lacks a set of distinctive characters (Patterson, 1989) and is likely to be segregated into a number of more homogeneous genera in the future (M. Porter, pers. comm.).

Linanthus maculatus is a small annual herb that grows in very loose soft sand on low benches along washes at the southwestern edge of the Mojave Desert and northwestern edge of the Colorado Desert. Despite it's "large" flowers (0.16-0.2 in., 4-5 mm, long), relative to the size of the plant, it is quite inconspicuous and is easily missed by collectors. Perhaps part of the reason it is seldom collected is that the white flowers blend with the white quartz sand in which it often grows. There was a prolonged period when no one could find this plant, at least with any regularity. There were a few collections from the 1940s to the 1960s, but then it went almost uncollected through the 1970s and early 1980s. When its habitat was finally identified, and systematic surveys for it began in appropriate habitats, a number of additional populations were discovered.

The plants have a slender, little-branched, tap root that extends over 6 cm into the sand and which probably taps "deep" supplies of moisture, beyond the reach of atmospheric drying. The plants branch at the ground surface and 3-12 short branches spread over the surface forming small cushions up to 6 cm across. Height of the plants is only 0.8-1.2 in. (2-3 cm). The general morphology of the species is well described by Patterson (1989).

Pollinators, germination requirements, seed longevity, and most other aspects of the biology of this species are unknown (Patterson, 1989). The color and form of the flowers suggests that this species is almost certainly insect pollinated, but the nature of the pollinators is unrecorded. The species is not even mentioned in the major work on pollination in the phlox family (Grant and Grant, 1965). The white color suggests a nocturnal visitor, but many diurnally pollinated flowers are white as well. The flowers are white and usually have 5 dark reddish-purple, "vermilion" (Munz, 1974) or "pink" (Munz, 1925) spots. Some plants have spotless flowers. The open corolla, color spots, and relatively large size (though still small) all suggest that this species is not autogamous, but rather is insect pollinated.

Habitat Requirements:

This plant seems to require very soft open sandy flats with few or no competing species and certainly with no large shrubs or trees in the microsites occupied. The sand is always loose and well aerated: soft to the touch and not consolidated. Populations are only found on sandy benches on the margins of washes and not on the disturbed sand of the bed of the wash, on soils with a hard surface layer of either rock or clay, or on loose blow sand in areas away from washes. Shrubs are always present in the general areas occupied, but these are not common on the sandy benches where *Gilia* actually is found. These loosely associated shrubs include: creosote bush (*Larrea tridentata*), brittle bush (*Encelia farinosa*), burro bush (*Ambrosia dumosa*), cheesebush (*Hymenoclea salsola*) and desert catalpa (*Chilopsis linearis*). *Gilia maculata* always occupies open sunny sites and is never found in the shade of larger plants. It is commonly associated only with other dwarf herbs such as sigmoid thread plant (*Nemacladus sigmoideus),* blushing thread plant *(N. rubescens)*, evening-primrose *(Camisonia pallida),* common loeflingia *(Loeflingia squarrosa),* Arizona nest-straw *(Filago arizonica),* Wallace's woolly sunflower *(Eriophyllum wallacei)*, etc. There are never dense stands of weedy annuals at the sites occupied. Populations have been found at elevations from 500-4000 ft. (150-1200 m).

Population Status:

Some recently discovered populations contain many thousands of plants, though others may contain as few as 200. Recent intensive searches for the species, since its habitat came to be understood, have revealed that it is much more numerous than previously believed, though only slightly more widespread.

There are about four major populations, two within the WMPA, though the major population area in the Joshua Tree and Yucca Valley area is broken into a number of discrete population units associated with individual washes. This species has a very narrow set of habitat requirements and its populations are correspondingly restricted.

Available population estimates are few, but the following give an idea of the size of known populations. North of Indian Ave. near mouth of Big Morongo Canyon -- ca. 10,000 plants in spring 1996 (G. Helmkamp, pers. comm.); between Joshua Tree and Indian Cove, right at the JTNP boundary -- plants were widespread in spring 1995 in flat areas along washes (G. Helmkamp, pers. comm.). Populations here contained thousands of individuals; Dry Morongo Canyon north of the county line -- a few hundred plants in 1995 (and earlier in 1992), but only 6 found in 1996 (G. Helmkamp, pers. comm.); South of the town of Joshua Tree on the road to JTNP -- 100 in 1986 (Patterson, 1989), "reduced markedly" in 1987 (Patterson, 1989), 150-200 in 1988, 25-30 in 1990, and 1000 in 1993 (CDFG, 1996).

It is obvious from examination of the above population estimates, especially those for the last site mentioned, that populations vary greatly with the environmental conditions between years. This is a normal phenomenon, but one which makes the determination of trends difficult.

Threats Analysis:

The greatest threat to this species is growing urbanization in the Yucca Valley and Joshua Tree area where the largest populations exist. This is a fast growing area and growth is extending right up to the JTNP boundary. The large populations along Morongo Wash, Mission Creek and west of Desert Hot Springs are threatened by urbanization spreading westward from Desert Hot Springs. The population at Palm Springs has probably already been extirpated by the growth of that city. The type locality is now in the middle of town and has undoubtedly been destroyed. When Parish visited in 1907, only five families lived permanently in Palm Springs (Parish, 1907), but today it is a large city. Any other populations in the area have likely been destroyed as well, but there is still some apparently suitable habitat on Agua Caliente Indian Reservation land in Palm Canyon (pers. obs.). Many of the recently discovered large populations near Joshua Tree and Yucca Valley are along washes that cross the park boundary. Many of these populations are partially in areas (private land) that are subject to destruction by development pressures.

A secondary threat to this species is OHV recreation. The small size of these plants, combined with their occurrence in open sandy areas along washes, makes them particularly vulnerable to vehicle damage. Washes are often used as highways by OHVs, because there are not as many shrubs to impede the vehicle's progress.

Biological Standards:

The most critical immediate issue is the determination of the extent to which the known populations near Joshua Tree and Yucca Valley extend into JTNP. All populations outside the national park must be considered highly endangered as they occur on relatively flat sites and predominantly on private land subject to development pressures or OHV damage. The extent of any populations on BLM lands must also be determined as soon as possible so that measures can be taken to avoid damage to those my misdirected recreational activities. Any populations on public land should be carefully protected from OHV damage by closing the occupied area to such use.

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MOJAVE MONKEYFLOWER

Mimulus mohavensis Lemmon

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Management Status: Federal: USFWS Species of Concern
California: S2.2, G2 (CDFG, 1998)
CNPS: List 1B, R-E-D code 2-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Mojave monkeyflower is found only in the Mojave Desert of California. Its highest population densities are in areas just south of Daggett and Barstow; and it has also been found within the Barstow city limits (CDFG, 1997b). An historic record of this species at Calico Ghost Town, ten miles northeast of Barstow (Lemmon, 1884), represents the northernmost reported location, while the easternmost population occurs at Kane Springs in the Newberry Mountains. It is uncertain whether the species still occurs at those two sites. Several occurrences were noted in the Mitchell Range near Fort Irwin Road about five miles north of Barstow in 1992 (CDFG, 1997b). There are numerous extant small populations east of the Mojave River drainage and west of Interstate 15 between Victorville and Barstow. The Mojave monkeyflower has not been reported from west of the Mojave River. CNDDB (CDFG, 1997b) reports a population at Old Woman Spring east of Lucerne Valley, but the plants have not been seen there since 1936. This is the southernmost reported occurrence of this species (CDFG, 1997b).

Distribution in the West Mojave Planning Area:

All of the known range of this species lies within the WMPA.

Natural History:

The Mojave monkeyflower is a member of the figwort family (Scrophulariaceae). These annual plants have purplish-red stems and leaves, and are covered with minute glandular hairs that are visible when magnified (10X). This species tends to grow erect and branch from the base, reaching a height of 1-6 in. (3-15 cm). The opposite leaves are from 0.3-1.1 in. (7-27 mm) long with an elliptic shape and acute tips. They are sessile on the upper stem, but may have petioles on the lower stem. The flowers are on 0.1 in. (2-3) mm long pedicels that arise from upper leaf axils. The bell-shaped red-purple calyx has unequal, pointed, ciliate lobes and minute hairs along the veins. It enlarges when fruits form, reaching 0.4-0.5 in. (10-12 mm) in length. Unique maroon corollas are radial with five spreading lobes with irregularly-toothed to ragged white margins, distinguishing it from other species (Hickman, 1993; Munz, 1974; Grant, 1924).

The Mojave monkeyflower blooms from April to June (Munz, 1974). The time of germination and requirements for germination are unknown, although amount of precipitation is probably a major factor, given the variation in population sizes from year to year (Bagley, 1991; CDFG, 1997b). There is no information available about the pollination ecology of this species. The showy flowers suggest biotic pollen vectors, most likely hymenopteran or lepidopteran (Faegri and van der Pijl, 1979). The white margin of the corolla may reflect ultraviolet light, and the maroon veins extending into this margin likely act as nectar guides. Other *Mimulus* species are insect-pollinated and mostly outcross (Vickery, 1964), but many are also self-compatible (Leclerc-Potvin and Ritland, 1994). Seed dispersal is probably mostly abiotic, since the seeds are small. Some populations are reported from rocky slopes above washes, and it is likely that gravity carries seeds down into the washes. Intermittent water flow may carry seeds further down washes. Biotic vectors of seed transport are unknown. However, there is a possibility that granivorous ants or rodents could carry seeds, and birds might be important in transporting seed longer distances.

Habitat Requirements:

The Mojave monkeyflower is found in Joshua tree woodland and creosote bush scrub communities. Occurrence reports show associations with creosote bush (*Larrea tridentata),* desert senna *(Senna armata),* cheese bush *(Hymenoclea salsola),* rattany *(Krameria* sp.), cholla *(Opuntia* sp.), burro bush *(Ambrosia dumosa),* indigo bush *(Dalea* sp.), cat-claw acacia (*Acacia greggii),* Bigelow's monkeyflower *(Mimulus bigelovii),* desert bells *(Phacelia campanularia)*, and desert trumpet *(Eriogonum inflatum).*

This species occurs primarily in granitic soils on gravelly banks of desert washes, in sandy openings between creosote bushes and along rocky slopes above washes, areas that are not subject to regular water flows. The elevation range at which this species occurs varies from 2000-3300 ft. (600-1000 m) (CDFG, 1997; Hickman, 1993).

There is plenty of apparently suitable habitat for this species, yet it is quite restricted geographically. Where it is found, population sizes can greatly vary from year to year (CDFG, 1997b). The amount and timing of precipitation are probably important factors affecting population size (Bagley, 1991; CDFG, 1997b). It is possible that this species has some unusual germination and establishment requirements that are unknown.

Population Status:

The 25-30 occurrences of Mojave monkeyflower between the Mojave River and Interstate 15 between Victorville and Barstow were first reported to CNDDB in 1992 (West, 1992). Some of these locations are very close together, even within a few hundred meters of each other. It is unclear whether each reported location represents a distinct interbreeding population, since the distance of pollen dispersal and reproductive strategy of this species are not known. Most of these locations have 100 plants or less, some as few as two plants, with an average of about 40 plants per location. There are no available data indicating current trends in numbers and fluctuation, although subsequent data have been collected. From the 1992 data, it appears that this region is not one supporting a dense concentration of these plants, but, since some populations occurring elsewhere have been known to fluctuate widely (Bagley, 1991; CDFG, 1997b), all that is really known is that the species is present; further assessment and monitoring are needed.

The highest population densities occur in areas south of Barstow and Daggett, especially along Camp Rock Road. The status of many of these populations was assessed in 1986 (CDFG, 1997b). At least four of the populations in the vicinity of Camp Rock Road contained more than 1000 plants. Several smaller populations of less than 50 plants were reported from the same area. Three populations reported in the late 1970s were not found again in the 1986 surveys, possibly due to dry conditions (CDFG, 1997b). Surveys of five Mohave monkeyflower sites from the

Newberry Mountains to Stoddard Valley conducted in 1991 (Bagley, 1991) revealed only dried remains at one site, while no plants of this species, not even dried remains, were found at the other four sites. It was concluded that the year was too dry, and that perhaps the surveys had been conducted too late in the season (June) for the plants to be apparent. A few plants had been observed by others in some of these areas earlier in the season (Bagley, 1991). A population of 200 plants was found in Daggett Wash in May of that year (Rutherford and Bransfield, 1991). Over 1000 plants were observed at one Camp Rock Road location in 1993, a year with more precipitation. Evidently more data have been collected since 1993 at many of these locations, but these data are stored in BLM files, and are not currently available.

Some historic locations have likely been extirpated, and the status of many populations is unknown. The type locality population, at Calico (Ghost Town; Lemmon, 1884), has not been seen since, but the CNDDB reports (CDFG, 1997b) assume that it is extant. This locality has heavy recreational use, and it seems likely that it would have been reported to CNDDB since 1884 if this species was still present. The population at Old Woman Springs, south of Highway 247, was first collected in 1937. It is presumed extant (CDFG, 1997b), but again, there are no subsequent reports of this species from that location. The Kane Springs population in the Newberry Mountains was last seen in 1906 but is presumed extant, as is another population last seen in 1941, located five miles south of Barstow, at Bloody Gulch mine. A mine by this name has not been documented in this area, but there is a Bloody Gulch mine in the San Bernardino Mts. near Big Bear. Location data were most likely incorrect, so it can't be certain if this population has been seen since 1941. Several collections of Mojave monkeyflower were labeled as being from Barstow in several years from 1904-1937. Populations were last seen there in 1941. The species may have been extirpated from Barstow due to urban development (CDFG, 1997b). Some of the collections may have been from the hills near Barstow (Grant 1924), while others indicate the location as the sandy banks of the Mojave River in Barstow (CDFG, 1997b). It is possible that all of these older collections were actually from the vicinity of Barstow, and not from within what is now the town. Collection labels in the past were often were much less detailed than modern labels: earlier collectors were not as concerned with precise localities as botanists are today. To label a plant as coming from Barstow was considered sufficiently precise, even if the specimen came from ten miles away; Barstow was the nearest named locality.

Threats Analysis:

Although there are numerous locations where the Mojave monkeyflower is known to occur, population sizes are quite variable annually. In 1986 known population sites were surveyed (CDFG, 1997b), and no plants were found at several of the locations. It was speculated that conditions may have been too dry that year for the plants. This species may experience major population fluctuations in response to environmental conditions including: 1) how much water is available, 2) when the precipitation occurs, and 3) in what form the precipitation occurs, and 4) what temperatures occur. It is presumed that seeds survive bad years and germinate when conditions are more favorable, but a series of harsh years may decrease the seed bank to a point where it is difficult to recover. When population sizes are small it is possible that inbreeding may contribute to a reduction of number of seeds set or of seed viability , although some rare species are known to self-pollinate with no detrimental effects (Barrett and Kohn, 1991; Carr and Dudash, 1996; Huenneke, 1991). Pollination vectors may be limited if plant populations are insufficiently large to attract them (Karron, 1991), and random fluctuations in environmental conditions can lead to pollinator unreliability (Menges, 1991). Genetic bottlenecks may occur due to small population sizes during a series of harsh years, thus limiting genetic variability in subsequent years, especially if the seed bank is not long-lived. Loss of genetic variability can lead to further negative impacts on populations (Huenneke, 1991; Hartyl and Clark, 1989). Pollination studies, population genetic studies, and seed bank studies could help determine which of these factors have the most potential to impact Mojave monkeyflower populations.

The populations of Mojave monkeyflower occurring between the Mojave River and Interstate 15 north of Victorville are situated on a patchwork of private and BLM lands. The region contains many quarries and test pits, some of which are adjacent to known populations (West, 1992). The area is also dotted with developed home sites, which could potentially impact these plants. The BLM is at present attempting to dispose of some of its land in that area, and some has already been sold to the private sector (West, 1992). The San Bernardino County Transportation Department has recently paved many of the dirt roads in this area, using ground asphalt removed from the renovation of Interstate 15. These roads include Rodeo Road, Corral Road, and Bonanza Trail, along which Mojave monkeyflowers have been found (West, 1992). Paving the road will increase traffic to this area, and will likely promote development. Even though the 1992 population sizes of Mojave monkeyflower reported from this area were not large, those between the Mojave River and Interstate 15 represent a substantial proportion of the known range of this species; substantial populations may be present here in some years. The major threat to these populations is that some of them are already on private lands, and more soon will be. Since this species has no legal status, a private land owner is not legally required to protect it. If the amount of relatively protected habitat on public land is continually diminished by transfer of these lands to the private sector, it is much more likely that this species will require listing in the future. Alternatively, if BLM could maintain control of the lands in this area, it may be possible to control the loss of Mojave monkeyflower habitat so that future listing might not be necessary.

Continued urbanization around Barstow, Dagget, and Newberry Springs may destroy habitat, and most likely has already had negative impacts on any populations that occurred within the Barstow city limits. South of Barstow and Daggett, off-highway vehicles pose a considerable threat to this species; several populations are located in or adjacent to the Stoddard Valley off highway vehicle (OHV) open area. This is a BLM managed area, and in some sites OHV competition events are staged. One reported population of the Mojave monkeyflower is bisected by Stoddard Valley Road, and several populations are known from areas adjacent to the heavily used Camp Rock Road. OHV tracks were observed at several known population sites along Camp Rock Road during a recent survey to assess habitat integrity (MacKay and Thomas, 1997). Multiple tracks were concentrated in a wash located at one location along Camp Rock Road where a considerable population was observed in 1995.

In addition to threats by OHVs, this area is currently being used for livestock grazing (D. Fisher allotment), and signs of recent grazing were observed during the habitat integrity survey in 1997. Trampling would most likely have negative impacts on populations, but it is not known if this species is palatable to livestock.

Current mining probably does not pose much of a threat to these populations. One population at Azucar gold mine lies about one mile east of Camp Rock Road. Except for old mine tailings, the habitat here appears intact, and plants were found there in 1986 (CDFG, 1997b). This mine never produced, and has been idle since 1945. However, there could be future impacts from mining in the event that new mining activities are approved within the species' range.

The Barstow pipeline project is currently under construction. Even though the pipeline does not run through known Mojave monkeyflower populations, it travels through potential habitat within the known range of this species (Brandman, 1994). The second phase of the pipeline, scheduled to be constructed soon, will cross to the east side of the Mojave River just south of Silver Lakes near Helendale. It will continue north between the National Trails Highway and the Mojave River on the west side of National Trails Highway. Mohave monkeyflower has not been found on the west side of this highway, with the exception of one occurrence northwest of the highway near Main Street in Lenwood. However, it is found just across the highway on the east side, and suitable habitat is available on the west side of the highway. Later phases of the pipeline are to be constructed starting on the north side of the Mojave River north of Barstow, and cutting south to cross the river just west of the Marine Corps supply center near Daggett. It will continue east along railroad easements between Interstate 40 and the Mojave River. Even though the Mohave monkeyflower has not been found along the pipeline route (Brandman, 1994), there is potential habitat for this species there, and it is found nearby just south of Interstate 40. Focused surveys for the Mojave monkeyflower were not conducted for the environmental report for this project (Brandman, 1994).

There are only a few known populations of Mojave monkeyflower which do not appear to be affected by significant human impacts: these occur along the powerline road just south of Daggett off Camp Rock Road. Although there is some vehicular traffic along this road, there were no signs of livestock grazing, OHV travel, or mining activity in these areas during the habitat assessment survey in September 1997. Kane Springs, at the edge of the Newberry Mountains Wilderness Area, should be protected from OHV impacts, although grazing is a permitted activity in wilderness areas. The status of the population there is unknown.

Biological Standards:

To maintain viable populations of the Mohave monkeyflower, it is important to afford protection to the areas where the species is known to occur. Few known populations are protected at present. Protective efforts could include the elimination of OHV use and livestock grazing at known population sites south of Barstow and Daggett, and maintenance of BLM ownership of lands located between the Mojave River and Interstate 15 between Victorville and Barstow. Focused surveys for this species should be conducted along the proposed Barstow pipeline route. Reducing or removing these potential hazards would not, however, eliminate population fluctuations, which are probably induced by random variations in precipitation affecting germination and seedling establishment.

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MOJAVE TARPLANT
Hemizonia mohavensis Keck

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Management Status: Federal: USFWS Species of Concern
California: Endangered, S1.1, G1 (CDFG, 1998)
CNPS: List 1A; (Skinner and Pavlik, 1994). The CNPS status of 1A, reported by both sources, indicates that the species is believed extinct. It has been rediscovered and this status will be altered, presumably to 1B, in the next edition of the CNPS Inventory.

General Distribution:

The Mojave tarplant is endemic to California and is restricted to several moist drainages on the arid slopes of the Peninsular Range (including the San Jacinto Mountains) in Riverside and San Diego Counties, one site at the north foot of the San Bernardino Mountains in San Bernardino County, and two sites on the desert slope of the southern Sierra Nevada Mountains in Kern County. It may also occur at Red Rock Canyon on the northwestern Mojave Desert (Faull, pers. com., 1998), but this has not been confirmed. Until the last few years, the habitat of this species was not understood, the species was believed extinct, and was known from only two historic sites (Tanowitz, 1982). It is possible that additional populations remain to be discovered, especially in the Southern Sierra Nevada Mountains. Most of the known localities (i.e., those in Riverside and San Diego Counties) are outside the WMPA, but the San Bernardino and Kern County localities are within the boundaries of the plan area. The species is not known from the south side of the San Bernardino Mountains, despite the report in Hickman (1993).

Distribution in the West Mojave Planning Area:

Only three sites are known within the WMPA, though it is possible that additional localities will be found. The type locality is at the confluence of the Mojave River and Deep Creek (Keck, 1935), which is along the southern edge of the plan area; the recently identified southern Sierra Nevada Mountains localities at Cross Mountain and Short Canyon are also within the area. Five-rayed tarplants at Red Rock Canyon that were previously reported (Faull, 1987) as Kellogg's tarplant (*Hemizonia kelloggii*) may actually to be Mojave tarplant (Faull, pers. comm., 1998).

The species is known at Deep Creek only from two collections made in 1933 (Keck, 1935; Tanowitz, 1982). It has not been seen at that locality since, despite extensive searching there and at numerous nearby localities with suitable habitat (Tanowitz, 1982; Sanders et al., 1997). These searches have extended over a period of several years and have involved several investigators. The inability of anyone to find the species, at the one locality from which it was unquestionably known, lead to the conclusion that it was probably extinct. It may have been extirpated at that locality, but is now known to occur elsewhere.

The southern Sierra Nevada localities were discovered during the preparation of this manuscript. A specimen in the UCR Herbarium, collected in 1977 at Cross Mountain, was found to be Mojave tarplant, rather than *H. arida* as it was labeled. This re-identification has been confirmed by Bruce Baldwin at UC Berkeley (Baldwin, pers. comm., 1998). Field work in the southern Sierra Nevada in the fall of 1998 failed to rediscover the Cross Mountain Population, but did discover a sizable population in Short Canyon near the Inyo County line, which had been rumored to exist.

Natural History:

The Mojave tarplant was collected three times in the early part of this century but was not found again for over 60 years and was widely thought to be extinct (e.g., Tanowitz, 1982; Hickman, 1993; Skinner and Pavlik, 1994). Despite repeated searches of the type locality on the Mojave River, this plant could not be found. Even at the time it was described, it was thought to be "exceedingly rare and in a precarious position as regards extinction" (Keck, 1935). A 1924 locality in the San Jacinto Mountains of Riverside County was widely questioned because the habitat at this site is so different from that at the type locality, and because a few searches had failed to find the species (e.g., Skinner and Pavlik 1994). Purely by chance, in January 1994 the species was rediscovered on the north slope of the San Jacinto Mountains along Twin Pines and Brown Creeks. Examination of herbarium specimens revealed the existence of misidentified collections of this species from the same general area. During the fall of 1994 and 1995 many suitable areas on the north and west sides of the San Jacinto Mountains were searched and a number of additional populations were discovered.

The Mojave tarplant is a tall annual sunflower (Asteraceae) of open moist sites in arid regions near the margins of the desert. Like other species of *Hemizonia*, this plant is characterized by the possession of both ray and disk flowers, a single row of chaffy bracts between the ray and disk flowers; the phyllaries in a single series, each subtending and half-enclosing a ray achene; fertile ray achenes (i.e., producing good seed); a disk pappus of scales or bristles, if not absent (in this case of scales), and not plumose or bristle-tipped; and the foliage lacks tack-shaped glands (Hickman, 1993). Mojave tarplant is in the section *Madiomeris* which is identifiable by presence of an annual habit, beaked ray achenes, chaffy bracts restricted to a fused outer ring, and a lack of spinose tips on the leaves and phyllaries (Tanowitz, 1982). This species is separable from other members of this section by the combination of yellow anthers, a disk pappus of short scales, five ray flowers (and phyllaries), entire basal leaves, and a densely flowered inflorescence (Hickman, 1993). Despite reports in the literature (e.g., Munz, 1959; Tanowitz, 1982), the disk achenes are often fertile. The foliage is pleasantly scented (Munz, 1959) and once experienced this is a memorable and useful characteristic (pers. obs.).

Unlike most species of *Hemizonia*, Mojave tarplant is self-fertile and reproduces freely in cultivation, becoming almost weedy in greenhouses (B. Baldwin, pers. comm., 1998) and also escaping into disturbed areas in a botanical garden (S. Boyd, pers. comm., 1998). In nature, flowering is reported in late July and continues through the fall and sometimes into winter if cold weather does not kill the plants. In cultivation, the plants seem to flower shortly after the summer solstice, apparently in response to decreasing day length (S. Boyd, pers. comm., 1998). Peak flowering is from August through October, but a few plants have been found flowering as late as January, at least in favorable years. Flowering, once begun, is continuous for as long as the plants are alive and fruit maturity and dispersal is likewise continuous. Nothing is known about seed dispersal vectors, but it may be that the relatively heavy dark colored seeds just fall around the maternal plant and maintain the population in that site. There are no obvious mechanisms for long-distance dispersal of the seeds (e.g., wings, hooks, etc.).

The original collections were evidently of small plants in marginal environmental conditions and so the manuals (Hickman, 1994; Munz, 1959; Munz, 1974; Ferris, 1960) all report that this plant is only 6-12 in. (15-30 cm) tall. In fact, it commonly reaches heights of about 40 in. (1 m), with some plants even reaching 60 in. (1.5 m). Shorter plants in the 6-12 in. (15-30 cm) range are easily found, especially on the margins of the moist habitat this species prefers, but if conditions are good the plants are much taller (Sanders et al., 1997).

Habitat Requirements:

Most known sites are within the belt of desert edge chaparral and the others are on arid coastal facing slopes (Sanders et al., 1997). These sites are often in a zone where rain and fog are infrequent and so skies, during the growing period, are commonly clear. This doubtless results in higher temperatures, lower humidity, and more intense sunlight than at more coastal sites where other *Hemizonia* species occur.

The Mojave tarplant occurs mostly in clay or silty soils that are saturated with water in winter and spring (Sanders et al., 1997). Plants are found along grassy swales, intermittent creeks, and at seeps. Occasional dwarfed plants are found in drier sites near occupied wet areas. This species seems to prefer areas where a fairly substantial water supply is available at depth through the summer, but which are dry at the surface (Sanders et al., 1997). The combination of early saturation and later desiccation may serve to reduce competition from other species. Competition may be further reduced by the complete dryness of these sites during drought years.

The most suitable habitat patches are found on gentle slopes and low gradient stretches of streams in generally mountainous terrain. Shrubs and trees are few and not dominant in the sites actually occupied (Sanders et al., 1997). Mojave tarplant also occurs in sand along intermittent creeks, as at the type locality, but we now suspect that most of these plants were waifs and that this is not a habitat where the species maintains permanent populations. There are some cases where substantial populations are found in sand immediately adjacent to more typical habitat (Sanders et al., 1997).

All populations occur between 2800 and 5250 ft. (850-1600 m) elevation, but most are located between 3000 and 4000 ft. (915-1225 m). The Cross Mountain locality has not yet been precisely enough located to determine elevation, but is probably at about 3300 ft. (1000 m). The Lawler Lodge site, 5250 ft. (1600 m), is well above the rest of the known locations and is densely wooded with pines and oaks (Sanders et al., 1997). There are no moist openings and the specimen was collected on the roadside (G. Helmkamp, pers. comm., 1996), which is the only open habitat present. The area was searched in fall of 1994 and the species was not found; it appears that the specimen was from a roadside waif.

Population Status:

The distribution of Mojave tarplant appears highly discontinuous and possibly somewhat relictual in character. It is locally common, but only in a few very restricted habitat patches. Populations fluctuate in response to environmental conditions, probably especially rainfall. The 1994 population at Twin Pines Creek, for example, was noticeably smaller than the 1993 population had been, based on dried skeletons from 1993 still present (Sanders et al., 1997).

Population estimates exist for many of the populations of this species, but unfortunately they are all based on observations from a single season. At the type locality, Mojave River at Deep Creek, there were only about ten plants present the last time the plants were seen (Keck, 1935). In fall of 1994, the total population in the Twin Pines Creek drainage of the San Jacinto Mountains was estimated at about 6000 plants (Sanders, et al., 1998). In fall of 1995, the populations in the Palomar Mountains of northern San Diego County, Cutca Valley and Long Creek, were estimated at 10,000 individuals, but there could easily have been twice that many. The populations in the vicinity of Indian Flats and Chihuahua Valley have not been counted, but probably total several thousand individuals. The size of the Cross Mountain population in Kern County is completely unknown, both with respect to physical size and number of individuals present. All that is known is that in 1977 two young and healthy individuals were collected.

All the known extant populations are physically relatively small, occupying a total area of no more than 2-3 mi^2 (5-8 km^2), but even within that small area the actual area of occupied habitat is much smaller. Populations are very strongly restricted to low damp areas and are seldom found more than a few meters from the bottom of a drainage way or a seep.

Many areas have now been searched that do not appear to support the species, even though the general habitat appears suitable. Areas in the San Bernardino Mountains, along the southern edge of the WMPA, searched in 1994 and 1995 that do not appear to support Mojave tarplant populations are listed by Sanders et al. (1997). The species was also not found in the Tule Valley and Anza areas of Riverside County, which are outside the WMPA.

Threats Analysis:

The type locality has been heavily modified by construction of a flood control structure, the Mojave River Forks Dam, and upstream the Mojave River is flooded under the permanent waters of Silverwood Lake (Sanders et al., 1997). Both these structures were built before there was any requirement for significant environmental review and so if this species was present, this cannot now be known. If the type collection was a population of waifs washed down from a permanent population upstream, this original population will now never be identified. There is potentially suitable habitat on the Las Flores Ranch, but that private property has not been available for botanical exploration (Sanders et al., 1997).

The type locality, probably at or just below the present Mojave River Forks Dam, is heavily used by off road vehicles in drier areas and is permanently wet and wooded or swampy in low places as a result of seepage from the dam (Sanders et al., 1997). Much of the upland area has been denuded by excessive vehicle use.

Habitat areas around Twin Pines Creek have been modified by low density development, mostly of a rural residential character (pers. obs.). It is likely that some populations on private land have been eliminated by this activity.

Grazing by cattle occurs in some Mojave tarplant occupied areas, and in the southern Sierra Nevada is locally intense, which may potentially pose a threat to populations. Plants of the genus *Hemizonia* are generally not very palatable to cattle, so the threat from livestock may not be great. There may be localized problems with trampling around isolated water sources in arid areas.

Biological Standards:

The immediate need for the protection of this species within the WMPA is extensive surveys of areas of suitable habitat, especially in the southern Sierra Nevada and along the north foot of the Transverse Range (San Gabriel Mountains, in particular). The identity of the five-rayed tarplant populations at Red Rock Canyon should be determined as soon as possible. Until the size and location of any remaining populations in the WMPA can be clearly specified, management will not be possible.

It may be that the most important populations of this species are outside the WMPA and that the known sites within the plan area are marginal or even insignificant. The Mojave River population appears to have been extirpated and we have no significant information on the size, or even the exact location, of the Cross Mountain population. All we know is that a population exists at a spring somewhere near Cross Mountain, and that plants are not common in the immediate vicinity. The only potentially important population known within the WMPA is the recently discovered one in Short Canyon.

Fortunately, many of the known populations outside the WMPA are on the San Bernardino or Cleveland National Forests and hence receive some degree of protection. The ownership of the land occupied by the Cross Mountain population is unknown.

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MUIR'S RAILLARDELLA

Raillardiopsis muirii (A. Gray) Rydb.

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Management status: Federal: BLM Sensitive
California: S2.3, G2 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 2-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Muir's Raillardella is a California endemic known from approximately 19 populations on granitic exposures or granitic soils of the southern Sierra Nevada Mountains in Fresno, Tulare and Kern Counties, with one disjunct population on Ventana Double Cone in the Santa Lucia Range of Monterey County (Baldwin and Kyhos, 1990; Skinner and Pavlik, 1994). With the exception of the disjunct population on Ventana Double Cone and the three southern populations of Muir's Raillardella (Baker Point, Church Dome, and Owens Peak), the species is restricted to the drainages of the Kings and Kaweah Rivers in the Sequoia and Sierra National Forests and Kings Canyon National Park (Baldwin and Kyhos, 1990).

Distribution in the West Mojave Planning Area:

The one WMPA population of Muir's Raillardella occurs in the Owens Peak Wilderness Area on the northeastern slope of Owens Peak at approximately 8000 ft. (2440 m) (Baldwin, pers. com., 1997).

Natural History:

Muir's Raillardella was first described by Asa Gray in 1876 from a collection sent to him by John Muir. Unfortunately, this specimen's label gives only a vague locality: "the Sierras in vicinity of Yosemite." The most northerly known populations of Muir's Raillardella are in the Kings River drainage and Muir explored that area in 1873 and 1875, including the North Fork of the Kings River and the "Yosemite of the Middle Fork of the King's River" - Tehipite Valley (Baldwin and Kyhos, 1990). Large populations of Muir's Raillardella are known to occur here and it seems highly probable that this was the locality of Muir's original collection. After Muir's collection, Muir's Raillardella slipped into obscurity with no additional collections made for 30 years. In August 1905, Alice Eastwood rediscovered Muir's Raillardella along the walls and floor of Tehipite Canyon (Eastwood, 1907).

Muir's Raillardella is a cespitose or mat-forming perennial that grows to approximately 7.5-12 in. (2-3 cm) tall from a branched woody rhizome or caudex (Munz, 1959; Baldwin, 1993b). The glandular-hairy stems support leaves that are opposite on the lower half of the stem and then graduate to alternate on the upper half. This character separates *Raillardiopsis muirii* from *Raillardella argentea* and *R. scaposa*, two allied and similar perennial species with mostly basal leaves, also found in the Sierra Nevada Mountains (Baldwin, 1993a; 1993b). The heads, with only disk flowers, are arranged in groups of 1-3 in a sparse inflorescence, which appears from early June to early October (Munz, 1959; Baldwin and Kyhos, 1990). Flowering occurs most frequently in July and August (Munz, 1959; Skinner and Pavlik, 1994). Muir’s Raillardella has a strongly self-incompatible breeding system requiring pollen from another individual to set viable seed (Baldwin and Kyhos, 1990).

The species appears highly resistant to insect attack and it may be that its restriction to a few limited habitats is due to an inability to compete for light and nutrients with other plant species. It appears that its present rarity cannot be due to herbivory by insects. For example, in a note to A. Sanders (1998), Bruce Baldwin said: “I've grown R. muirii in a few different greenhouses and it's amazingly repellent to any insects. During all of the outbreaks of aphids, mealy bugs, and white flies I've seen overwhelming other tarweeds, R. muirii is untouched. The plant seems to be bulletproof to any herbivores. It's rarity must be based on lack of ability to compete with other plants.”

Habitat Requirements:

Muir’s Raillardella occurs on semi-barren granitic outcrops or soils derived from granitic substrates in openings of lower and upper montane forests and chaparral between 3200 and 8000 ft. (1000-2440 m) in elevation. Although restricted to granitic substrates the species has no mineralogical requirement for granitic soils based on successful cultivation in non-granitic mixes (Baldwin and Kyhos, 1990). The species’ occurrence in sites with little plant cover may reflect secondary restriction to habitats with reduced competition (Baldwin and Kyhos, 1990). The population on Owens Peak occurs on open granitic ledges and granitic soils at 8000 ft. (2440 m), the highest known occurrence of Muir’s Raillardella (Baldwin, pers. com., 1997). The habitat of Muir’s Raillardella on Owens Peak is openings within park-like “mixed conifer series” (Sawyer and Keeler-Wolf, 1995) or “mixed conifer forests” (Holland and Keil, 1995) that includes Jeffrey Pine (*Pinus jeffreyi*), Limber Pine (*P. flexilis*), Singleleaf Pinyon (*P. monophylla*), Sugar Pine (*P. lambertiana*), White Fir (*Abies concolor*) and Sierra Juniper (*Juniperus occidentalis* ssp. *australis*). Several other sensitive species occupy the Owens Peak area with Muir’s Raillardella, such as Needles Buckwheat (*Eriogonum breedlovei* var. *shevockii*), Sweet-smelling monardella (*Monardella beneolens*), Nine-mile Canyon Phacelia (*Phacelia novenmillensis*), Hall’s Daisy (*Erigeron aequifolius*) and Owens Peak Lomatium (*Lomatium shevockii*).

Threat Analysis:

The populations of Muir’s Raillardella have several characteristics of a low risk threatened species, including a relatively wide distribution, many populations occurring on National Forests and National Park lands, and habitat consisting of rugged, isolated localities. Although these factors do offer protection for many Muir’s Raillardella populations, other populations face potential threats that need to be addressed. Several populations of Muir’s Raillardella do not occur within Wilderness Areas. These populations have the potential to be impacted by logging, grazing and maintenance activities in these areas. The population on Baker Point, although on Sequoia National Forest land, does not have the protection of being in a designated wilderness area. Development activities on and around the Baker Point lookout by the Forest Service could have a detrimental impact on this population (Baldwin, pers. com., 1997). Populations occurring along the McKinley Grove Road through the north fork of Kings Canyon could suffer serious to catastrophic impacts if the road is widened to increase vehicle flow through the valley (Baldwin, pers. com., 1997). Populations in Tehipite Valley of Kings Canyon National Park, although not directly trailside, have a high threat of human trampling if visitors stray from the designated trail routes (Baldwin, pers. com., 1997), but the area is not heavily vistied (S. Boyd, pers. comm., 1999). The Owen's Peak population of Muir's Raillardella occurs within the Owens Peak Wilderness Area, thus offering protection from threats such as grazing and logging. This population , although isolated from outside pressures by the Owens Peak Wilderness Area, may be exposed to low level threats from hikers due to its presence in the wilderness area.

The need of Muir's Raillardella for open habitat means that another possible threat comes from the closure of nearby forest canopies due to fire suppression and the corresponding accumulation of leaf litter. This may lead to mortality of nearby Muir's Raillardella plants due to burial in litter (Baldwin, pers. com., 1997).

Biological Standards:

All known populations of Muir's Raillardella outside of designated Wilderness Areas should be protected from potentially adverse human activity. The remoteness of many of the Muir's Raillardella populations, including the Owens Peak population, and the ruggedness of the occupied terrain greatly reduce the possibility of habitat destruction by humans, though the populations in Tehipite Valley, Kings Canyon National Park, are perhaps an exception. Even those populations are in an area that does not receive heavy use (S. Boyd, pers. comm., 1999). All populations should be well guarded from possible foot traffic by unwary hikers, but especially those populations in high visitor use areas. Any National Forest management decisions involving the Baker Point lookout should be made with awareness of the population of Muir's Raillardella at the site, and should minimize habitat alteration or destruction. Decisions on road maintenance, or expansion of McKinley Grove Road through the north fork of Kings Canyon, need to consider possible disturbance or alteration of Muir's Raillardella populations in the area. The suppression of regular fire patterns throughout known Muir's Raillardella habitat needs to be addressed to avoid habitat alteration and plant mortality. For the Owens Peak population, Wilderness Area management decisions such as Pacific Crest Trail maintenance, future trail expansion or fire prevention strategies should focus on known Muir's Raillardella populations to reduce the risk of habitat alteration or destruction.

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NINE-MILE CANYON PHACELIA
Phacelia novenmillensis Munz

Author: Scott D. White, Scott White Biological Consulting, 99 East C St., No. 206, Upland, CA 91786

Management Status:

Federal: USFWS Species of Concern
California: G2/S2.2 (CDFG, 1998)
CNPS: List 1B; R-E-D Code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Nine-mile canyon phacelia is a very narrowly endemic species of the mountain crest in the headwaters of the Kern River watershed (Chimney Creek) and on upper slopes of the adjacent east-facing canyons, southern Sierra Nevada Mountains. Elevations range from about 5400 ft. (1650 m) at Chimney Creek to at least 7700 ft. (2350 m) at several sites on the Pacific Crest Trail. All confirmed records are within 5 miles (8 km) of the point where Inyo, Kern, & Tulare Counties meet. It has also been reported about 25 miles (40 km) northwest, in Dark Canyon (Shevock, 1977), at about 8200 ft. (2500 m) elevation, though its occurrence there needs to be confirmed. All or most specimens have been collected near roads or along trails; these presumably represent only the most accessible populations, and the plant's distribution almost certainly extends several miles around the known population centers, on poorly accessible slopes both east and west of the mountain crest.

The Dark Canyon report is based on two specimens: one collected by Ernest Twisselmann (his no. 13905, presumably in the California Academy of Sciences collection) and one collected by James Shevock (no. 5600, kept in his personal collection). Since the earlier report, Shevock has determined that his specimen was mis-identified, and was unsure whether the Twisselmann specimen had been reexamined since its original determination (James Shevock, pers. comm.). These two specimens are evidently the only reports of Nine-mile canyon phacelia's occurrence outside the area described above. CNDDB location 4 is based on the misidentified Shevock specimen; locations 5 and 8 are from the same general area and evidently are not supported by vouchers. The reidentification of the Shevock specimen casts doubt on Nine-mile Canyon phacelia's occurrence in the Dark Canyon area.

Distribution in the West Mojave Planning Area:

The type locality, CNDDB occurrence no. 3, is in Nine-Mile Canyon (*Munz 19463*; [Munz & Roos, 1955]) at 6500 ft. (ca. 1980 m) elev. near the northwestern WMPA boundary "in pinyon-juniper woodland, dry, half-shaded disturbed bank; Nine-Mile Canyon, E. slope of S. Sierra Nevada, extreme S. Inyo Co." Follow-up surveys have not relocated the plant and it is probably best considered extirpated at this location, though it is likely extant in the canyon's uppermost slopes, near the mountain crest.

CNDDB occurrence no. 10 is on the Pacific Crest Trail, about two miles south-southwest of the type location, in Tulare County, just west of the WMPA boundary. CDFG reports this only as an observation by Ertter et al., but it is supported by a specimen (*Ertter 6391* RSA) collected on the same date at nearly the identical site. The observation and voucher likely represent the most accessible portion of a more widespread population, which may well extend east into the WMPA in adjacent Inyo County. CNDDB occurrence no. 11 is about 2 miles (3.5 km) farther south, in Kern County, and also is very near (but outside) the WMPA. CNDDB data indicates that the record needs to be verified, but the mapped location is very near a voucher collected in 1987 (*Ertter 7005* RSA; note that this voucher may also represent an unnumbered occurrence in CNDDB dated 26 May 1987). Again, this population is likely to extend into the WMPA.

CNDDB occurrence nos. 6 and 7 are on the east slope of Owens Peak, in the Indian Wells Canyon watershed, just within the WMPA. Both locations are based on reports by Shevock et al. in 1985. There evidently are no vouchers for these locations.

There also may be a population in Sand Canyon, within the WMPA, about midway between the Owens Peak and Nine-mile Canyon locations. Plants resembling *Phacelia novenmillensis* were observed there by G. Harris (pers. comm.), but were not keyed and no specimen was made. The site has not been revisited.

Natural History:

Nine Mile Canyon phacelia is an annual with one or several ascending to erect stems 5-10 cm tall, short soft-hairy and sparsely glandular. The lower leaves are generally pinnately lobed or compound, ca. 0.8-3.1 in. (2-8 cm) long (rarely longer); upper leaves are reduced, simple, and entire. Leaves are on long petioles, the blades or lobes lanceolate, oblanceolate, or narrow-elliptic; short-hairy on veins of the undersides. Inflorescences are of ca. 8-14 flowers in compact cymes, about 0.8 in. (2 cm) long. Flowers are on short (0.04-0.2 in [1-5 mm]) pedicles; sepals are linear, with long straight hairs along margins; roughly equal in length, ca. 0.08-0.16 in (2-4 mm) long at flowering, expanding to ca. 0.3-0.4 in. (8-10 mm) in fruit. The petals are fused into a lavender bell-shaped corolla, 0.12-0.16 in. (3-4 mm) long with five rounded lobes. The filaments are fused to the corolla, along with a series of narrow scales. The entire corolla falls early from the flower. The stamens and style are glabrous and reach to or just beyond the corolla lobes. The mature fruit is 0.08-0.12 in. (2-3 mm) long, ovoid, covered by short hairs, and surrounded by the expanded calyx. Roughly 2-4 seeds are produced by each fruit. An illustration of the fruit and calyx is provided by Wilken et al. (1993: 707). Important identification characters are the simple, entire upper leaves; relatively long sepals (in fruit); deciduous corolla with narrow scales and glabrous outer petal surfaces; glabrous filaments; and few ovules and seeds.

Munz (1959) reported Nine-mile Canyon phacelia flowering in May, probably based only on the type specimen. Since then, at least two flowering specimens have been collected in early June. Both these specimens were also fruiting. Barbara Ertter's collection no. 7005 was in flower but not yet fruit in late May.

No information is available on pollination vectors or self-compatibility, seed dispersal, mycorrhizal associates, population fluctuations with climatic variables, or other aspects of Nine-mile Canyon phacelia's natural history. The plant's flower form and color suggest a generalist insect pollinator. Its annual habit and occurrence on arid mountain slopes suggests that its numbers may vary widely with precipitation.

Habitat Requirements:

Nine-mile Canyon phacelia is generally found in sandy, gravelly, or rocky soils, sometimes disturbed, in the understory of pinyon **(***Pinus monophylla***)** and/or canyon live oak (*Quercus chrysolepis*) woodland. Barbara Ertter noted on herbarium labels that it was "locally common under oaks," (no. 6391) and "locally abundant, especially beneath [pinyon?] pines" (no. 7005). Steve Boyd & David Bramlet did not note on their label (no. 1954) whether the plant was beneath trees, but the specimen itself has an elongated habit, suggesting a shaded location. Shevock (pers. comm., 1998) recalled that it generally occurs around the dripline of pinyons and oaks, and also in open sun, but not in full shade. Specimens have been collected on flat sites (*Ertter et al. 6391* RSA) and on steeper banks (*Munz 19463* POM) . Parent material has not been noted on labels, but based on location, most specimens have presumably been collected from granitic substrates. No labels or other sources mention talus as Nine-mile Canyon phacelia habitat, but plants at the unconfirmed Sand Canyon location were on talus (G. Harris, pers. comm.) and habitat descriptions on some labels are consistent with talus.

Population Status:

The type locality in Nine-mile Canyon and several Chimney Creek/LaMont Meadow sites have reportedly been completely or nearly extirpated by grazing (within the WMPA) and campground construction (outside the WMPA) (Anon., 1981; Bowen, 1984; CDFG, 1997b). A 1986 collection (*Boyd and Bramlet 1954* RSA) was collected upstream from CNDDB occurrences 1 and 2 in 1986, suggesting that remnant populations may still be extant near the extirpated populations. Pacific Crest Trail locations from Owens Peak to Sawtooth Peak probably are not threatened by human activity. Some of the populations have reportedly been very small, but two were described as "locally common" or "locally abundant" on Barbara Ertter's herbarium labels. It is unclear whether populations may fluctuate widely from year to year, or whether the plant is significantly more common in some locations than in others. Most populations are in Wilderness areas and are poorly accessible due to topography and paucity of roads or trails.

Threats Analysis:

Skinner and Pavlik (1994) indicate that Nine-mile Canyon phacelia is "threatened by grazing and recreation," presumably based on unpublished notes and reports in California Dept. of Fish & Game files (Anon., 1981; Bowen, 1984). Both of these sources are worded strongly, indicating heavy overgrazing at the type locality (the woodland understory completely or almost completely barren), repeated negative survey results in the early 1980s at the type locality and Chimney Creek sites, and loss of a population in Chimney Creek / Lamont Meadows. Herbarium labels have often indicated Nine-mile Canyon phacelia growing beneath pinyon pine and Canyon live oak. Regular occurrence in shaded sites may tend to place the plant in areas preferentially used by cattle for feeding or resting. If herbaceous vegetation is absent or sparse at the Nine-mile Canyon site, as reported (Anon**.,** 1981**;** Bowen**,** 1984) then these areas may be inherently susceptible to overgrazing, and any *P. novenmillensis* populations growing within reach of cattle would likely be heavily impacted by grazing.

Biological Standards:

Ernest Twisselmann’s Dark Canyon specimen should be reexamined to determine whether it was correctly identified. Dark Canyon is not within the WMPA, but the population, if it exists, represents a significant extension of Nine-mile Canyon phacelia’s range and has direct bearing on understanding of the plant’s narrow endemism.

The Sand Canyon site should be revisited and carefully surveyed to determine whether Nine-mile Canyon phacelia occurs there. If accessible, other east-facing canyons between Little Lake Canyon and Indian Wells Canyon should also be surveyed to determine whether additional populations occur within the WMPA. Botanists should view herbarium material in flower and fruit prior to surveys and familiarize themselves with the key characters so that dependable identifications can be made from late May through mid-July. Any new locations should be documented by voucher specimens and reported to the CNDDB.

Range condition at the Nine-mile Canyon type locality should be evaluated. While the specific effects of grazing on Nine-mile Canyon phacelia are unknown, it is likely that heavy grazing would result in cattle feeding on the plant and/or regularly disturbing its habitat. It is unknown whether seeds survive passage through the bovine digestive tract, or if so, whether they can germinate from feces. Regular (or at least occasional) surveys at the Nine-mile Canyon site should be made, particularly if grazing pressure has been or is ever reduced.

Management actions planned within the species known and potential range (i.e., southern Sierra Nevada above about 5500 feet [1680 m] elev.) should consider potential effects to Nine-mile Canyon phacelia populations or habitat suitability. Potentially adverse actions include direct disturbance (e.g., road or trail construction); reductions in woodland canopy cover (e.g., logging or prescribed burning); and grazing.

No management standards for Nine-mile canyon phacelia can be recommended without an improved understanding of its population ecology, geographic distribution, and habitat requirements. Management conflicts should be minimal since its distribution is largely within wilderness areas and poorly accessible high mountain slopes.

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OWENS PEAK LOMATIUM

Lomatium shevockii

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Management Status: Federal: USFWS Species of Concern, BLM Sensitive
California: S1.3, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Owens Peak lomatium is a restricted endemic from the Owens Peak area of the southern Sierra Nevada Mountains. All known populations of this species apparently occur along fewer than 3 linear miles (5 km) of the rugged eastern Sierran ridgeline from Owens Peak south to the Mt. Jenkins (North Morris Peak) area (Hartman and Constance, 1988). There are three documented populations and one reported population, all of which are located in the Owens Peak Wilderness Area. The Mt. Jenkins populations fall just outside the western border of the WMPA.

Distribution in the West Mojave Planning Area:

The only documented population of Owens Peak lomatium in the WMPA occurs on the eastern slope of Owens Peak at approximately 8000 ft. (2440 m) elevation in gravelly to sandy soil.

Natural History:

This low growing, tufted perennial is placed in the subgenus *Euryptera* of *Lomatium* because of the broad, notched fruit apex and base, as well as the wings or rays of the fruit (0.08-0.12 in. wide, 0.04-0.44 in. long [2-3 mm and 1-11 mm respectively]; Hartman and Constance, 1988). These characters separate Owens Peak lomatium from most other *Lomatium* species found in the southern and central Sierra Nevada Mountains, such as alkali parsnip (*L. caruifolium* var. *caruifolium),* Congdon's lomatium (*L. congdonii),* hog fennel (*L. dasycarpum* ssp. *tomentosum),* fine-leaved parsley (*L. dissectum* var. *multifidum),* false fennel (*L. foeniculaceum* ssp. *fimbriatum),* Sierran parsley (*L. nevadense* var. *parishii),* Stebbins' lomatium (*L. stebbinsii*) and loyal parsley (*L. torreyi*). Owens Peak lomatium differs from *L. rigidum*, a similar species in the same subgenus, found only in the Big Pine and Bishop Creek areas of Inyo County, in having narrower fruit wings or rays (1-2 in. [25-50 mm]), and shorter fruiting pedicels (0.2-0.4 in. [5-10 mm]) in *L. rigidum* vs. (0.004-0.04 in. [0.1-1 mm] in *L. shevockii*; Constance, 1993). The young leaves of Owens Peak lomatium resemble those of *Oreonana clementis* and *Cymopterus* (Hartman and Constance, 1988). In light of this fact, care should be taken to observe fertile plant material for proper identification. *Lomatium shevockii* flowers from late April to mid-May, with the fruits developing by mid-June.

Pollination and seed germination requirements are not known for this species. Based on the deeply buried, elongated, taproot this species is undoubtedly a long-lived perennial which does not depend on frequent reproduction to maintain its populations. One can speculate that successful germination and establishment may occur only at long intervals following particularly favorable environmental conditions. The seeds are presumably wind dispersed, based on the presence of the two broad wings.

Habitat Requirements:

Owens Peak lomatium occurs on rocky, open tallus slopes derived from granitic or metamorphic substrates in mixed coniferous forest or Pinyon pine/canyon live oak woodland (Shevock, pers. com., 1997) . The associated coniferous forests are park-like "mixed conifer series" (Sawyer and Keeler-Wolf, 1995) or "mixed conifer forests" (Holland and Keil, 1995), between 7200 ft. (2195 m) and 8100 ft. (2470 m) in elevation. These forests include Jeffrey pine

(*Pinus jeffreyi*), limber pine (*P. flexilis*), singleleaf pinyon (*P. monophylla*), sugar pine (*P. lambertiana*), white fir (*Abies concolor*) and sierra juniper (*Juniperus occidentalis* ssp. *australis*) as dominant trees. Smaller associated species include Burlew's onion (*Allium burlewii)*, Wright's buckwheat (*Eriogonum wrightii* var. *subscaposum)*, purple sage (*Salvia pachyphylla)*, mountain pincushion (*Orochaenactis thysanocarpha)*, California fuschia (*Epilobium canum* ssp. *latifolium)* and monkeyflower (*Mimulus* sp.), with no single set of species, accompanying all populations. Several other sensitive species such as Needles buckwheat (*Eriogonum breedlovei* var. *shevockii*), sweet-smelling monardella (*Monardella beneolens*), Nine-mile Canyon phacelia (*Phacelia novenmillensis*), Hall's daisy (*Erigeron aequifolius*), Dedecker's clover (*Trifolium macilentum* var. *dedeckerae*) and Muir's raillardella (*Raillardiopsis muirii*) are also known from the Owens Peak area.

Threats Analysis:

The existence of only three confirmed populations in a small range poses the greatest threat to Owens Peak lomatium. The two documented populations on Owens Peak are bisected by the Pacific Crest Trail and so could be adversely affected by trail maintenance. Presumably these populations were partially eliminated by trail construction. These populations occur on very steep, rugged terrain which should minimize the chances of pedestrian traffic on the species (Shevock, pers. com., 1997). With a small number of populations and restricted distribution, this species could be vulnerable to chance extinction by climatic fluctuations, accidents, or other extreme phenomena.

Biological Standards:

All known populations of Owens Peak lomatium occur within the Owens Peak Wilderness Area, which should protect the species from logging and grazing pressures. The remoteness of the Owens Peak lomatium populations and the ruggedness of the habitat greatly reduce the possibility of habitat destruction by trampling. Wilderness Area management decisions such as Pacific Crest Trail maintenance, future trail expansion or fire prevention strategies should consider known Owens Peak lomatium populations to reduce the risk of habitat alteration or destruction.

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PARISH'S ALKALI GRASS
Puccinellia parishii A. Hitchc.

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Management Status: Federal: None
California: S1.1; G1 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 3-3-2 (Skinner and Pavlik, 1994)

General Distribution:

Parish's alkali grass is known from a few widely scattered locations in Arizona, New Mexico and California. The species is always very local in its specialized and limited habitat and even in these few sites is usually not common. There are eight locations in Arizona, seven around Tuba City in Coconino County, totaling approximately 400 plants (Phillips and Phillips, 1991) and one recently discovered along Little Shipp Wash near Bagdad in Yavapai County ("common", *A.L. Reina G. & T. R. Van Devender 96-192*, ARIZ, UCR). There is one reported population in New Mexico consisting of 200-5,000 plants (Phillips and Phillips, 1991).

Distribution in the West Mojave Planning Area:

There is only one known location in California, on privately owned land at Rabbit Springs near Lucerne Valley, San Bernardino County. Parish's alkali grass has never been found at any other location in California and an extensive search for the species in 1993, covering numerous apparently or potentially suitable sites in the western, southern and eastern Mojave Desert uncovered no additional populations (Sanders, 1993). However, it remains a possibility that this species does occur at unexplored seeps and springs on BLM lands within Joshua tree woodland and Creosote scrub communities of the Mojave Desert. In 1992, the Rabbit Springs population was estimated at 150 plants in a 500 square foot area, otherwise no plants had been reported there since 1950 (USFWS, 1994). Plants were observed at Rabbit Springs again in 1993 and were described as "fairly common" on both the N-central and NE edges of the seep (Sanders, 1993). Unfortunately, later, upon close examination of the plants in the herbarium under magnification, it was discovered that both Parish's alkali grass (*P. parishii*) and Great Valley alkali grass (*P. simplex*) were present among the specimens collected and so the proportion of each species present at Rabbit Springs is unknown. The exact identity of the 150 plants seen the previous year is also open to question because presumably both species were included in the counted populations. When collecting in 1950, J.C. Roos evidently noticed in the field that two taxa were present at Rabbit Springs because he carefully segregated the two species as separate collections, but he evidently was never able to identify the *P. simplex* material because it remained unidentified in his collection. Prior to 1993 it was apparently not known to active botanists that Great Valley alkali grass occurred at Rabbit Springs alongside Parish's alkali grass, despite the fact that the original description noted that the type sheet of *P. parishii* consisted of a mixture with *P. simplex*. This is the only site where the two species are known to occur together.

Parish's alkali grass was reported in 1992 at the Air Force Flight Test Center, east of Rosamond Dry Lake, on Edwards Air Force Base (D. Charlton, pers. com. to J. Greene, 1995), but the specimens collected (*Charlton, s.n., 15 May 1992*, UCR) later turned out to be *P. simplex*. There was historically a problem in the identification of *Puccinellia parishii* because *P. simplex* was not reported for southern California in any of the floras available (e.g., Munz, 1959; 1974) prior to publication of the Jepson Manual (Hickman, 1993). *P. parishii* and *P. simplex* are very similar and any plant of this type identified using *A Flora of Southern California* (Munz, 1974) would have been identified as *P. parishii.*

Natural History:

Parish's alkali grass was originally described by A.S. Hitchcock in 1928 from specimens collected by Samuel B. Parish at Rabbit Springs, San Bernardino County, California (Hitchcock, 1971). This locality is a large alkaline spring in open desert which has formed a large spring mound by accumulation of sand and dust trapped by the dense vegetation supported by the spring (Sanders, pers. obs.). Most current seepage is from the north and northeast sides of this mound. The spring area is bisected by Rabbit Springs Road, which cuts across the low northern arm of the spring hill. The major seepage area, on the south side of Rabbit Springs Road, has been considerably altered by construction of a pond and by the fencing of pasture. Access to this area has not been available, but it appears that Puccinellia plants are very few in this zone. Along the eastern edge of the Rabbit Springs complex there is a flood control drainage ditch that crosses Rabbit Springs Road. Rabbit Springs Road, the drainage channel and the artificial pond probably all destroyed some Puccinellia habitat. Most of the remaining plants are in the unfenced area on the north side of Rabbit Springs Road, along the north to northeast foot of the spring hill.

Parish's alkali grass is a dwarf annual that germinates in winter and flowers in spring. All plants are dead by early summer. It forms small tufts with many ascending stems from the base. The inflorescence is a rather compressed spike-like panicle, with flowers in April and May. The plants are 1.25-9.5 in. (3-24 cm) tall and inconspicuous if not being actively sought. The cauline leaf blades are generally inrolled and less than 0.05 in. (1 mm) wide when flattened. Flowers are perfect (possess both male and female parts) and are probably strictly wind pollinated. The inflorescence (above the lowest panicle branches) is 0.4-3.5 in. (1-8 cm) long with the lower branches erect to reflexed in fruit; the spikelet stalks are scabrous. The lemmas are hairy in lower half, and have a tip that is obtuse to truncate. The lemma margin is scabrous-serrate near the tip. The lowest lemma is about 0.08 in. (2 mm) long; the anthers of the lowest floret are about 0.02 in. (0.5 mm) long. The plants can be taller and have more culms at base than *P. simplex*, but the diagnostic features separating the species are the lemma tip shape and the extent of pubescence on the lower half of the lemma. Despite their morphological similarity, the two annual alkali grasses are definitely distinct species with different chromosome numbers (Munz, 1959) and thus an inability to interbreed: *P. parishii* is diploid (2n=14), whereas *P. simplex* is octaploid (2n=56).

Habitat Requirements:

Parish's alkali grass occurs in very specific desert alkali seep and spring habitat. It is dependent on continuously wet or moist soil during the growing season, and population size therefore fluctuates widely depending on climatic conditions (USFWS, 1994) and rate of spring flow. *Puccinellia* occurs only in open moist sites with, apparently, strongly alkaline and/or saline water at the surface. *Puccinellia* is not found where there is dense vegetation or where water is not present at the surface for at least part (winter/spring) of the year. Sites occupied do not have rapidly moving water, but neither is the water completely stagnant. Typically the plants occupy areas of alkaline clay soil with water either moving intermittently across the surface in a thin sheet or the margins of low gradient rivulets that carry water during the moist part of the year. It appears that *Puccinellia parishii* occupies sites that are too ecologically difficult for many other species and thus that it is able to avoid competition rather than being able to overcome it. It may be a refugee species occupying sites where there are few other species present to compete with it.

In California, the one known site is at an elevation of 2870 ft. (875 m). In Arizona the Bagdad population is at a similar elevation, but the Tuba City populations are at about 5000 ft. (1500 m).

The highly disjunct and specialized habitat of Parish's alkali grass strongly suggests it is a species that was formerly more widespread during periods when conditions across the Mojave Desert were moister than they are today. It is possible that there were once fairly continuous populations of this species at springs and along intermittent streams that fed into what are now the large dry lakes of the Mojave Desert of California and Arizona. The species seems to have persisted better in the moister areas to the east and at just the one site in California where there is an alkaline spring fed by runoff from the high San Bernardino Mountains. It may be that Rabbit Springs has been continuously wet since the Pleistocene, or before, and hence the large spring mound and the persistence of *Puccinellia parishii*.

Population Status:

The one known Californian population does not have any sort of protection. Furthermore, there is no reliable information on either the size of the population or the magnitude of population fluctuations. It is known that the population is more likely in the hundreds rather than the thousands, but could easily be less than 100 in many years. Because of the confusion with *B. simplex* this cannot be definitely determined from the existing limited information.

Threats Analysis:

Any activity that alters the soil moisture content around Rabbit Springs such as ground water pumping or flood control would likely affect this species (Skinner and Pavlik, 1994). The area around Rabbit Springs has already been developed for what seems to be livestock use, and further development, especially water development, could potentially alter the hydrology of the area (USFWS, 1994). Anything causing the lowering of the water table at Rabbit Springs will likely result in the destruction of the only known California population of this species, as this plant is absolutely dependent upon continued surface flows for its existence. Water is an increasingly valuable commodity in southern California, and especially on the Mojave Desert. There is a probability that there will be a continued increase in the rate of development and use of the groundwater resources in the Lucerne Valley area. This could easily result in the lowering of the local water table and consequent death of much vegetation, as has happened in the Coachella Valley near Palm Springs (Sanders, pers. obs.). The drying of Rabbit Springs, even for a relatively short period of time, could have catastrophic effects on the Parish's alkali grass population. Most annual grasses have very short lived seeds and are dependent on at least some reproduction every year to maintain populations. Even a single year when the spring does not flow may be sufficient to eliminate *P. parishii* from California.

There is significant weed invasion of the *Puccinellia parishii* habitat. Several exotic species are present in substantial numbers (Sanders, pers. obs.), and given the apparent inability of *Puccinellia parishii* to compete with dense stands of other vegetation this represents a direct threat to its populations. Several of the invasive species are distinctly salt tolerant and may thus have already occupied sites formerly the almost exclusive domain of *Puccinellia*.

Livestock have access to most of the currently known sites of Parish's alkali grass, and although it appears that cattle do not graze this grass, damage is likely from trampling, increased erosion and soil disturbance (USFWS, 1994).

Perhaps the most significant long-term threat to Parish's alkali grass is the potential of urban or low density rural residential occupation of its habitat. Human populations have been growing rapidly on the southern and western Mojave Desert, especially in the Victorville/Hesperia area to the west, as well as in the Yucca Valley and Landers areas to the east. The Lucerne Valley area is still quite isolated and development pressures are currently not significant, but as human populations in adjacent areas continue to grow, development pressures in the Lucerne valley area will doubtless increase. The fact that Parish's alkali grass occupies one minute site in California, little larger that a typical residential lot, puts it in extreme jeopardy if even a single residence is constructed in the wrong location.

<u>Biological Standards</u>:

The conservation of this species is a particular challenge because it faces two major threats: habitat conversion and water table lowering. The fact that Parish's alkali grass occupies only one site in California further magnifies the threat. Public or private conservation oriented acquisition of the occupied property must be a high priority. Without surface protection there is little hope that the species can be conserved. Equally important is interaction with local water authorities regarding possible measures necessary to maintain (or restore?) the water table at its historic level. Much could be done at Rabbit Springs to improve the existing habitat conditions. There is a need to remove or modify existing obstructions to natural spring or seep flows and to prevent direct human and livestock impact on the remaining populations. Removal of competing weed species would also be desirable. It would be desirable to search for previously unknown populations in other likely habitat areas and to monitor and carefully map the known population. As a safety measure, up to 5% of the available seed per year should be collected and used for seed multiplication and storage in a seed storage bank, such as the rare plant seed storage and research facility at Rancho Santa Ana Botanic Garden in Claremont, California. This will also provide an opportunity to investigate the biology of this plant, including germination requirements and genetic diversity, so that existing wild populations can be understood and managed.

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PARISH’S DAISY
Erigeron parishii Gray

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Management Status: Federal: Threatened
California: S2.1, G2 (CDFG, 1998)
CNPS: List 1B, RED code 2-3-3 (Skinner and Pavlik, 1994)

General Distribution:

Parish’s daisy is endemic to southern California and is restricted to the dry calcareous (primarily limestone) slopes of the San Bernardino Mountains, with a few collections from generally granitic areas at the east end of the San Bernardino Mountains and in the Little San Bernardino Mountains. The substrate at the sites where the species was collected away from the major carbonate deposits has often not been clearly specified and needs clarification. Most of the populations are on lands within the boundary of the San Bernardino National Forest. This species is reported by Nesom (1993) only from Cushenbury Canyon on the north slope of the San Bernardino Mountains, but specimens exist documenting its occurrence in many other nearby areas. There are reported to be 50 occurrences (USFWS, 1997) but many of these probably represent reports of different parts of single populations. Specific localities include: mouth of Marble Canyon (BLM land); Arctic Canyon, Bousic Canyon, Furnace Canyon, Grapevine Canyon, Cactus Flat (head of Cushenbury Canyon); Cushenbury Spring; Horsethief Flat, near Blackhawn Canyon, limestone outcrop 1.5 mi. (2.5 km) NE of Baldwin Lake, 6200 ft. (1890 m); 8 miles (13.3 km) S of Warren’s Well [= site of Yucca Valley Airport], and E of Long Canyon, 3600 ft.(1100 m). The latter two localities are in the Little San Bernardino Mountains.

There have been, over the years, a number of reports and collections that indicate that this species occurs in the Eastern Mojave Desert in the vicinity of the Ivanpah Mountains but these have all, upon examination, proved to be errors, usually based on the vaguely similar *Erigeron concinnus* (H. & A.) Torr. & Gray [=*E. pumilus* var. *concinnoides*] and the species has never been reported from that area by any major flora (e.g., Nesom, 1993; Munz, 1974). It has also been erroneously reported from other areas based on the related *E. utahensis* (USFWS, 1997), which occurs on limestone slopes in the Providence Mountains (Nesom, 1993).

The Cactus Flat locality is somewhat dubious in that the habitat is not typical (largely or entirely granitic instead of calcareous) and it is based only on an old Marcus Jones collection. It is probable that Jones was camped at Cactus Flat and collected the *Erigeron* in the carbonate either below in Cushenbury Canyon, above in the Lone Valley area, or around Blackhawk Mtn. Jones is fairly notorious for generalized localities based on the site where he stayed and collected out from (e.g., Barstow, Blythe, etc.) and he is responsible for highly dubious records from a number of locations. There are also comparable problems with the Little San Bernardino Mountains locality, in that two of the three collections are by Edmund Jaeger. Jaeger had a life-long habit of intentionally misplacing or blurring collection sites slightly in order to protect the identity of his favored camping localities (P. Roos, pers. comm.). One of his Parish’s daisy specimens, in fact, is merely labeled “Joshua Tree National Monument”, but is generally presumed to be from the same site as his more precisely located specimen taken four days earlier. There is a more recent reported collection by P. Leary from the same area, which means that the species probably does occur, although the identity of the Leary specimen (presumably located in the herbarium at Univ. of Nevada, Las Vegas) seems not to have been confirmed. A search for the species in the late 1980s failed to find the Little San Bernardino Mountains locality and did not find any suitable habitat (either suitable washes or carbonates) in the area where it was reported. At least some people think the species was erroneously mapped (K. Barrows, pers. com., 1997). The CNDDB (CDFG, 1989) reports this locality as having the plant "growing out of a steep slope beneath pinyon pine" which is a somewhat unusual habitat for the species given the its preference for washes and loose soil elsewhere, but the plant does occur on dry slopes in the San Bernardino Mountains. The most serious peculiarity of this site is that there is no carbonate rock reported in the area (Dibblee, 1967a), and the labels of the collected specimens do not specify substrate.

Distribution in the West Mojave Planning Area:

Parish's daisy barely enters the WMPA along the north foot of the San Bernardino Mountains from the vicinity of Gordon Quarry on the west to the Terrace Springs/Round Mountain area on the east. It also occurs in the Pioneertown/Burns Reserve area at the eastern foot of the range, and reportedly in the Little San Bernardino Mountains in the western end of Joshua Tree National Park. There is also a reported location at Rattlesnake Canyon, E of Terrace Springs, but this needs confirmation. All known locations along the north side of the San Bernardino Mountains appear to be within one mile (1. 6 km) of the San Bernardino National Forest boundary, except perhaps for the site at Rattlesnake Canyon, if that is confirmed. Reported localities within the WMPA include: 0.25 mi. (0.5 km) NW of Cushenbury Springs on the outwash fan of Marble Canyon, 4080 ft., T.3N R.1E Sec 11; 1.1 mi. (2 km) NE of Cushenbury, 4680 ft. (1425 m), T.3N R.1E Sec 12; 0.6 mi. (1 km) SE of Cushenbury Springs, 4320 ft. (1320 m), T.3N R.1E Sec 11; mouth of Bousic and Furnace Canyons, elev. 4320-4600 ft. (1400 m), T.3N R.1E Sec 7; outwash fan NW of Arctic Canyon, 4200 ft., T.3N R.1E Sec 8; and lower Arrastre Creek. Anomalous locations in granitic areas include: 8 miles (13.3 km) south of Warren's Well [= site of Yucca Valley Airport], east of Long Canyon, 3600 ft. (1100 m), T.1S R.5E Sec 35 [apparently somewhere south of the present Black Rock Campground]; Rattlesnake Canyon, south of Old Woman Spring, 3800 ft.(1160 m), T.3N R.3E [this is a granitic area with no carbonates reported in the immediate vicinity (Dibblee, 1967c) but there is limestone a few miles west at Round Mountain/Terrace Springs and this species has been reported from near Terrace Springs -- it may be that the locality is slightly misplaced]; and north of [UC] Burns Pinyon [Ridge] Reserve, NW of Yucca Valley, 4140 ft. (1260 m).

Natural History:

Parish's daisy is an herbaceous perennial with a long simple tap root that extends for some distance (perhaps 50 cm) into the loose carbonate alluvium, which the species favors. This species was first described by Asa Gray in 1884 from specimens collected by S.B. Parish (#1251) at Cushenbury Springs in May 1881 (Ferris, 1960; Krantz, 1979). Though, oddly, the second edition (apparently unaltered) of the original description (Gray, 1888) merely says "rocky cañons, borders of the Mojave Desert, S.E. California, *Parish*." Later authors must be relying on additional information derived from the label on the type specimen, since their locality descriptions are more expansive than the original description.

The stems are erect or ascending and may be either numerous or rather few on each plant, but on mature plants are typically at least 20 in number. The stems tend to be faintly zig-zag rather than straight. They arise from a somewhat woody base that usually bears the remains of previous years branches. The plants are 3-12 in. (7-30 cm) tall and have the stems and foliage covered with a conspicuous, loose, whitish to grayish appressed pubescence. This pubescence is particularly thick and persistent on the stems and these often stand out as whiter than the leaves. The older leaves appear to gradually lose pubescence so that they are often greener than the rest of the plant. The pubescence is often described as silvery-white. The leaves are slender and entire.

The flower heads are solitary on bracted, almost leafy, peduncles, but there are commonly 2-4 peduncles per stem. The total number of heads on a mature plant can easily equal 50 in a given season. The heads bear lavender ray flowers and yellow disk flowers.

The method of pollination is unknown for Parish's daisy, but is certainly by insects, based on the conspicuously colored flowers. Likely candidates include bees, butterflies or long-tongued flies, based on the known pollinators of other composites of similar general flower structure. Seed dispersal is unstudied as is the relative importance of seeds versus possible vegetative spread in the maintenance and expansion of populations, though seedlings have been reported at several sites (Krantz, 1979) and are probably the predominant mode of reproduction. Flowering is reported to occur from May to July (Krantz, 1979), but the peak of flowering seems to be from mid May to mid June. At least in some years a few plants continue flowering into July and some even into August (M. Provance, pers. com., 1998). Flower heads have been found to be attacked by insect larvae [Tephritid flies?] but the extent and effect of such damage is unknown, though reported to be "not widespread" (Krantz, 1979).

Habitat Requirements:

Parish's daisy is largely restricted to carbonate substrates, but has been found on other rock types occasionally. Plants appear to be most commonly found either along washes on the canyon bottoms or on loose alluvial deposits on adjacent benches, but are also regularly found on steep rocky slopes. It appears that the Pioneertown site is primarily granitic, but along the washes where the species occurs there are reported to be some carbonate materials washed down from higher elevations (K. Barrows, pers. com., 1997). This is not certain and needs to be confirmed. There is limestone in the general vicinity (Dibblee, 1967b). It may be that the apparent carbonate preference is based on reduced competition from other plants on this substrate. Certain non-carbonate sites that are otherwise ecologically favorable could thus support the species. Two of the collections that appear to be from granitic areas are old (old collections are more frequently inaccurate or vague in their site data than more recent ones) and do not specify the substrate at the site where the plant was collected. However, there are recent reports of this species on non-calcareous, decomposed granite, slopes within the carbonate region on the north slope of the San Bernardino Mountains (M. Provance, pers. comm., 1998). These reports are very few, however. All sites where the soil was actually tested have been found to have strongly alkaline soils, regardless of predominant origin (M. Provance, pers, comm., 1998). This implies that even the granitic areas may have been somewhat influenced in their soil chemistry by drift from adjacent carbonate slopes.

Parish's daisy occurs, based on available specimens, at elevations from 3700-6600 ft. (1125 - 2012 m), though Nesom (1993) gives a range of 800-2000 m (2625-6560 ft.). The low end of the range given by Nesom seems definitely to be in error as that elevation (2625 ft.) would put the species far out onto the flats of the Mojave Desert, where it has never been collected.

Population Status:

This species is naturally of rather restricted distribution and is probably largely confined to a very specific substrate that is not of wide occurrence within its range. That particular substrate (limestone) has become economically valuable in recent years and so many populations have been destroyed or damaged by limestone mining.

Parish's daisy is clearly declining, much habitat has been destroyed by limestone mining, but is still among the more common of the carbonate endemics of the San Bernardino Mountains. This species was reported to be "abundant on stony hillsides at Cushenberry Springs" by Hall (1907), which suggests a change in abundance over the past 90 years, but this is obviously not conclusive since the precise meaning of "abundant" in Hall's mind is unknown. It is possible that Hall never actually saw the plant at this site, since he notes that as of the date he wrote only Parish had collected it. He may have based his description of daisy abundance on notes on one of Parish's collections or on discussions with Parish (whom he knew personally). If Hall had seen it himself, at a suitable season, it seems likely he would have collected the plant.

Parish's daisy seems better able to recover after disturbance than some carbonate endemics. There is considerable need for clarification of its distribution and substrate preference at the eastern end of the San Bernardino Mountains (Pioneertown area) and in Joshua Tree National Park. These are areas where the reported occurrence is based on just a few specimens, often very old or poorly located (especially with respect to substrate). There were fewer than 25 occurrences of this species known prior to its listing as threatened by the USFWS, with a total of ca. 16,000 individuals reported. But, that occurrence total has since been increased to ca. 50 (USFWS, 1997). There are several problems with both the original estimate and this expansion based on the newer "occurrence" estimate. The largest problem is that it is not at all certain that the various reported occurrences actually represent separate populations or that some of the individuals reported in one "occurrence" are not also reported again in another.

Threats Analysis:

The major threat, in fact the only significant one, to Parish's daisy is the ongoing mining of limestone by a series of large mining operations on the north side of the San Bernardino Mountains (pers. obs.; USFWS, 1994; Krantz, 1988). Virtually the entire range of this species is under claim by one mining company or another (USFWS, 1997) and there is the threat that, even though currently much of the population is on public lands, these mining claims will eventually be patented and move into private hands where protective management of this species will be much more difficult.

There has been some low density residential development in the Pioneer town area that poses a threat to this species, and more locally there are threats from sand and gravel mining, off-highway vehicles (USFWS, 1997), and other recreational activities. It has been reported that there is a substantial threat from gravel mines near the mouth of Cushenbury Canyon, but this is not yet obvious.

An indirect affect, associated with limestone mining and processing, is the spread of fine limestone dust over large areas in the vicinity of the mine and processing plant at the mouth of Cushenbury Canyon. This dust covers many areas, including the plants growing in these locations. After moistening, this dust seems to harden into a cement-like coating. This dust is now effectively controlled, but a limited current problem may persist.

Biological Standards:

The most important issue in the protection of this species is clearly the need for the establishment of reserves that support adequately large populations of this species and that are protected from limestone mining. Exactly what would constitute "adequately large" still needs definition. There are no significant populations that are currently in protected status. The size of populations at the Burns Pinyon Ridge Reserve and in Joshua Tree National Park are completely unknown, but are apparently either very small or highly restricted in geographic extent such that they are very rarely observed. Even in the Bighorn Wilderness there are pre-existing mining claims that could be operated, if they are shown to be valid and if the value of the minerals is economically sufficient.

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PARISH'S PHACELIA

Phacelia parishii Gray

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Management status: Federal: None (former C2)
California: S1.1 (CDFG, 1998)
CNPS: List 2/RED 3-3-1(CDFG, 1997a)(Skinner and Pavlik, 1994).

General Distribution:

Parish's phacelia has been collected at three sites in San Bernardino County, California (Skinner and Pavlik, 1994), and is more widely distributed to the east and northeast, in Clark, Lincoln, Nye, and White Pine Counties, Nevada, and Mohave County, Arizona (Cronquist et al., 1984; James Morefield, pers. comm.). Understanding of its distribution and habitat has been plagued by misidentifications, vague location descriptions, and the overall paucity of collection and documentation of the lowland Mojave Desert flora.

Parish's phacelia has been reported from the Santa Rosa Mountains in Riverside County, but this report was based on a misidentified specimen (*Munz 15101* POM), annotated in 1941 by J.T. Howell as Lemmon's phacelia (*P. lemmonii*). Duplicates of Munz's specimen at the Dudley Herbarium (Stanford) and at UCLA evidently remain misidentified and have been cited in unpublished summaries of the plant's distribution (Cochrane 1979; Constance 1979; Blomquist et al., 1995). All Parish's phacelia collections from California have been from alkaline playas or lakebeds below about 900 m (3000 ft.) elevation. In Nevada, it occurs in similar habitat to about 1800 m (6000 ft.) elevation. It also has been reported from volcanic and gypsum outcrops and gravelly bajadas (Cochrane, 1979), but these reports are evidently based on misidentifications of Beatley's phacelia (*P. beatleyae*) or a new taxon not yet formally described (Duane Atwood, pers. comm.; James Morefield, pers. comm.).

Distribution in the West Mojave Planning Area:

All three California locations are within the WMPA. Two are reported as "presumed extinct" (Skinner and Pavlik, 1994), and the only confirmed extant location is southeast of Coyote Dry Lake, near the southern boundary of Fort Irwin.

The type locality of Parish's phacelia is described as "near Rabbit Springs, of the Mohave Desert" in Gray's original description (Gray, 1883, citing S.B. & W.F. Parish's collection taken in 1882 [no number cited]). Given the plant's habitat, this locality might be interpreted as Rabbit Springs itself, Rabbit Dry Lake to the south, or Lucerne Dry Lake to the north. Parish's phacelia was collected again at or near the type locality, at about 880 m elevation (2900 ft.), Lucerne Dry Lake in 1941 (*Ripley and Barneby 3265* POM; Howell, 1943). This specimen's identification was recently confirmed by D. Atwood. Constance (1979) reported that "recent searches of the type locality have been unsuccessful," and Skinner and Pavlik (1994) presumed that the type location is extinct. There is no written documentation in California Native Plant Society or California Department of Fish and Game files reporting unsuccessful searches in this area (Melissa Kauffman, pers. comm.). Both Lucerne and Rabbit Dry Lakes are largely undisturbed, though both are crossed by paved roads.

The second California location was described as "Waterman's near Calico," collected in 1884 by J.G. Lemmon (Cochrane, 1979) and has been reported by Skinner and Pavlik (1994) as "presumed extinct." It has been interpreted by the California Dept. of Fish and Game (1997b) as occurring on the USGS Yermo 7½-minute topographic map, within a 1- mile radius of a mapped point on the bajada below the Calico Mountains. This interpretation is unrealistically precise, given Lemmon's vague location, and is well above seemingly more suitable flat topography nearer to the town of Yermo and west to Barstow and beyond. The location of "Waterman's" is probably best interpreted as the ranch of Robert W. Waterman, a "desert valley rancher near the site of the future Barstow" (Pierson, 1970). His ranch was near the present-day location of Waterman Road at the western margin of Barstow, south of Highway 58 and north of the Mojave River. This is also the location of a railroad stop between Barstow and Hinkley once known as Waterman (Preston, 1974) and is the site reported for Waterman's Ranch in the Jepson Herbarium on-line place name atlas (http://www.ucjeps.berkeley.edu). Calico, now a ghost town and tourist attraction, was a more significant regional reference point than Barstow in the late nineteenth century.

The only known extant California location is southeast of Coyote Dry Lake, along a string of dry lakes between Manix Tank Trail and Coyote Dry Lake, about 20 km (12 miles) northeast of Yermo. It was first reported by Bagley (1989), and subsequently by Rutherford and Bransfield (1991) and Trask (1993). These reports have indicated thousands, or even millions (Rutherford and Bransfield, 1991; Trask 1993) of individual plants in the habitat where it occurs. Several remarked that suitable unsurveyed habitat extends well beyond the mapped locations. Rutherford and Bransfield (1991) also searched for Parish's phacelia at several sites around the margins of Coyote Dry Lake and along the roadside on the lakebed, but did not find it. The occurrence has been documented by two voucher collections (*Sanders 16397* RSA, UCR; and *Sanders 16401* UCR, both taken in 1995).

One additional specimen, *Charlton s.n.* RSA, taken in 1992 and recently annotated by D. Atwood, seems to represent an otherwise undocumented occurrence. Charlton's label reads "Powerline Rd. near Surprise [Sunrise?] Canyon Rd. offramp, Yermo. East of Barstow . . . clay lakebed. . . ." Sunrise Canyon Road is immediately north of Interstate 10, east of Yermo, and is reached via the Minneola Rd. exit. The junction of Powerline Road and Sunrise Canyon Road is about 1 mile east of the freeway exit, in Township 10 North, Range 2 East, Section 34. The USGS Yermo 7½' topographic map shows this area as a small basin at about 1880 ft . (570 m.) elevation. This location does not appear in other literature, and is about 6 miles (10 km) southwest of the Coyote Dry Lake site.

Natural History:

Howell's (1943) detailed description of Parish's phacelia is summarized here. It is an annual with several finely glandular-puberulent stems, 2-6 in. (5-15 cm) long spreading from the base. The leaves are oblong, elliptic, ovate, or obovate, about 0.5-1.5 in. (1-3 cm.) long, sparsely glandular and minutely coarse; the basal leaves are on pedicels about 0.5-1 in. (1-2 cm) long, while upper leaves are nearly sessile. The flowers are in dense, elongate, coiled racemes. The sepals are glandular and hairy, about 0.14-0.18 in. (3.5-4.5 mm) long in flower and elongating to about 0.25-0.3 in. (6-7.5 mm) long in fruit. In flower, they are oblong or obovate, about 0.04-0.1 in. (1-2.5 mm) wide and unequal in width; in fruit, one sepal is conspicuously wider than the others, obovate in shape and about 0.1- 0.16 in. (2.5-4 mm) wide. The corolla is about 0.2 - 0.23 in. (5 - 6 mm) long, bell-shaped, lavender, with pale yellow at the base of its tube. The fruit is ovate to oblong, about 0.16 in (4 mm) long, with many seeds, each about 0.04 in (1 mm) or slightly longer. The plant is illustrated in Skinner and Pavlik (1994: p. 224), Cronquist et al. (1984: p. 171), and Abrams (1951: p. 513).

Parish's phacelia's simple leaves, toothed to shallowly lobed, distinguish it from many other *Phacelias* which often have deeply divided leaves. Howell (1943) noted that Parish's phacelia is distinguished from closely related species by the unequal size of the sepals (in fruit); other species within its range with similarly unequal sepals have much showier corollas. Constance (1979) discussed other *Phacelia* species occurring in similar habitat and geographic ranges: Common heliotrope (*P. distans*) and tansy phacelia (*P. tanacetifolia*) are larger plants with larger leaves and flowers, and with only 2-4 seeds per fruit. Thick-leaved phacelia (*P. pachyphylla*) has characteristic black tack-shaped glands and many more seeds per capsule. The most closely related species are Beatley's phacelia (*P. beatleyae*) and the undescribed taxon mentioned above. These occur within Parish's phacelia's range in southern Nevada, but neither plant has been collected in California. Beatley's phacelia occurs on volcanic outcrops and is distinguished by its more erect stature, absence of basal rosette, generally smaller seeds and more seeds per capsule (about 40-50 rather than 30-40), and two (rather than one) calyx lobe distinctly wider than the others (Reveal and Constance, 1972). The undescribed taxon occurs at 13 known sites on clay knolls within and around the Nevada Test Site (Clark and Nye Cos.; James Morefield, pers. comm.). Diagnostic characters are not yet available.

The flowering season for Parish's phacelia has been reported as April - June (Munz, 1974) and April-July (Howell, 1943; Skinner and Pavlik 1994), but all California collections and observations have been made between 6 April and 11 May. The June and July dates have generally been for collections made in White Pine County, Nevada, at much higher elevation and latitude than the California occurrences.

No information is available on pollination vectors, self-compatibility, seed dispersal, mycorrhizal associates, or other aspects of Parish's phacelia natural history. Given its restriction (at least in California) to seasonally wet alkaline flats, and its many small seeds, it probably is not normally dispersed more than a few feet from the parent plant, but may occasionally be ingested by shorebirds or picked up with mud on their feet, and carried long distances. Mycorrhizae are unlikely to be important the dry pools where Parish's phacelia grows because the symbionts are inhibited by anaerobic conditions during saturation and by severe drying later in the year (Rendig and Taylor, 1989).

Habitat Requirements:

All known occurrences are on sparsely vegetated alkaline flats, generally in dry, cracked mud flats of seasonal pools filled in years of high rainfall. Most accounts have given little attention to co-occurring plants, but saltbush (*Atriplex*), patata (*Monolepis nuttalliana*), Fremont's phacelia (*P. fremontii*), thick-leaf phacelia (*P. pachyphylla*), and split grass (*Schismus barbatus*) have been mentioned on field reports or herbarium labels. Sanders (*16397* UCR) described its habitat at the Coyote Dry Lake site as "Shallow dried alkaline pools, mostly barren except for annuals. Pool bottom bare except for skeletons of plants from previous years. Growth appears controlled by water level and timing. Generally there is a band of *Monolepis* above . . ." Evidently, these ephemeral plants may appear at different levels of the pools, depending on water levels in a given year. Other habitat descriptions transcribed from herbarium labels by Cochrane (1979) read: "gray gumbo playa," and "damp alkaline mud."

Rhodes and Williams (1977), Rhodes et al. (1979) and Cochrane (1979) described several sites in Nevada where Parish's phacelia was reportedly growing on knolls of sedimentary or volcanic material. The plants are from the French Valley area of the Nevada Test Site, near the type locality of Beatley's phacelia. Further, Rhodes and Williams (1977) noted that the calyces of these plants had two wider lobes and three narrower ones. Parish's phacelia has only one wider calyx lobe (Howell 1943), but Beatley's phacelia has two (Reveal and Constance, 1972). Parish's phacelia is either rare or absent on the Test Site, and it is restricted to playas and flats (Duane Atwood pers. comm.). Plants reported from knolls at the Test Site must be interpreted as either Beatley's phacelia or the new taxon, misidentified as Parish's phacelia.

Population Status:

Field data forms and herbarium labels have often described Parish's phacelia as abundant, but it is an ephemeral annual and its occurrence in any given year is apparently undependable. Rutherford and Bransfield (1991) estimated total numbers at the Coyote Dry Lake site as 200 million, by estimating densities in square-meter plots and extrapolating to the estimated area of occupied habitat. Bagley (1996) visited the same site and found "huge numbers of skeletons from last year. No sign of any growth on the playas this year. Very, very dry." Ripley & Barneby (*3265* POM) reported it as "locally abundant" at the type locality, but that occurrence has not been documented since. Charlton (*s.n.* RSA) reported it as "locally common." Rainfall is the most likely determinant of the plant's numbers in any given year, but there is no information available on the necessary amount or season, or on other climatic variables that may affect its numbers.

Rhodes and Williams (1977) felt that Parish's phacelia was rare enough to warrant status as a federal candidate for listing as threatened or endangered, and discussed its likely extirpation at historic occurrences on the Nevada Test Site and at Indian Springs Valley (Clark County, Nevada). Following surveys in years of greater rainfall, Rhodes et al. (1979) reported Parish's phacelia in much higher numbers and recommended against consideration for candidate status.
Their recommendation were evidently based on misidentifications (above), and should not be considered in management planning for Parish's phacelia. Confirmed Parish's phacelia is known from 15 occurrences in Nevada, some of which are very large (James Morefield, pers. comm.).

Threats Analysis:

Because Parish's phacelia is known from only one or two extant occurrences in California, extending over a relatively small area, it may be at risk of stochastic or catastrophic extinction. Part or all of the well-documented occurrence is within the proposed Fort Irwin expansion area, and some military land uses (e.g., tank maneuvers) would likely extirpate the species. Several field forms and written reports have cited off-road vehicle use as potential threats, and other development (e.g., powerline and access road construction) would affect populations if they crossed Parish's phacelia occurrences or interrupted their hydrology.

Biological Standards:

The distribution of Parish's phacelia in California remains unclear. Actual locations of historic occurrences at Lucerne Dry Lake, "Waterman's," and Yermo should be identified and suitable habitat near the sites surveyed in years of relatively high rainfall to confirm the reported extirpations at the first two sites and the reported occurrence at the third.

The wide geographic distribution but irregularity of documented occurrences suggests either that Parish's phacelia is very rare in California, or that its habitat has not been adequately searched.

Surveys should be completed for any new projects or land use changes that might cause soil disturbance or affect surface hydrology of suitable habitat. Additional surveys of alkaline flats, playas, dry lake beds and their margins throughout the Mojave Desert, carried out whenever funding and scheduling allow, might improve understanding of the plant's distribution. Surveys should be completed between early April and early May in years of above-average rainfall. Botanists should be familiar with the plant's diagnostic characters (Howell, 1943; Wilken et al., 1993). Any new locations should be documented by voucher specimens and reported to the CNDDB.

The single well-documented extant California occurrence should be given special attention, perhaps by designation as a BLM "Area of Critical Environmental Concern," and any proposed land use changes should be closely analyzed to confirm that the population is not affected. Rutherford and Bransfield (1991) recommended changing the site class from Multiple Use to Limited Use, minimizing military and recreational impacts by restricting vehicles to the eastern portion of the tank trail, acquisition of private land supporting parts of the Parish's phacelia population, and implementing an annual monitoring program. Monitoring should be designed to seek correlations between plant densities, pool depths, and rainfall patterns. These
data would likely be useful to identify the most similar sites and best years in which to survey potential new locations.

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PIUTE MOUNTAIN JEWEL-FLOWER

Streptanthus cordatus Nutt. var. *piutensis* J. Howell

Authors: Julie A. Greene, P.O. Box 451, Los Alamitos, CA 90720 and Andrew C. Sanders, Herbarium, Department of Botany and Plant Sciences, University of California, Riverside

Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S1.2; G5T1 (CDFG, 1998)
CNPS: List 1B, R-E-D Code: 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Piute Mountain Jewel-flower has traditionally been reported only in the Southern Sierra Nevada Mountains of Kern County, but we find specimens that appear to fit the description of this taxon also have been taken relatively recently in eastern Tulare County. Although Skinner and Pavlik (1994) report approximately ten occurrences in Kern County, this does not mean that there are 10 distinct populations. In fact, Piute Mountain jewel-flower seems to be known from only four or five areas (see discussion below).

All the collections cited in the original description (Howell, 1963) seem to be from the same vicinity: an "extensive colony" in and around the Bodfish Piute cypress grove (Twisselmann, 1967), southeast of Bodfish in the Lake Isabella South quadrangle. This colony apparently straddles the boundary between BLM and Sequoia National Forest land. It should be noted, however, that while Howell gives the location of the type specimen *(Breedlove 3840)* as southwest of the Bodfish-Havilah road, all other information would place it with the other collections, southeast of the road. Whether this was a typographical error on the label or in the preparation of HowellÕs manuscript, we cannot determine at this time. Skinner and Pavlik (1994) report the presence of Piute Mountain jewel-flower in the Miracle Hot Springs quadrangle, but this seems to reflect only the directional error in Howell's description (Howell, 1963).

Twisselmann (1967) reports two collections of Piute Mountain jewel-flower in the "isolated and inaccessible mountains at the head of Jawbone and Pine Tree canyons." The first collection he places at Champagne Spring on the northwest shoulder of Cache Peak (Tehachapi NE quadrangle) and the second on Sweetwater Ridge southeast of Cache Peak (Cache Peak quadrangle). The only other report of this plant in Kern County is from 1897 in the area around Erskine Creek and Mt. Laura, ca. 5 mi. (8 km) due east of the Bodfish locality.

We have recently discovered that plants very similar to those described in the literature as *S. c. piutensis* (e.g., Rollins, 1993; Buck et al., 1993) occur near Chimney Peak, Tulare County. The populations in this area are documented by very few collections and these, as presently known to us, are inadequate to unambiguously determine the taxon that is present. They appear to key directly to *S. c. piutensis* (Rollins, 1993; Buck et al., 1993) but we find that only leaf shape is apparently distinctive. It appears possible that the plants are intergrades or variants of *S. c.* var. *cordatus*. In any event, these populations are not within the West Mojave Planning Area.

Distribution in West Mojave Planning Area:

The two occurrences reported by Twisselmann near Cache Peak are inside the WMPA. No plant counts were given for these populations (CDFG, 1997b), but Twisselmann (1967) reported the species to be "scarce".

Natural History:

This perennial herb in the mustard family (Brassicaceae) was originally described by Howell (1963) from plants collected in the Bodfish area by Dennis E. Breedlove in 1962. These tall, 20-40 in. (5-10 dm), plants have a woody stem base and upper cauline leaves that are lanceolate-oblong, acuminate and deeply clasping. The basal leaves are widely obovate, toothed above the middle, often have bristly teeth, and have petioles equal in length to the blades. The leaf margins are often ciliate. The calyx is radially symmetrical with the sepals 0.32-0.52 in. (8-13 mm) long, yellow to greenish in buds, becoming purple in flowers, and the sepal tips have short hairs. The petals are exserted from the calyx, 0.4-0.56 in. (10-14 mm) long, linear, and purple in color. The stamens are free and equal in length. The stigma is two-lobed (Buck et al., 1993). The fruits are wide, straight, flattened siliques, 2-4 in. (5-10 cm) long and 0.1-0.24 in. (2.5-6 mm) wide. This description is drawn from Howell (1963) and Buck et al. (1993). Piute Mountain Jewelflower blooms from May through July (Skinner and Pavlik, 1994).

Streptanthus cordatus, as a species, is widespread in the Great Basin and eastern Sierra Nevada (Rollins, 1993). Over most of its range it appears to be relatively uniform with respect to morphology, but in the Sierra Nevada of California there is enough variation that additional varieties have been described. Two of these additional varieties have received some degree of acceptance. *S. c.* var. *duranii* Jeps. was not recognized by either Munz (1959) or Rollins (1993), but was accepted by Buck et al (1993). *S. c.* var. *piutensis* has been generally accepted (Munz, 1968; Rollins, 1993; Buck et al., 1993) since its original description (Howell, 1963), but its status seems not to have been carefully reviewed. Piute mountain jewelflower is supposed to differ from typical *S. c. cordatus* in that the plants are much larger (to 1 m), are somewhat woody based, have more strongly flattened and wider (>5 mm) pods, and a distinctive leaf morphology with more attenuate leaf tips, rather than the broad blunt-tipped leaves of typical *S. cordatus*.

The accounts of Streptanthus cordatus in the *Jepson Manual* (Buck et al., 1993) and in *The Cruciferae of Continental North America* (Rollins, 1993) are not perfectly clear nor consistent. *The Jepson Manual* recognizes *S. c.* var. *duranii* Jepson in the southern eastern Sierra, and this name might apply to the Tulare Co. plants here considered to probably be *S. c. piutensis*. Rollins, however, synonymizes var. *duranii* with var. *cordatus*.. It seems possible to separate the varieties only by leaf form.

Clinal variation is one possible explanation of the difficulty distinguishing the varieties. It could be that, from north to south, var. *cordatus* grades into var. *duranii* and var. *duranii* grades into var. *piutensis*. A second possible explanation is hybridization**:** var. *cordatus* and var. *piutensis* may once have been genetically isolated by physical separation, but subsequent geographical spread, probably by var. cordatus, resulted in contact and hybridization. This hybridization may have created the intermediate var. *duranii*.

Piute Mountain Jewelflower can be distinguished from the also rare southern jewelflower (*Streptanthus campestris*) by the wider flattened siliques, shorter stems, wider cauline leaves and usually larger flowers (Howell, 1963) of *piutensis*. *Streptanthus campestris* is also reported to have the fruits somewhat curved and spreading away from the stem, while the fruits of *S. cordatus* in all its forms are relatively straight and either erect or ascending (Buck et al., 1993).

There appears to have been no detailed study of the biology of Piute Mountain jewelflower, but in a study of the related mountain jewel-flower (*Streptanthus tortuosus*), Preston (1994) reported flowers from both high and low elevation populations are self-compatible, but set few seeds in the absence of pollinators. Bees are the most common and consistent floral visitors, although wasps, flies, butterflies, and beetles were also observed visiting the flowers foraging for pollen and nectar. Floral differences do not appear to be linked to breeding system differences or to pollinator differences but may instead be associated with some other phenomenon, such as climatic adaptation. Whether these observations apply to Piute Mountain jewel-flower is uncertain, but given the similarities of flower form, the pollinators are very probably similar or identical.

Habitat Requirements:

Most of the occurrences are associated with the groves of Bodfish Piute cypress (*Cupressus nevadensis*) and California juniper (*Juniperus californica*) in the Piute Mountains, but they are also associated with broad-leaved upland forests, Closed-cone coniferous forests, and Pinyon-juniper woodland (BLM, 1990; Howell, 1963; Twisselmann, 1967). Collections have been made at 3600-7000 feet (1,200-2,100 m) elevation. The two population sites near Cache Peak, 5200 and 5700 feet (1585 and 1738 m), are associated with Canyon oak (*Quercus chrysolepis*) and Pinyon pine (*Pinus monophylla*). The highest reported elevation of collection is at 7000 feet (2134 m) in the Southern Sierra Nevada Mountains in Chimney Creek Canyon south of Chimney Meadow. This is one of the Tulare County collections of questionable identity. These populations are associated with single-needled pinyon (*Pinus monophylla)*, oak (*Quercus)*, and manzanita (*Arctostaphylos*.), based on herbarium label data.

These plants occur in a variety of soils from shattered metamorphic rock, gravel and gravely loam, to heavy clay soils. Rollins (1993) reports it from "heavy clay on brushy slopes, rocky red clay, Piute cypress association". The Chimney Creek Canyon population was recorded as occurring on a sandy slope. Collections by Howell in the Piute mountains report both stony gabbro substrate and very dark brown-red soil and rock.

Population Status:

This species is apparently endemic to the Piute Mountains in Kern County, California, though there may be populations or hybrids extending northeast into eastern Tulare County. At present, there are only four undisputed areas in which the plant grows, but much of its potential range is poorly explored. Actual population counts and estimates are few and somewhat contradictory. Some reports indicate that as few as 100 plants are known (CDFG, 1997b) while others imply larger populations (Twisselmann, 1967).

Twisselmann reported an extensive colony occupying much the same area as the Bodfish cypress grove, which implies much more than 100 plants at that time.

Threats Analysis:

Cache Peak and Tehachapi NE quad populations within the WMPA are currently threatened by maintenance of wind energy facilities (Hare, 1995). All occurrences are threatened by off highway vehicle (OHV) use on public land, and any future construction on private land. While there is no current known cattle grazing around the populations, the area has been used for cattle grazing in the past (Hare, 1995). Future cattle grazing, construction, logging or mining could potentially threaten the remaining populations (Skinner and Pavlik, 1994) by both destruction of individual plants and reduction and/or elimination of their habitat, or the habitat of their pollinators and populations should be protected from these threats to the degree possible.

Biological Standards:

The extent and condition of all populations needs to be determined as soon as possible. With portions of populations already destroyed by wind energy development (see Threats above), the need for careful range and habitat assessment is obvious. Listing may discourage future development on BLM land. Private landowners need to be formally notified of the existence of this rare species, where it is, and how to prevent future disturbance of individual plants or the species' habitat. Soil disturbance could be easily prevented by restricting vehicular access to roads and jeep trails, through use of locked gates. Jeep trails through the habitat area should at least be closed when they are wet, which is when soil compaction is greatest. Perhaps the Cache Peak occurrences on public lands can be protected due to the fact that there are recorded archaeological sites at Sweetridge just southest of Cache Peak (Robinson and Riddell 1984; Uli and Schiffman, 1984; Whitley and Simon, 1991). Due to the proximity of the Pacific Crest Trail to Cache Peak, it is recommended that BLM put up signs asking hikers to stay on the trail due to rare plants occurring in the area.

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RED ROCK POPPY
Eschscholzia minutiflora S. Wats. ssp. *twisselmannii* Clark and Faull

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S2.2, G5T1 (CDFG, 1998)
CNPS: List 1B RED code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Red Rock poppy is known only from the northeast end of the Rand Mountains (more precisely, the Summit Range), and from the El Paso Mountains, both in Kern County, or the former perhaps extending into San Bernardino County. According to Clark and Faull (1991), three-quarters of the known population occurs in Red Rock Canyon State Park. There is a possible occurrence on Edwards Air Force Base, based upon a photograph taken by David Charlton and shown to Mark Faull (Faull, pers. comm., 1997). The poppy may also occur in the Death Valley area. Dedecker (1984) reports *Eschscholzia parishii* from the Black Mountains (east of Death Valley), which Clark and Faull (1991) believe may be Red Rock Poppy but they had not examined specimens from that area, so this is far from certain. The identification appears to be based largely on the fact that the Death Valley region is outside the range of Parish's Poppy (*Eschscholzia parishii*), as otherwise understood.

Distribution in the West Mojave Planning Area:

All known occurrences of Red Rock Poppy, including the probable occurrence on Edwards Air Force Base, are within the WMPA. The possible location in the Black Mountains is outside the eastern boundary .

The taxon is definitely known from only four locations: Red Rock Canyon State Park (although it occurs in many locations within the Park which have been documented by Mark Faull) (Clark, pers. comm., 1998); Mesquite Canyon, 0.4-0.6 mi. (0.6-1 km) north of Randsburg Road; 2 mi. (3.2 km) SE of Searles Station (which may be in San Bernardino County, and is in the Summit Range); and on an "unnamed road 1.2 mi. (1.9 km) N of Red Rock-Randsburg Rd at a jct 3.3 mi. (5.3 km) E of the jct of CA Hwy 14 and Red Rock-Randsburg Rd. *Clark 641*" (Clark, pers. comm., 1998).

Natural History:

Very little is known about the biology of this subspecies. It was first described in 1991 (Clark and Faull, 1991) and has remained poorly known since that time.

Nothing is known about its pollination biology or seed dispersal, though presumably it is outcrossing and insect pollinated, based on the relatively large size of its flowers. The entire *E. minutiflorum* (s.l.) complex consists of strict annuals that depend entirely on seed to maintain populations from year to year. Presumably the seeds of this species are relatively long-lived and can persist in the soil through several years of drought, as is true of many other desert annuals. The plants of this subspecies are spring annuals that germinate in the fall or winter and flower the following spring. *Eschscholzia minutiflora* s.l. will not germinate after summer rains when soil temperatures are relatively high.

Eschscholzia minutiflora s.l., as presently understood (Clark, 1993), is a widespread annual which includes the three subspecies (*minutiflora, covillei*, and *twisselmannii*). Plants are generally erect and about 2-14 in. (5-35 cm) tall. Like all members of the genus, they are glabrous and the foliage tends to be gray or blue-glaucous, apparently due to a waxy covering. An important difference that is supposed to separate *E. minutiflora* (especially the large flowered Red Rock Poppy) from Parish's Poppy is that the leaf segments in *E. minutiflora* are short and obtuse at the tip, whereas those of Parish's Poppy are longer and more acute. Based on specimens at UCR, this distinction appears to be subtle and perhaps inconsistent. It's utility appears questionable in many cases. *E. minutiflora* is generally most conspicuously characterized by its very small flowers and particularly by the related shortness of the petals. However, Red Rock Poppy is distinctive within the species, in that it has larger flowers (petals 0.16-0.8 in., 4-20 mm) that resemble those of *E. parishii*, but this fact is somewhat confounded by the great range of variation in all the subspecies. There is a large amount of overlap with Coville's poppy (*E. m.* ssp. *covillei*; petals 0.28-0.72 in., 7-18 mm) in particular. However, Clark and Faull have observed that "in regions where two or more of the subspecies co-occur, at any one time the petals of ssp. twisselmannii are consistently larger than those of ssp. covillei, and the latter are consistently larger than ssp. minutiflora, but petal size markedly decreases in all three subspecies over the course of a growing season" (Clark, pers. comm., 1998 from unpublished data).

The most diagnostic characteristic of Red Rock Poppy, relative to the other two subspecies of *E. minutiflora* is that it is diploid with a chromosome number of n=6 (Clark and Faull, 1991), whereas ssp. *covillei* and ssp. *minutiflora* have 12 and 18 chromosomes, respectively. Red Rock Poppy appears to be the diploid ancestor of the two more widespread subspecies.

Seeds of Red Rock Poppy, and the other subspecies of *E. minutiflora*, are more oblong and lack micropapillae (minute finger-like projections) and jugiform cells (paired curved cells forming a donut-like structures), which distinguishes them from seeds of *E. parishii*, which have micropapillae, are spherical and commonly have jugiform cells (Clark and Jernstedt, 1978; Clark and Faull, 1991).

Habitat Requirements:

Red Rock Poppy may be substrate-specific to rhyolite tuffs, granitics and similar rocks (Clark and Faull, 1991), but since these are common rock types, this is not much of a restriction. Also, since the number of observations of the species is small, the ability to generalize from the few samples is limited.

Populations occur at elevations between 2300 and 3280 ft. (700-1000 m), with the probable Edwards Air Force Base population also within this range. The possible Black Mountains population is at an unknown elevation.

Population Status:

According to Clark and Faull (1991), three-quarters of the known population occurs in Red Rock Canyon State Park, but the number of individuals involved was not estimated at the time of the original description of the taxon. Faull has since estimated these numbers (Clark, pers. comm., 1998). The extent of the distribution of this species and the size of populations is apparently still poorly known. It is not clear exactly how many of the herbaria of California were sampled before the subspecies was described; however, the collections at the University of California, Berkeley (UC), Rancho Santa Ana Botanic Garden (RSA), University of California, Davis (DAV), and the California Academy of Sciences (CAS) were examined. Clark notes that there is a "Mosquin collection at UC, RSA, and presumably UCLA from near Searles Station that is undoubtedly ssp. twisselmannii. There were no other specimens at UC, DAV, or CAS in the 1970s, or RSA in the mid-1980s" (Clark, pers. comm., 1998 regarding his personal observations).

Threats Analysis:

The CNPS inventory (Skinner and Pavlik, 1994) states that Red Rock Poppy is threatened by vehicles, but the extent of this threat is unknown. There may be other threats in various areas, but so little is known about this plant that it is impossible at this time to outline the nature of any additional threats. Certainly there is nothing in the literature that documents any existing major threats. The fact that a significant percentage of the known population is within a protected area (Red Rock Canyon State Park), suggests that any threats are not critical at present.

Biological Standards:

This taxon is probably reasonably well protected by virtue of the fact that much of its known population is within the boundaries of Red Rock Canyon State Park where potential disturbance is minimal. However, the extent of populations outside that area is poorly documented. The presence of unconfirmed and suspected populations far from the area of known occurrence strongly suggests a need for extensive survey work for this species to determine its exact status. It is entirely possible that this plant has many more populations scattered across the Mojave Desert than is presently known. It may be either an extremely rare and local species, as it presently appears, or a relatively widespread, though still rare, one as appears at least remotely possible based on the few scattered records and reports. It would be extremely desirable to have a wide range of herbarium specimens examined to determine whether there are additional populations that have been collected, but which were misidentified as Parish's Poppy (*Eschscholzia parishii*), or another species.

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RED ROCK TARPLANT
Hemizonia arida Keck

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Management Status: Federal: USFWS Species of Concern
California: Rare, S1.2, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Red Rock tarplant is a very local endemic of the western El Paso Mountains in the Mojave Desert of eastern Kern County and has never been found in any other location (Tanowitz, 1982; Skinner and Pavlik, 1994).

Distribution in the West Mojave Planning Area:

The entire distribution of this species is within the WMPA. Traditionally it has been reported only from Red Rock Canyon (e.g., Tanowitz, 1982), but it is now known to occur in adjacent Last Chance Canyon as well (Faull, 1987). In Red Rock Canyon it was reported to be restricted to one seeping area in the canyon in the vicinity of the Hwy. 14 crossing (Twisselmann, 1967), but actually apparently extends almost continuously for a distance of about 4-5 miles (6.5-8 km) along the canyon bottom (Faull, 1987; pers. comm.).

Natural History:

Red Rock Tarplant was not described as a species until 1958, although it had been collected as early as 1935 (Tanowitz, 1982). It has been collected a number of times since its description, but otherwise remains remarkably little known.

Red Rock tarplant is an annual sunflower (Asteraceae) of open moist sites in the El Paso Mountains on the western Mojave Desert. It is illustrated in Ferris (1960). Like other species of *Hemizonia*, this plant is characterized by the possession of both ray and disk flowers; a single row of chaffy bracts between the ray and disk flowers; a single series of phyllaries, each subtending and half-enclosing a ray achene; fertile (i.e., producing good seed) ray achenes; a disk pappus of scales or bristles, or in this case absent, and not plumose or bristle-tipped; and foliage lacking tack-shaped glands (Hickman, 1993). The disk flowers do not produce fertile achenes (M. Faull, pers. comm., 1998). Red Rock tarplant is in the section *Madiomeris* which is identifiable by presence of an annual habit, beaked ray achenes, chaffy bracts restricted to a fused outer ring, and a lack of spinose tips on the leaves and phyllaries (Tanowitz, 1982). This species is separable from other members of section *Madiomeris* by the combination of yellow anthers, absence of a pappus on all achenes, possession of solid stems and villous foliage, and deeply toothed basal leaves (Tanowitz, 1982; Hickman, 1993).

Recent observations (M. Faull, pers. comm.) indicate that Red Rock tarplant usually has 8 ray flowers, but not uncommonly has 10, and a few individuals can have up to 12-14 rays on early flowers in a wet season. Conversely, particular individuals have been observed to display a decreasing number of ray flowers as their life cycle proceeds, with some plants having as few as 3 ray flowers per head by the end of the growing season (M. Faull, pers. comm.).

The Red Rock tarplant's closest relative appears to be Kern tarplant (*H. pallida*) from the Central Valley of California (Twisselmann, 1967; Faull, 1987). There is a low degree of fertility in crosses between Kern tarplant and Red Rock tarplant, but Red Rock tarplant is completely incapable of forming fertile hybrids with any of the other four species with which it has been crossed (Clausen, 1951). Apparent natural hybrids between Red Rock tarplant and Kellogg's tarplant (*H. kelloggii*) have been reported at Red Rock Canyon (Faull, 1987), but all studied hybrids between these species were sterile (Clausen, 1951), as is often the case for interspecific crosses in *Hemizonia* (Kyhos, et al., 1990). More recent observations have suggested the plants thought to be Kellogg's tarplant are actually Mojave tarplant (*Hemizonia mohavensis*), but this remains to be confirmed (Faull, pers. comm., 1998). It appears likely that Red Rock tarplant and Kern tarplant are descendants of a relatively recent common ancestor, perhaps similar to or identical with, Kern tarplant. Perhaps an originally continuous tarplant population was broken in two by the rise of the southern Sierra Nevada and Tehachapi Mountains (Clausen, 1951; Twisselmann, 1967). After long isolation and large population fluctuations, genetic drift, along with natural selection for a different set of characteristics in the distinctive environment of Red Rock Canyon, may have resulted in speciation.

Unlike most species of *Hemizonia*, Red Rock tarplant is self-compatible (Tanowitz, 1982). Tanowitz reported (1982) that it is the only self-compatible species in the genus, but it has since been discovered that Mojave tarplant is also self-compatible (B. Baldwin, pers. comm., 1997). The two self-compatible species in the genus are thus ones that occur as local populations on the edge of the desert, rather than as extensive populations in the dry grasslands and shrublands of the coastal slope. Most *Hemizonia* species are highly dependent on outcrossing and in fact are unable to produce fertile seed even in crosses with closely related individuals (B. Baldwin, pers. comm., 1997). It is probable that lack of self-fertility is fatal to tar plant populations subject to periodic catastrophic reduction in population size due to restricted habitat.

Red Rock tarplant is subject to herbivory by rabbits and possibly by ground squirrels. Herbivory can be heavy during the dry summer and fall months when other green food is scarce (Faull, 1987). Up to 75% of plants in one population were found to have had their main stem and major branches removed by herbivores, apparently rabbits (Faull, 1987). Heavy predation on both seeds and foliage by California ground squirrels has been recorded on two other species of *Hemizonia* in the Central Valley (Fitch, 1948) and it is expected that at least one of the two ground squirrel species at Red Rock Canyon uses Red Rock tarplant similarly (Faull, 1987). In the Central Valley, tarplants are "important food plants" for ground squirrels, especially in the summer when they are one of the few species that can serve as a moisture source and in the fall when the seeds ripen (Fitch, 1948). The extent of insect predation on Red Rock tarplant is unknown, but some insect predation has been noted on other *Hemizonia* species. The meloid beetle *Epicauda punctata* is known to feed on the flowers and pollen of other *Hemizonia* species (G. Ballmer, pers. comm., 1998) and presumably does on this one as well, as it is a widespread insect. Foliage feeding by two species of tree crickets (*Oecanthus*) has been recorded for other *Hemizonia* species (Walker and Rentz, 1967). In addition, the larvae of tephritid flies have been recorded as seed predators in the developing heads of at least four species of *Hemizonia*, but Red Rock tarplant has not been studied in this respect (Goeden, 1985; R. Goeden, pers. comm., 1998). Insect predation may be partially controlled by the sticky exudate that covers the foliage of the plants, especially late in the year. Several species of insects have been found trapped and dead in this exudate, including even such large and strong species as honey bees (Faull, 1987).

Pollination in this species has been little studied, but observation by Faull (1987) found that honey bees and small beetles (Coleoptera: Melandryidae) were visiting the flowers. The flowers of other species of *Hemizonia* are reported to be pollinated or visited by insects including flies and moths (Babcock and Hall, 1924) and syrphid and tachinid flies and halictid bees (Tanowitz, 1986). More specific pollination observations on other species of *Hemizonia* involve an andrenid bee, *Calliopsis pugionis* , which commonly gathers pollen and nectar from smooth tarplant (*Hemizonia pungens laevis* ; Visscher and Danforth, 1993; Visscher et al., 1994). The same studies found that Ruths cuckoo bee (*Holcopasites ruthae*) visits *Hemizonia* for nectar only (G. Ballmer, pers. comm. 1998). It is certainly the case that the predominant pollinators of all *Hemizonia* species are insects, but the precise species involved have usually not been clearly identified. Strong evidence for insect pollination in the genus overall includes the yellow color of the flowers and the "clumpy" rather than powdery pollen of *Hemizonia* species in general (Clausen, 1951), a condition that has been confirmed for *H. arida* (pers. obs.).

Seed germination in this species appears to be unstudied. Most species of *Hemizonia* with fertile ray and disk flowers have achenes of different form produced by the two types of flowers. Red Rock tarplant produces few or no fertile disk achenes, but fertile ray achenes are consistently produced. It is normally the case that *Hemizonia* ray achenes have some level of dormancy, while the disk achenes germinate readily (B. Baldwin, pers. comm., 1998). The ray achenes, perhaps the only fertile achenes in this species, could thus play a role in permitting *Hemizonia* species to persist through difficult climatic periods. The extent of ray achene longevity appears unstudied.

Habitat Requirements:

This species occupies seeps, springs and seasonally moist alluvium in an extremely hot and arid part of the Mojave Desert in the rain shadow of the southern Sierra Nevada Mountains. It is reported by Faull (1987) from 1) sandy to gravelly washes, 2) moist alkaline margins of seeps and springs, 3) sandy alluvium at the foot of ridges and cliffs, and 4) ledges of dry colluvium supported by ribs of bedrock on cliffs. The details of the ecological conditions in the latter two habitats need to be further described. There is no indication of the size of the populations in these locations and, based on all earlier descriptions, it appears that the preferred habitat of this species is along the wash bottom. Presumably these alluvial soils, especially those on steep slopes, are somehow moister than the general conditions in the desert, but this needs further investigation. It is possible that the coarse texture of the alluvium allows the retention of moisture at depth, much as does sand in arid area (M. Faull, pers. comm., 1998). The atmosphere cannot extract moisture from the soil beyond a depth of a few inches and so in arid areas coarse or sandy soils are relatively moist because of good moisture penetration and reduced atmospheric extraction (Walter, 1973).

There are three major geologic formations in the area occupied by Red Rock tarplant. These are a Cretaceous age granophyre (i.e., silica-rich igneous rock), the Miocene age Ricardo group consisting of non-marine sedimentary rocks, and Pleistocene and recent alluvium (Faull, 1987). Faull has noted that Red Rock tarplant is strongly associated with the alluvium derived from the Ricardo group, specifically with the subdivision of that known as the Dove Springs Formation. The Dove Springs Formation consists of two members, and the Red Rock tarplant occurs primarily in alluvium derived from member two, which consists of "pale red to light gray poorly sorted volcanic-plutonic pebble conglomerate, massive to crossbedded, coarse poorly sorted lithic sandstone, and tuff breccia" (Faull, 1987). It is possible that the size of included clasts (rocks) in the conglomerate or the specific mineral content are major factors in the distribution of Red Rock tar plant, but exactly how these might influence the species is unknown.

Occupied soils are sandy to sandy loam and have an alkaline pH of 8.0-9.0 (Faull, 1987). Unoccupied soils have not yet been tested and so any differences cannot yet be described (Faull, 1987). The species occurs at elevations between 2230 and 2820 ft. (680-860 m) according to Faull (1987).

Population Status:

Populations of this species, which were counted at ca. 13,000 individuals in 1986 (Faull, pers. comm., 1998), are scattered over a very small area in the immediate vicinity of Red Rock Canyon State Park. Even within that small area, plants are further restricted to two small areas of moist soil in this arid region. However, all known populations are well protected by the California State Parks Department and are not currently significantly threatened. Populations are stable or increasing and their prospects for survival appear excellent (Faull, 1987; Faull, pers. comm., 1998).

Threats Analysis:

It has been noted that Red Rock tarplants do not survive where they are continuously subject to disturbance by vehicles (Faull, 1987). In the recent past, the primary threat to this species was from off-highway vehicle (OHV) recreational activities. In 1965 the entire crop of this species was believed destroyed by OHV activity (Twisselmann, 1967). Fortunately, however, such activities are now limited by the state park management (Faull, 1987). For example, a population in Red Rock Canyon at Red Cliffs was enhanced by the control of OHV use, camping, and vehicle parking (Faull, 1987; pers. comm., 1998). The recovery of this population after protection from vehicle traffic is evidence both of the effects of such traffic on this plant and of the careful protection the species is currently receiving.

The weedy shrub tamarisk (*Tamarix ramosissima*) shows the potential to dominate the available moist alkaline habitat and to crowd out the Red Rock tarplant (Faull, 1987). Control measures have been initiated by the California Dept. of Parks and Recreation (Faull, 1987).

Historically, cattle and sheep were driven through Red Rock canyon and may have had a severe impact on these plants, though the species was able to withstand this disturbance and survive to the present (Twisselmann, 1967; Faull, 1987). At the time that large herds of livestock were driven through the canyon, the Red Rock tarplant was unknown to science and no detailed observations of the effects of livestock were recorded.

Biological Standards:

Red Rock tarplant appears relatively secure, despite its highly restricted population, because it is being well protected by the Parks Department (Faull, 1987). All known populations now occur on lands directly administered by the California Department of Parks and Recreation (Faull, 1987; Faull, pers. comm., 1998).

The immediate need with respect to the management of this species is to discover the major factors controlling population size and the careful delimitation of the size and boundaries of the existing populations.

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ROBISON'S MONARDELLA

Monardella robisonii Epling

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: S2.3, G2 (CDFG, 1998)
CNPS: List 1B, RED code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Robison's monardella is apparently endemic to the immediate vicinity of the Little San Bernardino Mountains (Munz, 1959; 1974), in and around Joshua Tree National Park (JTNP), and is most commonly reported in the vicinity of Key's Ranch, the type locality. It is likewise apparently endemic to California and specifically to the WMPA. The only populations known from outside JTNP are on the north side of Yucca Valley and near Sheep Hole Pass, northeast of Twentynine Palms.

As with many poorly understood species, there are also unsubstantiated reports of Robison's monardella far from its few areas of known occurrence. There is a report from the Granite Mountains north of Amboy (Munz, 1968), but that location was not reported by Munz subsequently (1974), nor is it reported in the CNPS Inventory (Skinner and Pavlik, 1994). A letter in the files of the California Dept. of Fish and Game (R. York, 4 Feb. 1987) indicates that the collections from the Granite Mountains, filed in the herbarium at UC Santa Barbara, had been re-identified by Claire Hardham *as M. linoides*, though the plants were apparently thought to be possible hybrids. The Jepson Manual (Hickman, 1993) suggests that this species may also occur in Baja California, but I know of no other reports from that area and do not know the basis for this suggestion.

Distribution in the West Mojave Planning Area:

Robison's monardella is endemic to the southern part of the WMPA, primarily in the Little San Bernardino Mountains. See discussion under general distribution.

Natural History:

Robison's monardella is a perennial herb or weak subshrub, very similar to the widespread narrow-leaved monardella (*M. linoides)*, except that the stems and leaves are covered with longer spreading (instead of short and appressed) hairs. The similarity of the two species has long been noted (Jaeger, 1940), but their precise relationships have not been studied. The flowers, as in all monardella species, are nearly regular and are clustered into compact heads. Based on specimens at UCR, the individual flowers are white to lavender or pale rose, sometimes with a darker stripe down center of each corolla lobe. The flower heads are subtended by subscarious ovate bracts, which are typically pale in color. The leaves are narrowly lanceolate and opposite.

The reported differences between Robison's monardella and narrow-leaved monardella in involucral bract shape and texture and in overall involucre form (Hickman, 1993) are not apparent. Careful study of a series of specimens of both species at UCR revealed no consistent differences, except perhaps a tendency for the involucral bracts of Robison's monardella to be a bit paler in color.

The species was described, very briefly, in 1935 from specimens collected on 20 April 1934 by C. Epling and Wm. Robison (Epling, 1935). Since that time the species has gone virtually unstudied and the publications mentioning it are predominantly floristic in character. The most recent, and only, monograph of the genus *Monardella* (Epling, 1925) was prepared 10 years before this species was described, and hence there has been no opportunity for careful revision based on modern methods and more extensive collection.

This species is very doubtfully distinct from narrow-leaved monardella (*M. linoides)*, and would perhaps be better treated as a subspecies of that plant. It is noteworthy that in his monograph Epling (1925; pg. 6) notes that "The pubescence is of value in distinguishing subspecies but by reason of its response to the environment must be used with care as a basis for specific differentiation." He went on to note that leaf hairs may point upward or downward on different individuals in one population or even on different parts of one individual. Narrow-leaved monardella was specifically noted as a plant with variable leaf hair characteristics. It would appear that by 1935 Epling had forgotten his own recommendation, when he erected *M. robisonii* based entirely on pubescence type (Epling, 1935). As noted above, except for the longer spreading rather than appressed hairs, Robison's monardella appears indistinguishable from narrow-leaved monardella.

Pollinators, germination requirements, seed longevity, and most other aspects of the biology of Robison's monardella are unknown. It is possibly pollinated by a long-tongued bee or a butterfly, based on flower morphology. Narrow-leaved monardella has been observed to be visited by large bees (M. Provance, pers. comm.) and the pollinators for Robison's monardella are doubtless similar. The species is a perennial herb or weak subshrub, probably relatively long-lived, and seems to reproduce primarily by seed. Rhizomes are reported to be present, but are apparently poorly developed.

Jaeger (1940) reports that this species is "aromatic", and the type description (Epling, 1935) likewise says that the plant is strongly scented ("odoratissima") but this needs to be confirmed. Jaeger also says *M. linoides* is strongly scented, whereas in my experience it is hardly scented at all. Jaeger may have been generalizing from other species of *Monardella*, which typically do have a strong sweet-minty scent. It is possible that Epling (1935) was doing the same. If Robison's monardella is truly aromatic, then this could represent an additional difference from *M. linoides*.

The chromosome number is 2n=21, which is the same as that reported for many other *Monardella* species which have been counted (Munz, 1968; Raven, Kyhos and Hill, 1965). Unfortunately, the chromosomes of *M. linoides* seem not yet to have been counted. A chromosome count of a different number would be good evidence that the two taxa are distinct species.

Habitat Requirements:

This plant seems to be entirely restricted to rocky granitic slopes at moderate elevations, 3800-4500 ft. (1160-1373 m; Munz, 1959) or 3600-4900 ft. (1100-1500 m; Hickman, 1993) on the southern Mojave Desert. Most specimens are from among granitic boulders, and some authors report it from "among rocks" (Jaeger, 1940; Munz, 1959).

Likewise, the only ecological observations included in the original description are that it was growing “among boulders and in crevices” (Epling, 1935). The general habitats occupied are mostly in pinyon-juniper woodland, but also in creosote bush scrub and Joshua tree woodland.

Population Status:

Robison’s monardella populations are apparently stable, although the species is poorly known and little studied. The fact that most of the known distribution is within the boundaries of JTNP, and thus not subject to the standard list of threats and disturbances, suggests that this plant is already well protected.

This plant is apparently naturally very rare and there is no evidence that any human activity has had a significant impact on the populations to date. It appears that it is very specific in its habitat requirements and has never spread beyond a very limited area.

Threats Analysis:

Threats to Robison’s monardella appear to be slight or non-existent. The only potential threat is from the numerous rock climbers that use the granitic boulder piles around Key’s Ranch, its preferred habitat. It is conceivable that plants could be damaged or destroyed as people climb up through occupied cracks, or that plants at the bases of favored boulders could be trampled. The extent of any threat from climbers is undocumented, but appears minor.

Biological Standards:

This species needs additional study, but is probably already adequately protected. The extent of any potential threat from rock climbers should be examined, as should the taxonomy of the plant.

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SAGEBRUSH LOEFLINGIA

Loeflingia squarrosa Nutt. var. *artemisiarum* (Barneby & Twisselm.) R. Dorn

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Management Status: Federal: BLM Sensitive
California: S2.2, G5T4 (CDFG, 1998)
CNPS: List 1B, R-E-D Code 2-2-2 (Skinner and Pavlik, 1994)

General Distribution:

The sagebrush loeflingia occurs in the Great Basin of Oregon, Wyoming, California and presumably Nevada, but the varietal status of the plants ("rare") reported for Washoe County is not given (Kartesz, 1988), though this is almost certainly the variety present since California loeflingia (*L. s. squarrosa*) is unreported east of the Sierra Nevada. Sagebrush loeflingia is also not discussed in the literature on the rare plants of Nevada (Mozingo and Williams, 1980; Morefield & Knight, 1992). The type specimen was collected on sandy flats 3 mi. (4.8 km) south of Wright's Point, Harney County, Oregon (Barneby AND Twisselmann, 1970).

In California, this plant is reported east of the Sierra Nevada from Lassen and Plumas Counties in the northern part of the state (Barneby and Twisselmann, 1970) and from Inyo, Kern, Los Angeles, and Riverside counties (Skinner and Pavlik, 1994) in the southern part of the state, but it is very poorly known and populations are not well documented. The report for Riverside County is highly questionable as it is well away from the rest of the species' known range in the eastern Sierra, CNPS does not have a specific locality for that county (Skinner and Pavlik, 1994), and the species is not reported in that county by Hartman (1993). A relatively large population is reported on BLM land in the Big Pine area in Inyo County, north of the WMPA (Chamberlain, 1982), and Big Pine is a locality reported for this plant in the original description (Barneby and Twisselmann, 1970).

Distribution in West Mojave Planning Area:

The distribution of this plant in the WMPA is very poorly known. In the original description (Barneby and Twisselmann, 1970) this species is reported from Buckhorn Dry Lake, near Buckhorn Lake on the route to "Old Pancho Barnes place", and the south end of Rogers Dry Lake, all in Kern Co., as well as from 5 miles north of Lancaster in Los Angeles County. These are here considered to be the only reliable records of this plant in the western Mojave Desert. There are more recent reports, but we are unaware of specimens documenting these localities, so they must be considered tentative. Recent reported localities include: Edwards Air Force Base near the intersection of Mercury Boulevard and 140th street (Charlton, 1992) and washes west of the Rosamond Hills (Charlton, 1992). Neither of these localities is inherently unbelievable, but both are within the zone of overlap of *L. s. squarrosa* and *L. s. artemisiarum* and thus, in the absence of verified specimens, we cannot consider these to be definite localities.

Natural History:

This species is a diminutive annual in the pink family (Caryophyllaceae). It is compact, branched at the base, taprooted, and has glandular-hairy, rather stiff stems that may be either erect or prostrate. The leaves, 0.16-0.24 in. (4-6 mm) long, are slender and have a sharp tooth at the tip (cuspidate). Plants grow 0.4-2.75 in. (1-7 cm) tall, but are never strictly erect. The green, cleistogamous (fertilized unopened) flowers appear from April-May. They have three to five rudimentary petals, or none at all, and five spine-tipped sepals, which strongly resemble the leaves and are always straight and short (little longer than the ripe capsule). The three to five stamens are included in the flower as are the three short styles. The fruit capsule is lanceolate to ovate in profile. The seeds are ca. 0.02 in. (0.4-0.5 mm) long. It can reportedly be distinguished from California loeflingia by its shorter (2.7-3 vs. 3.5-6 mm), straight (vs. strongly recurved), and equal length sepals, but none of these characters seems sharply distinct. Plants with relatively straight sepals, for example, can occur in populations within the exclusive range of California loeflingia.

The wide distribution of this plant in the Great Basin combined with the few records suggests that it is under-collected. The apparent weakness of the characters separating this from California loeflingia, and the relative abundance and ecological success of California loeflingia on the coastal slope, suggests that sagebrush loeflingia may be much more common and widespread than is currently known. It is also possible some of the widely scattered reports are errors based on misidentifications of the nominate variety (especially the Riverside Co. report), or that the taxon is not consistently distinct from *L. squarrosa* var. *squarrosa*. The two varieties are reported to have generally separate ranges, and that they occur together only in the dunes at Buckhorn Dry Lake, Kern County (Barneby and Twisselmann, 1970). The morphological differences between the two varieties do not appear great and Twisselmann (1967) reported that intergrades between this (as *L. pusilla* Curran) and typical *L. s. squarrosa* were common, presumably at Buckhorn Lake. This is a taxon in desperate need of widespread collection efforts and of careful taxonomic study.

Habitat Requirements:

Sagebrush loeflingia grows in sandy soils of desert dunes and flats in Great Basin sagebrush scrub and Mojave desert scrub. It occurs at elevations of 2300-4000 ft. (700-1200 m) according to Hartman (1993) but the type description reports it at “mostly between 4000 and 7000 feet” but at “approximately 2450 ft.” in the western Mojave Desert. It is reported to occur in “stiffer, more alkaline soils” than *L. s. squarrosa* (Barneby and Twisselmann, 1970; Twisselmann, 1967) where the two varieties occur together at Buckhorn Lake. The Big Pine population is associated with Inyo gilia (*Gilia inyoensis*) and golden gilia (*Linanthus aureus*) in coarse sand bordering clay slicks (Novak, 1983).

The known distribution of this plant is largely in the cold deserts of the Great Basin, extending south into somewhat similar habitats on the western Mojave Desert. To the west of the Sierra Nevada and to the south and southwest, it is replaced by California loeflingia (*L. s. squarrosa*).

The typical variety is better known ecologically and is a plant of sandy or gravelly open areas; often occupying flats between shrubs and sandy roadsides. The species never occurs in shade under shrubs but always in full sun in exposed areas (Sanders, pers. obs.). From the limited information available, it appears that sagebrush loeflingia occupies very similar sites.

Population Status:

The size of only one population of sagebrush loeflingia has been documented. The Big Pine population, Inyo County, contained about 1000 plants in a 5 acre area when examined (Novak, 1983). None of the other populations has had population counts reported.

This taxon occurs over a wide area, but is very seldom reported. It may well be that populations are small and widely scattered, though the inconspicuous nature of this plant has doubtless also served to reduce reports. The northern California populations in Lassen and Plumas Counties (Barneby & Twisselmann, 1970), are apparently known only from a few old specimens. Likewise, populations in Kern and Los Angeles Counties appear little known and virtually unstudied. As previously noted, the report for Riverside County (Skinner and Pavlik, 1994) is very doubtfully correct.

Threats Analysis:

Until this taxon is better understood, the extent of any threats will remain poorly known. It is reported to be threatened by residential development in the Rosamond Hills area (Charlton, 1992). There is some cattle grazing in the area of the Big Pine population but no impacts were detectable (Novak, 1983). However, increased grazing could cause more surface disturbance which would eliminate this population (Novak, 1983). Skinner and Pavlik (1994) do not detail threats to this species.

Biological Standards:

Sagebrush loeflingia is so poorly known that it is currently impossible to determine what is necessary to conserve it. The populations at the few known sites should be monitored and studied both taxonomically and ecologically. Additional areas should be surveyed and additional populations sought. Given its extensive overall range (extraordinarily vast for a rare plant), the fact that it does not appear to occupy any unusual habitat type, and the fact that *Loeflingia* is a rather inconspicuous genus of plants that is probably not very frequently collected, or even noticed, the probability that significant additional populations remain to be discovered appears high. Until additional surveys can be conducted, any gross soil disturbances in the vicinity of known populations should be avoided.

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SAND LINANTHUS

Linanthus arenicola (Jones) Jeps. & Bail.

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Management Status: Federal: None
California: S2.2, G2 (CDFG, 1998)
CNPS: List 2, RED code 1-2-1 (Skinner and Pavlik, 1994)

General Distribution:

Sand linanthus occurs on the Mojave Desert of California and southern Nevada. In Nevada, it is reported to be widespread in Clark, Esmeralda, and Nye Counties (Mozingo and Williams, 1980; Kartesz, 1987; Beatley, 1976), and extends north to Churchill County (Kartesz, 1987). In California, populations occur from the vicinity of Giant Rock, north of Yucca Valley (pers. obs.) to Ubehebe Crater at the northern end of Death Valley National Park (DeDecker, 1984), and east to the Nevada state line. The species is not reported to occur in Arizona (Lehr, 1978).

Distribution in the West Mojave Planning Area:

Sand linanthus occurs widely on dunes and other sandy substrates of valley floors in the eastern and northern parts of the WMPA. It is widespread in the southern, central, northern, and eastern Mojave Desert, but is apparently unrecorded southwest of a line drawn from Lucerne Valley to Barstow and then Inyokern. Populations are known from Barstow; Pisgah Crater; Cronese Valley; Pipes Wash near Giant Rock; Twentynine Palms Marine Corps Air-Ground Combat Center (MCAGCC); near Ridgecrest; Searles Valley; and Poison Canyon, south of Trona.

Natural History:

Sand linanthus is an inconspicuous annual member of the phlox family (Polemoniaceae) which occurs exclusively on dunes and other sandy substrates. Both the plant itself and the flowers are small and inconspicuous and hence the species is seldom observed or collected. Many writers have commented on its inconspicuous character and the fact that its distribution is poorly known (Beatley, 1976; Mozingo and Williams, 1980; Peterson, 1984; Kartesz, 1987). Plants are commonly only 0.4-1.2 in. (1-3 cm) tall, but are reported to reach 3.2 in.(8 cm; Patteson, 1993).

Sand linanthus is a spring-flowering annual that germinates in the fall or winter after the onset of the winter rains. Flowering is reported to occur from March to April (Munz, 1959) and, based on specimens at UCR, this appears to be correct. The plants have an elongate slender taproot that doubtless permits the plants to secure moisture supplies below the surface layers that are quickly dried by the wind and low atmospheric humidity characteristic of its desert environment. Based on UCR specimens, it appears that the roots are typically much longer than the stems. The roots appear never to spread laterally through the soil, but rather to be directed downward almost exclusively.

The plant is characterized (Munz, 1959; Patterson, 1993) by its combination of an annual habit, presence of a conspicuous hyaline margin of the sepals that partially fills the sinuses between calyx lobes and forms a “pseudotube”, the short <0.02 in. (<5 mm) pedicels, short calyx 0.016-0.02 in. (4-5 mm) and the stamens inserted deep in the corolla throat. In addition, the pale yellowish flowers with a purple throat are helpful, though these colors are shared by a few similar species. The exact flower color is open to question as the descriptions are probably based on dried specimens and few, if any, collectors have recorded the color of fresh flowers. The corolla is short and does not have a greatly expanded limb. The foliage is often described as glabrous, but in reality it is sparsely puberulent and somewhat ciliate on leaf margins near the base.

Pollinators, germination requirements, seed longevity, and most other aspects of the biology of this species are unknown. It is probably insect pollinated, unless the plant is autogamous or otherwise self pollinating as the small size of the flowers could suggest. There apparently have been no specific studies of pollination in this species, but some *Linanthus* with small inconspicuous flowers are autogamous (Grant and Grant, 1965) which may also be the case in sand linanthus. It is known that the flowers are open in the evening rather than during the day (Patterson, 1993), which suggests moth pollination is a possibility.

Habitat Requirements:

Sand linanthus is a species of well-aerated sandy soils on the valley floors, particularly near high mountains and along the courses of the larger desert rivers and washes, such as the Mojave River and Pipes Wash, where abundant fine-grained alluvium is being deposited. It is probable that it’s distribution is distinctly scattered, because the sandy patches it prefers are not generally continuous, but rather are irregular in their distribution. The plant is commonly not reported in floras of upland areas (e.g., Stone and Sumida, 1983; Prigge, 1975) but is regularly found in areas that include valley bottoms with blow sand. Munz (1974) and Patterson (1993) report the elevation range of sand linanthus as 2500-4000 ft. (762-1220 m) and 800-1400 m (2600-4600 ft.) respectively. However, recent observations in the Silurian Valley have revealed many sand linanthus populations below 2500 ft. (760 m), including at least ten sites below 1000 ft. (300 m) and with one at only 395 ft. (M. Bagley, pers. comm.). In addition, the species has been reported at elevations up to 4900 ft. (1500 m) in Nevada (Cochrane 1979, Holland and Schramm 1979). The currently known elevation range for sand linanthus is thus 395-4900 ft. (121-1500 m), but most populations appear to be between 1000 and 3500 ft. (300-1050 m). However, it appears that the most important environmental characteristic directly controlling the distribution of sand linanthus is the presence of a loose sand substrate. It is probable that the species is controlled by elevation only indirectly. At higher, and thus moister, elevations the greater vegetation cover effectively controls the presence of significant deposits of loose sand and eliminates any habitat for this species. Drier sites, especially those near a significant sand source, are probably preferred by this species.

Sand linanthus occurs in loose wind blown sands or loose sandy to fine gravelly soils, on dunes, alluvial slopes, valley flats, or along washes. Munz (1974), Patterson (1993) and Kartesz (1987) all report this species on gypsum rich soils, but this is certainly not a requirement of the species. In fact, I have never observed it on gypsum soils. Bagley (pers. comm.) likewise has not observed it on gypsum at sites in Eureka Valley, Indian Wells Valley, Wingate Pass, Cronese Valley, Soda Mountains, and Silurian Valley. Sites occupied by sand linanthus typically have only relatively gentle slopes; it does not occur on steep hillsides or high-gradient alluvial fans. It is probable that it does not occur on steeper slopes because the higher energy erosional environment there prevents the extensive deposition of the fine-grained materials it prefers.

Sand linanthus occurs almost entirely within the creosote bush community as defined by Munz (1959; 1974), but has also been reported in desert sink scrub (CDFG 1997b) and desert saltbush scrub (CDFG 1997b). Munz (1974; Munz, 1959) also reported this species in Joshua tree woodland, but this appears to be only marginally so. The plants on the Sand Hill training range of the Twentynine Palms MCAGCC are in an area with a sparse stand of Joshua trees (pers. obs; pers. comm., M. Elvin).

Population Status:

Populations of sand linanthus are almost completely unstudied, but are probably reasonably stable. Plants are not usually common, but rather are present as scattered individuals. About 200 plants were recorded in about one hour in Cronese Valley (pers. obs., 1978) but otherwise the plants are generally recorded as infrequent or scarce. Some populations have doubtless been lost to highway construction, urbanization, and other human activities within its habitat, but this cannot be conclusively shown. There appears to be no reason to believe that this species has suffered significant declines in population size.

A convincing case cannot be made at present that this species is rare, though it is certainly not a common species. It appears that this is a plant that has never been much more common than it is today. It has a moderately specialized habitat and for some reason seems not to form large populations, even within this preferred habitat.

Threats Analysis:

Threats to sand linanthus are difficult to define, but doubtless include off-highway vehicles, which heavily use some of the dunes occupied by this species. Some populations have probably been lost or reduced by urbanization, highway construction and other similar activities, but the extent of this cannot be documented.

Biological Standards:

There is a crucial need for surveys to test the hypothesis presented here, that this species is not currently rare enough to require special protection measures. My prediction is that as additional areas of suitable habitat within the species' known range are surveyed, additional populations will be found. In addition, I predict that if sites of know population are surveyed it will be found that populations are more extensive than is presently known. If my hypothesis is wrong, then it will be difficult or impossible to find additional populations and the known populations will be found to be small and restricted in area.

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SHORT-JOINT BEAVERTAIL

Opuntia basilaris Engelm. & Bigel. var. *brachyclada* (Griffiths) Munz

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Management Status: Federal: USFWS Species of Concern
California: S1.2, G5T1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Short-joint beavertail occupies northern slopes of the San Gabriel Mountains. It occurs from Quigley Canyon and ranges east northeast to the Anaverde Valley west of Palmdale. From there, it appears to follow the San Andreas rift zone to the Cajon Pass, although it departs somewhat from the rift zone near Mill Creek Summit within the Angeles National Forest. It occurs mostly at elevations between 3000-6500 ft. (900-2000 m). However, the westernmost reported location in Quigley Canyon near Newhall is at 1400-1600 ft. (425-490 m). The University of California at Riverside herbarium has a collection from Pole Canyon, near the Santa Clara River off of Soledad Canyon Road approximately 12-15 mi. (19-24 km) northeast of Newhall, and there is a report from Quail Spring about five miles east of that, but in general, there are very few reports from areas between Quigley Canyon and the Anaverde Valley. Plants from the Anaverde Valley and west of there appear to have intermediate morphology, and are probably intergrades with *Opuntia basilaris* var. *basilaris*. There are several reports east of Cajon Pass in the northern San Bernardino Mountains, extending through Horsethief Canyon and Summit Valley to the Mojave River Forks south of Hesperia. Most of these populations also show intergradation with *Opuntia basilaris* var *basilaris*. It also occurs on the coastal slope of the transverse ranges in the Cajon Pass area at Mormon Rocks.

There is a 1920 collection from the eastern side of the Providence Mountains at Colton Well (CDFG, 1997b) that is reported to be this variety, but the plants could not be found there when the site was checked in 1979. A CNPS field survey form indicates that short-joint beavertail was found at or near this location in 1983, apparently by Maureen Pendleton, but this information did not appear in the CNDDB (CDFG, 1997b), and it is not certain whether there is a voucher specimen available. This location is a considerable distance from the main part of the range for this taxon, and it is possible that plants found here are not true variety *brachyclada*. Short-joint beavertail has also been reported from Vulcan Mountain in San Diego County, also a long distance from the taxon's main range (Benson 1969). Surveys should be conducted in the Providence Mountains and Vulcan Mountain to determine if this variety indeed occurs there. The 1995 administrative review draft for the WMPA reports that new populations of short-joint beavertail have been found near Isabella Lake, but CNDDB reports for these populations were not available, and pending firm documentation this population cannot be accepted as valid.

Distribution within the West Mojave Planning Area:

Within the WMPA, short-joint beavertail is reported in the Anaverde Valley just west of Palmdale, and from there it follows the San Andreas rift zone, both in the Angeles National Forest and in the WMPA, southeast to Largo Vista. East of Largo Vista its distribution within the WMPA is mostly north of the rift zone near the Forest Service boundary to near Mountain Top at the junction of Highway 138 and Highway 2. Scattered plants have been observed within the WMPA in south Phelan, east of Mountain Top, for several miles along the Forest Service boundary. Plants then reappear near Cajon Summit, Oak Hills, and Baldy Mesa. From there it extends east through Horsethief Canyon, mostly within the San Bernardino National Forest, but sometimes extending into the WMPA. Its eastern-most reported occurrence within the WMPA is near the dam at Deep Creek and Mojave River Forks.

Natural History:

Short-joint beavertail is a member of the cactus family (Cactaceae), and more specifically fits within the sub-genus *Platyopuntia* of the genus *Opuntia*, having flattened joints and no tubercles. It has bluish-gray stems with no spines, but possesses glochids borne on areoles 0.2-0.6 in. (0.5-1.5 cm) apart. The fruit is dry at maturity. Flowers have magenta to rose-colored perianth segments and white stigmas, and are clustered at the ends of joints. Variety *brachyclada,* first described by Griffiths (1914), is distinguished from other members of the species by having small joints which are 1.2-2.4 in. (3-6 cm) long, rather than the 2.8-6.0 in. (7-15 cm) long joints possessed by other members of this species. These joints are often almost cylindrical and club-shaped instead of flattened (Hickman, 1993; Munz, 1974), but older joints within a clone seem to flatten as they age. Fruits are also smaller at 0.4-0.8 in. (1-2) cm, compared to fruits of other varieties which are 1.2 in. (3 cm) long. Flowers, however, are not always smaller; plants in pinyon-juniper woodland in Pinon Hills have been observed with flowers as large as those of other varieties. It flowers in May to June, a month later than other varieties, and has been called the 'snow flower cactus' because the flowering follows snow melt in pinyon woodland (Dawson, 1966).

The characteristics that distinguish the short-joint beavertail from var. *basilaris* are at least in part due to genetic differences, since some individual plants of both varieties maintain distinct phenotypes when growing sympatrically, as in Horsethief Canyon (MacKay and Sanders, 1997). It is not known whether any of the unique features of the short-joint beavertail help them to survive and/or reproduce more efficiently within their range. It was speculated that this taxon could be of hybrid origin between a cylindric species and a flat-jointed species (Britton and Rose, 1963), and although hybrids are found within both sub-genera (Gibson and Nobel, 1986), it is now clear that hybrids do not occur between the sub-genera *Cylindropuntia* and *Platyopuntia*.

Like all of the southwestern *Platyopuntias*, short-joint beavertail flowers are large, bowl-shaped, have many brightly-colored perianth segments, many touch-sensitive stamens, and a massive central style and stigma. Transfer of pollen by vectors is probably important in this taxon, as it is in many protandrous cacti (Mistretta and Parra-Szijj, 1991). Flowers with this pollination syndrome were previously thought to be beetle-pollinated (Faegri and van der Pijl, 1979; Grant and Hurd, 1979), and indeed, beetle visitors are very commonly reported in these flowers. However, more recent studies have shown that the beetles found in cactus flowers do not frequently contact stigmatic surfaces, and that medium-sized and larger bees are the important regular pollinators of this and other *Platyopuntias* (Grant and Grant, 1979, Grant and Hurd, 1979).

Seeds of the short-joint beavertail will germinate under greenhouse conditions at temperatures greater than 70 F, but sometimes scarification is required (Mistretta and Parra-Szijj, 1991). The presence of what appear to be hybrid swarms, especially east of Cajon Pass in Summit Valley, would suggest that viable seeds are produced by crosses with var. *basilaris*. Both varieties are diploid with the same chromosome number (2n=22) (Pinkava, et. al. 1977). Seeds of plants from an apparent hybrid swarm population in Horsethief Canyon showed 95% embryo viability when tested with tetrazolium (MacKay, 1998). Cloning is also evident in short-joint beavertail from the formation of spreading patches of this taxon in some areas. It has been suggested that patch width might be used to estimate ages of plants, although growth rates and longevity of the short-joint beavertail are not known (Mistretta and Parra-Szijj, 1991). However, most plants don't produce multiple joint segments that will break off and be dispersed, so cloning may be limited (Mistretta and Parra-Szijj, 1991). The juicy bright colored fruits of the short-joint beavertail are most likely dispersed by birds, but the seeds do not appear to germinate within the fruit itself, probably due to the presence of chemicals in the pulp that inhibit seed germination (Mistretta and Parra-Szijj, 1991). Seeds might be eaten by insects, rodents, and birds. Cochineal insects (*Dactylopius coccus*) have been observed on short-joint beavertail, but they do not appear to threaten the survival of the plants (Mistretta and Parra-Szijj, 1991).

Habitat Requirements:

Short-joint beavertail is known to occur in chaparral, joshua tree woodland, Mojave Desert scrub, and pinyon-juniper woodland communities at elevations of 3000- 6500 ft. (900-2000 m). Within the WMPA it is mostly associated with Joshua tree (*Yucca brevifolia),* California juniper *(Juniperus californica)*, scrub oak *(Quercus john-tuckeri),* ceanothus *(Ceanothus greggii)*, California buckwheat (*Eriogonum fasciculatum* var. *polifolium)*, pinyon pine (*Pinus monophylla),* purple sage *(Salvia dorrii)*, and linear-leaved goldenbush (*Ericameria linearifolia).* Within the Angeles National Forest it is associated with chamise (*Adenostema fasciculatum*), ceanothus (both *Ceanothus crassifolius* and *Ceanothus greeggii* var. *vestitus*), the Lord's candle (*Yucca whipplei* ssp. *caespitosa*), California sycamore (*Platanus racemosa*), chaparral white-thorn (*Ceanothus leucodermis*), big-berried manzanita (*Arctostaphylos glauca*), sugar bush (*Rhus ovata*), silk-tassel bush (*Garrya veatchii*), big sagebrush (*Artemisia tridentata*), Mexican elderberry (*Sambucus mexicana*), rubber rabbitbrush (*Chrysothamnus nauseosus*), yerba santa (*Eriodictyon trichocalyx*), and other species. It has been reported from a wide variety of soils, from sandy to rocky, in open stream beds and on rocky slopes (CDFG, 1997b).

Population Status:

CNDDB reports for short-joint beavertail have very little information on population sizes within the WMPA, and there is no information on trend at reported sites. Many of these reports indicate single plants, while others have no data on numbers of plants (CDFG, 1997b). Known occurrences within the WMPA will be discussed, starting with the westernmost location at Quigley Canyon. There are no population data for the Quigley Canyon population, and plants there appear to be intergrades with *O. basilaris* var. *basilaris*. In 1989 Myers (CDFG, 1997b) reported four locations at City Ranch in the Anaverde Valley west of Palmdale, many of the which appeared to be intergrades with *O. basilaris* var. *basilaris* . One of these locations had 300 plants, while another had 12. There are no further population data for these locations, nor are there counts for the other two Anaverde populations. A population with at least 23 individuals was found south of Palmdale near an air strip in an area a developer retained as natural open space (CDFG, 1997b), but there is no current information on the status of that population. An unknown number of short-joint beavertail were found at Big Rock Creek, east of Pearblossom. These were unusual in that they occurred in creosote bush scrub habitat.

Although it is not within the WMPA, MacKay and Thomas (1997) have recently discovered a large population of at least several hundred plants further up the Big Rock Creek drainage at 5250 ft. (1600 m) elevation. These plants are on private land at the old Paradise Springs Camp, and the naturalist at that camp has been notified. A smaller and less dense population was observed at South Fork Campground, also outside of the WMPA. It is likely that the short-joint beavertail also occurs along Rock Creek between Pearblossom and South Fork Campground within the WMPA, but this has not been documented.

A population on Largo Vista Road, near highway N-4, extends slightly over the Angeles National Forest boundary into the WMPA. Mistretta and Parra-Szijj (1991) reported 140 plants for the whole population, but it is not known how many of these were within the WMPA. Several populations occur in Mescal Canyon (CDFG, 1997b), but there are no population size data available. MacKay has frequently observed short-joint beavertail at many scattered locations in Pinon Hills and south Phelan. Plants were never dense in these areas, and population data were not taken. A population of 150 plants extends into the WMPA from the Angeles National Forest (Mistretta and Parra-Szijj, 1991) in Horse Canyon, but it is not known how many of these plants are actually within the WMPA.

Several populations have been found in the Oak Hills and Baldy Mesa areas. In 1986, one plant was found in Baldy Mesa, three miles north of Cajon (CDFG, 1997b), an unknown number of plants were found at Newton's Outpost Truck Stop on the west side of Highway 395, and one plant was found at the I-15 freeway and Highway 395 exit. Five more populations were found scattered within the Oak Hills and Baldy Mesa area.

MacKay and Sanders (1997) have observed populations of 25 or more individual plants in Horsethief Canyon east of Cajon Pass, along the Pacific Crest Trail. These plants were mostly outside of the WMPA, although some of them may extend into the WMPA. Many of these plants appear to be intergrades with *O. basilaris* var. *basilaris*, although some specimens retain all of the characteristics of var. *brachyclada.* Meyers also has found short-joint beavertail populations that lie at least partly within the WMPA, at Las Flores Ranch, Grass Valley, and Deep Creek Dam, but population sizes were not assessed.

Mistretta and Parra-Szijj (1991) have conducted surveys for short-joint beavertail within the Angeles National Forest. They counted a total of approximately 900 plants at fifteen localities, two of which were within the boundaries of the San Bernardino National Forest. Plants were found in the Tujunga and Valyermo Districts of the Angeles National Forest, and in Lone Pine Canyon in the San Bernardino National Forest.

It is likely that the distribution of the short-joint beavertail is much wider within the WMPA than what is described here. Much of the land is in private hands, making field surveys difficult.

Threats Analysis:

Most of the short-joint beavertail range that is within the WMPA in San Bernardino County is on private land, and these plants are threatened with mechanical removal by Off Highway Vehicles (OHVs) and by residential construction. There has been a marked human population increase in the vicinities of Pinon Hills, Phelan, and Oak Hills due to development of home sites, and much of the remaining land is zoned for residences. Many of the developed and undeveloped lots are between two and a half and five acres (1-2 ha). There is a tendency for residents to clear their acreage of native vegetation, mostly since it considered a fire hazard, but also to build corrals for animals. In addition, many residents do not like having cacti on their property, as they feel cacti pose a danger to children and animals. However, some property owners in Pinon Hills are aware of the unique nature of the short-joint beavertail, and encourage it to grow in their rock gardens. Away from the residential areas, prime short-joint beavertail habitat in the hills south and east of Phelan, from Cajon Canyon extending to the Oak Hills and Cajon Pass area, is used extensively by OHV enthusiasts. Much of the landscape is scarred by OHV trails, and erosion is apparent in many places. In addition, undeveloped homesites at lower elevations are often traversed by OHVs, especially those lots that are not protected by fences and signs.

Future activity at a presently inactive limestone mine could potentially threaten a population northeast of Wrightwood. Sheep grazing in the Baldy Mesa area could pose a threat from trampling of plants, but it is unlikely that the sheep find the cacti palatable. Short-joint beavertail east of the Cajon Pass in the Summit Valley area is greatly threatened by the proposed and approved Las Flores Ranch housing development. In addition, a housing development is planned south of Hesperia near Hesperia Airport. Land-clearing for construction of roads, utilities, and buildings will cause mechanical removal of these plants.

At Quigley Canyon, there are major disturbances due to oil drilling. Continued urbanization around the Palmdale area has most likely had heavy impacts on short-joint beavertail populations, but these impacts are not documented. The known populations are all on private land, some of which is being developed as residences, as in the Anaverde Valley, and a population has been found at an air landing strip southeast of the city. In general, however, impacts to short-joint beavertail habitat in Los Angeles County have probably not been as great as in San Bernardino County. The Los Angeles County Planning Dept. has designated several Significant Ecological Areas (SEA) within the range of this species, including Littlerock, Big Rock Creek, and Mescal Canyon, close to the San Bernardino County line, although a water pipeline has been proposed in the Mescal Canyon area. Developing a homesite within an SEA sometimes requires dedication of fifty per cent of the land as conservation easements to be maintained as open space. In addition, amenities such as water and electricity are absent from many of these areas in Los Angeles County, so there is less incentive to build there. Even though this land is in private hands, the result has been a much lower density of development, and therefore far fewer impacts on the short-joint beavertail so far. It must be kept in mind, however, that human populations in nearby Palmdale and Lancaster urban areas are expected to increase sharply in the near future, and utilities will most likely increase in availability, making this area prime for development.

Where the short-joint beavertail occurs in Los Angeles County on USFS land, it is not threatened by homesite development. However, large expanses of this land are designated for off-road vehicle travel, from Bear Canyon just east of Placerita Canyon, and east to a point just south of Littlerock. The same designation applies to USFS areas from near Valyermo and east to the

San Bernardino County line. This includes the upper reaches of Mescal Canyon where populations of short-joint beavertail have been reported. Scattered off-road tracks were found in this area during a habitat integrity survey (MacKay and Thomas, 1997), but many places were too steep and the vegetation too dense and impenetrable to allow intense OHV travel.

The unique compact form and beautiful flowers of the short-joint beavertail make it very desirable for cactus collectors. It is not known if horticultural collection has impacted populations within the WMPA, but there is the potential for future impacts from this activity.

Most species of *Opuntia* evolved in areas where they were not subjected to frequent fires (Sauer, 1988). It has been suggested that the rapid infiltration of desert ecosystems by introduced grasses most likely increases fire frequency, and this may decimate some *Opuntia* species (Sauer, 1988). Introduced European grasses are increasing their range and numbers within the range of the short-joint beavertail, especially in the Cajon Pass area, Oak Hills, Phelan, and Pinon Hills, and also around Palmdale. This will most likely alter future fire frequency, but it is unclear if this increased frequency will pose a threat to the short-joint beavertail. In addition, prescribed burning has been planned in desert chaparral areas within the range of this taxon (Mistretta and Parra-Szijj, 1991). These cacti can apparently survive at least a single burning incident. A resident of Pinon Hills reported that several large patches of this plant on her property at 5000 ft. burned completely in the Scout Fire of June 1994. They have now resprouted from patch edges, but have not yet flowered . One of these burned patches near a garden area, which therefore receives extra water, has attained larger joint length than other patches receiving no extra water.

<u>Biological Standards</u>:

To prevent extirpation of short-joint beavertail within the WMPA, it is first necessary to determine where it is found and to assess population sizes. Focused surveys must be carried out prior to making management decisions, and mitigation measures must be carried out both on public and private land.

Natural areas should be set aside within lots to be developed, where property owners are not permitted to clear portions of the land or disturb the plants. It is also possible to successfully transplant the short-joint beavertail, so isolated plants could be transferred to more protected locations. Perhaps a tax incentive could help motivate land owners to carry out mitigation measures with monitoring from local agencies.

Los Angeles County Planning Department growth projection estimates should be consulted to foresee the potential for habitat loss in this region. The county should require that extra mitigation measures be taken when development occurs where this species is present. In 1991, an action plan was developed to eliminate threats to the short-joint beavertail within the Tujunga and Valyermo Districts of the Angeles National Forest. This plan was to be implemented and overseen by the Angeles National Forest and Rancho Santa Ana Botanic Garden (Mistretta and Parra-Szijj, 1991). It is not known whether this plan is being carried out.

OHV use must be curtailed on privately-owned acreage in residential areas, and especially in the area southeast of Phelan and east of Mountain Top junction, between Cajon Canyon and Cajon Pass.

Research is needed to determine if short-joint beavertail survives repeated frequent fire, and what effects fire has on seed survival and germination; such information could help determine appropriateness of management practices such as prescribed burning.

Genetic studies would not only help to elucidate the typical reproductive strategy employed by this taxon (Karron, 1991), but could offer critical information on the genetic diversity within this taxon and the likelihood of its persistence through time (Huenneke, 1991).

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SMALL-FLOWERED ANDROSTEPHIUM

Androstephium breviflorm S. Wats.

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Management Status: Federal: None
California: S1.3 (CDFG, 1998)
CNPS: List 2, R-E-D code 3-1-1 (Skinner and Pavlik, 1994)

General Distribution:

Small-flowered androstephium occurs from the deserts of eastern California (White, et al., 1996) through southern Nevada (Kartesz, 1988) and the southeastern two-thirds of Utah (Albee, et al, 1988) to western Colorado and south to northern Arizona (Cronquist et al, 1977). It is reported to be uncommon in Nevada (Kartesz, 1988), but appears widespread and perhaps fairly common in Utah (Albee, et al., 1988). The distribution of this plant in California is extraordinarily poorly documented. There are a number of reports from scattered areas, but few of these appear to be supported by specimens and only only a single observer has recorded many. Confirmed California records are discussed below. There is a report of a single individual in Silurian Valley in 1993 (BLM, 1997) and subsequent reports of other individuals in that area (M. Bagley, pers. comm.) but these reports are not supported by specimens and cannot be conclusively confirmed. This species is also reported from an indefinite locality in Inyo County (Skinner and Pavlik, 1994), but this record has been carried in the CNPS Inventory for well over ten years with no definite locality or confirmation ever forthcoming, though the report is supported by generalized reports from Inyo County in the Black Mountains and Greenwater Valley (DeDecker, 1984), but there appear to be no specimens from these localities (unless they're in the private herbarium of M. DeDecker) and confirmation would be very desirable.

Distribution in the West Mojave Planning Area:

In California, this species is known with certainty only from along Interstate 15, from Midway and Dunn (northwest of Afton Canyon toward Alvord Mountain) to Cave Mountain and Cronese Valley, and in Cadiz Valley, east of Twentynine Palms. The Midway/Dunn to Cronese Valley localities are definitely within the WMPA, while the Cadiz Valley location is just outside the southeastern boundary. Except for the Cadiz Valley location, all documented sites are along Interstate 15, the major route of travel across the Mojave Desert. This suggests that the known distribution pattern may largely reflect areas of frequent access by collectors, rather than the actual distribution of the plant. In addition to the areas of known occurrence, there are unconfirmed reports of this species from two other areas in the WMPA. Small-flowered androstephium is reported to occur west of Victorville (Clark et al., 1984), but that location is far from other well documented sites and the documenting specimen cannot now be found (Clark, pers. comm.). It is possible that this record actually applies to crowned muilla (*Muilla coronata)*, a somewhat similar plant, which is known from almost exactly the site reported by Clark. The available published sources describing crowned muilla at the time that Clark et al. wrote (e.g., Munz, 1959; 1974; Abrams, 1923) were inaccurate in a number of respects (Shevock, 1984) and this could have caused a misidentification, though the major key characteristics were described accurately. Vegetative plants thought possibly to be small-flowered androstephium have been found in sandy soil in the southwestern part of the Twentynine Palms Marine Corps Air-Ground Combat Center (UCR, 1993), but these need to be have their identity confirmed when the plants are flowering.

Natural History:

Small-flowered androstephium is a perennial herb growing from a corm with a dense, tawny, fibrous coat. It is early flowering and inconspicuous when in flower, but becomes somewhat more obvious when in fruit due to the greatly enlarged capsules in fruiting material. Flowers are about 0.6-0.9 in. (15-22 mm) long and are dull white to pale violet in color, but the capsule valves are more conspicuous and are ovate to almost round. The color of the flowers fades to brownish in dried material. The capsule valves are 0.44-0.52 in. (11-13 mm) broad and to about 0.8 in. (20 mm) long at maturity. The seeds are black and strongly flattened; about 0.24-0.32 in. (6-8 mm) in diameter, but less than 0.04 in. (1 mm) thick. Each plant has 2-3 slender leaves from the base and sends up a single stiff peduncle supporting an umbel of flowers in the spring (about March in California, but as late as May at higher elevations farther east). The pedicels of the individual flowers are relatively short at flowering but elongate greatly in fruit and become up to 2.4 in. (60 mm) long, though some individuals can have fruiting pedicels as short as 0.32 in. (8 mm). The branches of the umbel are subtended by conspicuous bracts, which persist and become papery in fruit.

Nothing appears to be known about reproduction, germination requirements, seed dispersal or pollination in this species. It can be inferred that, like many similar monocotyledons, small-flowered androstephium reproduces regularly by the production of vegetative offsets from mature corms. Other species of similar habit (e.g., *Dichelostemma capitata,* wild hyacinth) multiply rapidly by this means during favorable periods (pers. obs.), though such reproduction is not detectable on the 16 flowering specimens with intact corms examined during preparation of this note. The corms are apparently normally located quite close to the soil surface, with all those examined having been buried less than two inches, most only one inch, below the surface. Many specimens, however, are collected without corms (10 such specimens examined) and it is possible that these include many with more deeply buried corms. Few of the 26 specimens examined, from throughout the range of the species, showed any evidence of herbivore attack, either by insects or vertebrates. A single specimen showed damage from, and the dried body of, a lepidopteran (moth) larva. There was a hole in an unopened bud and the dried body of the herbivore was present in this. Aside from this one insect, there were no dried aphids, scales or other insect predators present on any of the specimens, though such plant feeding insects are commonly inadvertently preserved on herbarium specimens.

Habitat Requirements:

In California this appears to be primarily a species of open sandy flats and bajadas at low to moderate elevations. All specimens taken in California are from elevations between 890 and 2100 ft. (270-640 m), though Keator (1993) reports the species occurs from “700-1600 m”. Keator had seen no specimens from California and probably based his elevation range on specimens from outside the state, where it has been collected at elevations up to 7550 ft. (2300 m). Its apparent restriction in California to sites with relatively sandy soils, often stabilized blowsand, needs to be emphasized. This species’ recorded scarcity in California is difficult to understand since its preferred habitat is not particularly restricted or small in amount. There may be ecological details about the sites occupied that are not obvious, or it may be that many suitable sites have not been searched at appropriate seasons. The scattered unconfirmed reports of the species certainly suggest the possibility of additional occupied habitat. In adjacent states, this species is reported from a greater range of habitat types than it is known from in California, where it is at the edge of its range. However, in northern Arizona it is reported “mostly in sandy soil” (McDougall, 1973), which is consistent with its ecological preferences in California.

The species, considering its range as a whole, occurs primarily in locations that are cold in the winter, which suggests that it may have a vernalization requirement for flowering. Consistent with this is the fact that the only other species in the genus, the blue funnel lily [*A. caeruleum* (Scheele) Torr.], is endemic to the south-central U.S. (Kansas to Texas) which is also an area with cold winters. However, the closest genus to *Androstephium* may be *Bessera* (Mabberley, 1997), a Mexican genus of distinctly tropical affinities with which Androstephium has frequently been united, but this relationship is doubtful (J.C. Pires, pers. com.). Such a hypothetical requirement for winter chilling may not be met by the conditions on the low desert of California, and this environmental condition may cause the southern limit of its distribution. This plant was, until recently, not reported at all from the Sonoran Desert (Shreve and Wiggins, 1964), though the Cadiz Valley location (White, et al., 1996) is at the northern edge of that desert.

It may be noteworthy that this species occurs primarily east of California in areas with relatively high amounts of summer rainfall and that all the well documented sites in California are toward the eastern side of the Mojave desert in areas where summer rainfall is relatively frequent (Rowlands, 1995). Except for the Clark collection, this species is not reported from the western Mojave Desert in the areas strongly influenced by the Californian summer dry weather regime.

Population Status:

This appears to be a species that has just never been very common in California. It was unreported for California in most floras written prior to *A California Flora* (Munz, 1959) and was probably just overlooked by the early collectors (Jepson, 1925; Munz, 1935; Jaeger, 1941), though it was reported rather indefinitely from “vicinity of Needles” by Abrams (1923). The identity or origin of any specimen that motivated that report may be in question, since there appear to be no reports by more recent authors of this species from the vicinity of Needles. In fact, Munz (1959; 1974) and Keator (1993) even indicate that this species needs clear documentation as occurring in California at all. Though, there were a few specimens available in California herbaria prior to 1993 (White, et al., 1996), but these were not well known. Reported populations are widely scattered and additional populations could probably be found by diligent searching of appropriate habitat zones. It may be that the species genuinely is scarce because it’s at the edge of its range and habitat conditions are marginal for the species. The restriction to sandy soils suggests that lack of moisture may be a major factor controlling this species: farther east in its range it is reported from clay soils (Weber, 1987). In arid areas, sandy soils are effectively wetter than clay soils because water can more readily penetrate to sufficient depth to avoid being removed by the atmosphere. In clay soils the greater surface area of the soil particles holds the water from the scarce rains in the top few inches of soil where it can readily be removed by the dry atmosphere (Walter, 1973).

The known populations of this species are apparently all very small, but there appear to have been no attempts to systematically count any of the populations. In the late 1970s, the populations in the Cronese Valley and at Midway were very small and the plants widely scattered (pers. obs.). Observations in March 1998 revealed that the Cronese Valley site still held a very small population (<20 plants) but that the Midway population could not be rediscovered at all (pers. obs.). Recent reports in the Dunn and Cave Mountain areas are all of very small populations, almost all less than 10 individuals. The largest reported population is of 20 flowering plants, plus some sterile ones, south of East Cronese Lake in 1993. The recent collection from Cadiz Valley was from a population of "12 plants in scattered patches" according to the specimen label (and see, White, et al., 1996).

It is entirely possible that this species is more common in California than is currently known. There have not been many searches for the plant and probably none that covered extensive areas of approximately suitable habitat. This species is one that cannot be found much of the year due to its geophytic habit and relatively short period of active growth, thus making it easy to miss.

Threats Analysis:

Significant current threats to this species are not obvious. The areas occupied are largely remote from large scale economic activity and the specific sites occupied are generally so arid that little forage is produced and so grazing is generally not conducted on a significant scale. There is off-road vehicle activity in the areas occupied, but the extent of any damage being done by such vehicles has not been quantified. Some individuals have been lost to highway construction and other acts of land conversion, but it is difficult to see that the populations in California are significantly different than they ever were in historic times. Some plants were doubtless destroyed in the construction if Interstate 15, but the number is unknown. At Midway, the species occurred on the sides of the freeway, as well and in the median strip between the east and west bound lanes in the 1970s. It could not be found in that area in 1998 and may have been destroyed by the expansion of roadside rest areas (pers. obs.). In any event, it is virtually certain that it formerly occurred in the area now covered by the asphalt of the freeway. Other construction activities in the areas where it occurs may occasionally result in the destruction of a few individuals, but this has not been documented. There are several reports based on surveys along proposed utility corridors, so there may be some threat from construction of powerline towers or pipelines. There is no known threat to the species by urban or residential development since all three populations occur on remote federal lands.

There are no existing mechanisms for the protection of this species. While it may be very rare in California, it has been reported at such scattered locations at such a distance from human activity that it has never been seriously considered for protection. It appears not to be threatened and may be more common than is currently known.

Biological Standards:

At the present time the natural distribution of this species is so poorly documented in California that it is impossible to outline areas critical for its survival or the areas where populations are densest. As things stand, all we have are a few scattered sites from which the species is known, but there have been no systematic surveys for the species and as a result it is very poorly known. It is not known how extensive the existing populations are or whether other larger populations may exist elsewhere. The Clark specimen needs to be found and checked to determine whether this species does in fact occur in the Victorville area.

Several recent reports of this species (BLM, 1997) are unsupported by specimen records from the area where the species is reported and hence are of marginal value. Future surveys must document any populations found with specimens deposited in recognized herbaria.

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SPANISH NEEDLE ONION

Allium shevockii McNeal

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Management Status: Federal: BLM Sensitive
California: S1.3, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-1-3(Skinner and Pavlik, 1994)

General Distribution:

Spanish Needle Onion is known from only two populations, both in Kern County, on or near the crest of the southern Sierra Nevada Mountains. The larger population, several thousand individuals, occurs on Spanish Needle Peak, which is approximately three-fourths of a mile south of the Tulare County line. The plants occur in seven small canyons just below the summit on the west and northwest faces of the peak, and in two canyons on the east face (McNeal, 1987). The only other known population, 40-50 individuals, occurs in the Horse Canyon area, approximately 12 miles northeast of Tehachapi, at the extreme southern end of the Sierra Nevada range. Before discovery of the Tehachapi population, it was estimated that only 10% of possible habitat had been surveyed for this species (McNeal, 1987).

Distribution Within the West Mojave Planning Area:

The Spanish Needle Peak population appears to straddle the WMPA boundary. Due to the imprecise plotting of the boundary line on available maps, it is not possible to give an accurate estimate of what percentage of the population is within the boundary. The Tehachapi population is a short distance outside the WMPA boundary.

Natural History:

Spanish Needle onion is a perennial herb, 6-8 in. (15-21 cm) tall, that grows from a bulb. It has showy flowers, with tepals that are white to light green below and maroon on the reflexed and curled distal half. There is a single terete leaf.

McNeal places Spanish Needle onion in the *Allium sanbornii* alliance. It shows some similarities to Great Basin onion (*Allium atrorubens),* fringed onion *(A. fimbriatum)* and mountain onion (*A. monticola)*, but is distinguishable from each of these species. Most notable among its differences are: "...1) obovate to oblanceolate outer perianth segments, the outer series of which are strongly reflexed to coiled in the distal half; 2) the light-lemon yellow fresh bulb coats; 3) long filamentous secondary rhizomes that develop from the main bulb, or more commonly from basal bulblets that form on short, stout primary rhizomes at the base of the main bulb" (McNeal, 1987, p. 153).

Allium shevockii reproduces primarily vegetatively, at least in the Spanish Needle Peak population, where McNeal (1987) reported that few mature flowers with developing capsules had been observed. However, Hare (pers. comm., 1997) reported that the Horse Canyon population produces capsules with seeds.

At the type locality, on the west and northwest faces of Spanish Needle Peak, this species occurs in open, predominantly conifer forest, with occasional Jeffrey pine (*Pinus jeffreyi*), sugar pine (*Pinus lambertiana*), pinyon pine (*Pinus monophylla*), canyon live oak (*Quercus chrysolepis*), western juniper (*Juniperus occidentalis*), and limestone mountain mahogany (*Cercocarpus intricatus*) (McNeal, 1987). Understory species in the immediate vicinity of the *Allium* populations are sparse because the slope is so steep and unstable (McNeal, 1987), but herb and subshrub associates include Needles buckwheat (*Eriogonum breedlovei* var. *shevockii*), naked-stemmed buckwheat (*E. nudum*), sulfur-flowered buckwheat (*E. umbellatum*), Wrights buckwheat (*E. wrightii* ssp. *subscaposum*) Davidson’s rock cress (‘*Arabis davidsonii*), elegant rock cress (*A. sparsiflora* var. *arcuata*), Fort Tejon woolly daisy (*Eriophyllum ambiguum* var. *paleaceum*), golden yarrow (*E. confertiflorum*), prickly phlox (*Leptodactylon pungens* var. *pulchriflorum*), California fuchsia (*Epilobium canum* ssp. *latifolium*), chocolate drops (*Caulanthus pilosus*), gaping bush-penstemon (*Keckiella breviflora*), monkeyflower (*Mimulus* sp.), bird’s-foot fern (*Pellaea mucronata*), desert beeplant (*Scrophularia desertorum*) and Parish’s snowberry (*Symphoricarpos parishii*) (McNeal, 1987). Shevock and Ertter (1987a) also report Nine Mile Canyon phacelia (*Phacelia novenmillensis*) and large-fruited blue-eyed mary *(Collinsia callosa)* as associates on the west face.

On the east face of Spanish Needle Peak, Shevock reports occasional jeffrey, sugar, and pinyon pines as well as canyon live oak (Shevock et al., 1986b), indicating a very similar community to that on the west slope, but it remains extremely rocky and steep, and is less forested (Shevock, pers. comm., 1999). Other reported associates on this slope (Shevock et al., 1986a) include limestone mountain mahogany *(Cercocarpus intricatus)*, bush rock-spiraea *(Holodiscus dumosa*), beavertail cactus (*Opuntia basilaris)*, spreading phlox *(Phlox diffusa)* and limestone dudleya *(Dudleya calcicola*).

Slopes on the northwest face are moderately (20-45) to extremely (45) steep, and the plants are found at elevations from 5800-7500 ft. (1768 - 2287 m; Shevock, 1985a). In 1987, additional plants were discovered on the west face, extending the population at the type locality down the canyon to 5800 ft. (1768 m) elevation (Shevock and Ertter, 1987b). Because they occur continuously down the same canyon, the west face and northwest face occurrences are treated here as one site. McNeal stated that there were “several thousand” individuals total at the Spanish Needle Peak localities (McNeal, 1987, p.153).

On the east face, the CNDDB report describes the slopes as steep (CDFG 1986) but no quantitative measurements are given. No information about the steepness of the slope is given on the field survey form accompanying the report (Shevock et al., 1986b), so it is unclear where the CNDDB got this information. Less than 500 individuals occur on the east face of Spanish Needle Peak (Shevock et al, 1986b), at an elevation of 6600-7550 ft. (2012-2302 m). (There is a discrepancy between the elevations given in the CNDDB report and on the label of the specimen collected at this site. The report stated the elevation as 6600 ft., but the label indicates 7550 ft. Also, the CNDDB report states there are over 500 individuals present, but the Field Survey Form indicates there are less than 500.)

At Horse Canyon, the plants are reported (Hare, 1996) to occur in four small groups, at least two of which are on a rocky, east-facing slope at an elevation of ca. 4800 ft. (1463 m). Hare (pers. comm., 1997) reports that the plants occur in a narrow elevational range of approximately 50 feet, but the elevation indicated on the label of the specimen from this locality is 5100 ft. (1555 m) (Shevock #13254, CAS; B. Bartholomew, pers. comm., 1997) These inconsistent reports need to be clarified. Surrounding vegetation is sparse pinyon, juniper, and scrub oak woodland, on volcanic tuffs and agglomerates (Hare, 1996). Two groups of plants occur in a small wildflower field/meadow adjacent to ephemeral creeks on private land. The other two groups occur on a dry, stony, open slope on public land. The onion was collected in this area "on a grassy, rocky volcanic slope, with *Dudleya*.." (Shevock and Hare, 1996) Other associates of the Horse Canyon population include Palmer's mariposa lily (*Calochortus palmeri*), pale yellow layia (*Layia heterotricha*,) and Hansen's larkspur (*Delphinium hansenii*; Hare, 1996). Additional species in the same area include other mariposa lilies (*Calochortus* spp.),other species of onion (*Allium* spp.), phlox (*Phlox* sp.), Wright's buckwheat (*Eriogonum wrightii*), death camas (*Zigadenus* sp.), and needlegrass (*Stipa* sp.; Hare, pers. comm., 1997).

Currently, ten years after the plant was first described, there is still no information about seed production or dispersal, germination requirements and/or times, nor any information about pollination ecology, population ecology, mineral requirements, unusual tolerances, or genetics. There is, however, a small population of Spanish Needle onion growing in cultivation at East Bay Regional Parks Botanic Garden, Tilden Park, San Francisco. A few bulbs were taken to the Arboretum in 1987 (B. Ertter, pers. comm., 1997), and are reported to be doing well there, growing in well-drained, rocky soil in full sun. They have been blooming every year, and the number of individuals is slowly increasing (S. Edwards, pers. comm. 1997). Dr. Ertter at that time also gave a few bulbs to the botanic garden at the University of California in Berkeley, but it is her understanding that these bulbs died (Ertter, pers. comm. 1999).

Habitat Requirements:

Spanish Needle onion is a plant of high-elevation, rocky habitats. On Spanish Needle Peak, it occurs in soil pockets in dark-colored metamorphic outcrops and on steep talus slopes at 7216-7708 ft. (2200-2350 m). The bulbs mainly occur along margins of the outcrops where the slope is more stable (McNeal, 1987). The presence of associates like *Cercocarpus intricatus* and *Dudleya calcicola* implies the presence of carbonate rock in the area.

In Horse Canyon, the plants occur in a north-south line on a rocky, east-facing slope, where they occur about the base of scattered large rocks. The substrate here is primarily volcanic rock of pyroclastic origin, mainly tuffs and agglomerates (Hare, 1996).

Allium shevockii does not occur in areas where the dominant substrate is granitic, contrary to Shevock's note on the Field Survey form dated June 15, 1985, (Shevock, 1985a), the label of his specimen #11219 (Shevock 1985b), and the report by McNeal (1987) of the plant occurring on an igneous (aplite) intrusion at the type locality (J. Shevock, pers. comm., 1997).

Little is known about the requirements of this species at present. More research needs to be done to determine both the true extent of the species' range, and its habitat requirements.

Population Status:

After more than ten years of exploration, only one new occurrence of Spanish Needle Onion has been documented (i.e., the Horse Canyon population). Thus, it appears that *Allium shevockii* is a highly restricted and rare California endemic (J. Shevock, pers. comm. 1999).

Threats Analysis:

The only known threat to the Spanish Needle Peak population is maintenance on the Pacific Crest Trail. The population occurs completely within the Owens Peak Wilderness (J. Shevock, pers. comm., 1997), and the terrain is so rugged that there is no danger to the vast majority of the plants.

About half of the Horse Canyon population occurs on an island of public land, recently made a BLM Area of Critical Environmental Concern (ACEC), surrounded by private land. There is a small chance that an adjacent portion may be used for wind energy farms at some time in the future, but this has already been attempted and rejected, so is not likely to come up again soon (S. Hare, pers. comm., 1997).

Another possible, but at present unlikely, threat is from development on a nearby parcel that has been proposed and approved for subdivision. No development has occurred, however, and it seems unlikely that it will in the near future (S. Hare, pers. comm., 1997). If the development should occur, the presence of greater numbers of people in the area could lead to destruction or modification of habitat by greater numbers of off-road vehicles, hikers and equestrian groups, which constitute the majority of current uses in the area.

There is a possible threat of over-collection by bulb collectors, because the flowers of Spanish Needle onion are showy. However, the remoteness and ruggedness of the terrain make this potential problem very unlikely at the Spanish Needle Peak locality. It is somewhat more likely to occur at the Horse Canyon locality because of accessibility.

There is not enough information about Spanish Needle onion to determine whether existing regulatory mechanisms alone are adequate to protect the plant. However, the ruggedness and remoteness of the terrain in the Spanish Needle Peak area virtually assures protection for that population, regardless of any regulatory mechanisms.

As much as half of the Horse Canyon population occurs on a BLM Area of Critical Environmental Concern (ACEC). Here, on this island of public land surrounded by private land, the question of the adequacy of existing regulatory mechanisms will be tested. Presumably, the existing mechanisms for protection are adequate. At the least, they are (or should be) closely monitored for effectiveness, and could be modified quickly if it becomes necessary to provide more protection for the species.

Existing legal and regulatory mechanisms for protection of the portion of the population that occurs on private land are weak and therefore inadequate. The only requirement is that the species be “fully considered” during the CEQA process prior to any proposed development. There is no requirement for the project proponent to take any action to protect the species, and little anyone else can do if the proponent and/or the planning agency lack the inclination to protect the rare plants. As a result, the plants on private land are at a high risk of extirpation.

Some plants may be destroyed by natural earth movements on the steep slopes on which the species is found. A major rockslide could destroy a large number of the plants in an area, and a large earthquake could trigger devastating rockslides. The species has survived a number of large seismic events in the past, (e.g., the earthquake of 1857), so it is unlikely that such an event would extirpate the entire population. However, it could cause reductions in the numbers of individuals so severe that the species might then succumb to stochastic events, to which it is vulnerable due to its restricted distribution and limited number of populations. Any type of blasting or large-scale earth movement in the area by man could have the same effect. Although this type of activity is very unlikely to occur at Spanish Needle Peak, because of the terrain and the wilderness status of the area, it is much more likely to occur at the Horse Canyon site because of its greater accessibility.

Biological Standards:

At the present, very little is known about requirements for the species' survival. Even the number of existing populations is uncertain. As noted above, in over ten years of explorations, only two localities supporting populations of this species have been discovered. Continuing systematic surveys for other populations will help to answer questions, and will contribute additional information about the species biological requirements.

A small percentage of the population at Spanish Needle Peak may be impacted by periodic maintenance work on the Pacific Crest Trail, which cuts through the lower portion of the population. This threat can be minimized by performing work carefully.

The threats of habitat destruction, trampling, over-collecting, etc, stemming from possible development on the parcel near the Horse Canyon site, could be minimized by fencing, or by other management techniques.

The ACEC on which a portion of the Horse Canyon population occurs, was created for paleontological and archeological resources. The BLM could add botanical resources to the reasons for the ACEC existence; this would increase awareness of the potential vulnerability of the plants, and perhaps lessen bureaucratic delays should more protection for them suddenly become necessary (e.g., if the approved development in the area should suddenly begin, or there was an increase in off-road traffic through the area).

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SWEET-SMELLING MONARDELLA
Monardella beneolens

Author: Mark Elvin, 3143 Avenida Olmeda, Carlsbad, CA 92009

Management Status: Federal: BLM Sensitive
California: S1.3, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code of 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Only three highly restricted populations of sweet-smelling monardella are known. All three occur along the crest of the southern Sierra Nevada in Kern, Inyo, and Tulare counties: Owens Peak on BLM managed land, Olancha Peak on USFS managed land, and Cottonwood Creek on BLM managed land (Shevock et al., 1989).

Distribution in the West Mojave Planning Area:

As noted above, two of the three known populations are on BLM managed lands at the western edge of the WMPA.

Natural History:

Sweet-smelling monardella (n=21) is a matted, loosely rhizomatous herbaceous perennial in the mint family (Lamiaceae). It's leaves and stems are covered with a mixture of fine glandular and spreading non-glandular hairs. The stems are up to 12 in. (30 cm) high and decumbent to erect, or sometimes branched. The 5-13 pairs of leaves on each stem are short petioled to nearly sessile. The ovate to narrowly triangular blades are densely hairy above and below and have undulating margins. The verticillasters (flower heads) are solitary, rarely occurring in whorls, or a panicle (Jokerst, 1993). The flowers are lavender to pale rose and bloom from July to September.

The matted habit and undulating leaves distinguish this species from other *Monardella* in the area. It appears to be most closely related to gray monardella (*M. cinera)*, endemic to the San Gabriel Mountains, and Arizona monardella (*M. arizonica)*, endemic to Arizona desert ranges; but also shares similarities with two coastal dune species, crisp monardella (*M. crispa*) and San Luis Obispo monardella (*M. undulata* var. *frutescens* [=*M. frutescens*]), and two other geographically restricted species, Robison's monardella (*M. robisonii*) and Stebbins' monardella (*M. stebbinsii*) (Shevock *et al*., 1989; Hardham and Bartel, 1990). This species was first described in 1989 from a collection made at Olancha Peak in 1986. Subsequent searches of herbaria yielded unidentified/misidentified material of this species dating back to 1896 that had been collected from the known locations (Shevock et al., 1989).

The biology of this species is little-studied, but certain inferences can be drawn from the morphology of the plant. It appears from Figure 1 in Shevock et al. (1989) that the number of flowers per verticillaster can vary from 5-20 or more. The figure also indicates that there are 4 ovules per flower, as with other *Monardella*, for a maximum of four nutlets per flower. Seed production is thus about 20-80 seeds per verticillaster, but the number of verticillasters produced per plant in a year doubtless varies greatly between years and plants. There is no information on pollinators, seed dispersal mechanisms, or whether sexual reproduction is even important for the sweet-smelling monardella. If pollination occurs, the typical *Monardella* pollinators, butterflies and bee-flies, may be the vectors.

Habitat Requirements:

This plant is found only in granitic soils on the slopes of subalpine coniferous forests/woodlands and alpine boulder and rock fields 8,200 to 11,000 ft. (2500 to 3500 m). It occurs near the summits "...on rocky granitic or metamorphic slopes...where rooting substrate consists of rocky scree..." (Shevock, et al., 1989). The terrain in these areas is very dry and "...extremely rugged, with steep terrain rising from the desert floor" (Shevock, et al., 1989). Figures in Shevock (1988) indicate that plants occur in full sun to partial shade, in areas with perhaps 5-30% total vegetation cover. The paratypes were taken from areas with west, south and east exposures (Shevock, et al., 1989). There are few associated species that occur with each of the populations. Each of the individual sites, however, does contain "...a surprisingly high concentration of rare localized southern Sierra Nevada endemics" (Shevock et al., 1989), such as Olancha Peak buckwheat (*Eriogonum wrightii* var. *olanchense)*, DeDecker's clover (*Trifolium macilentum* var. *dedeckerae)*, Owens Peak lomatium (*Lomatium shevockii)*, and Gilman's goldenbush (*Ericameria gilmanii)*, but no one associate occurs at all of the sweet-smelling monardella occurrences.

Population Status:

Sweet-smelling monardella is a very localized endemic restricted to just the three known populations mentioned above, but occurs in places far from the sorts of activities that typically pose threats to plant populations. In addition, it is anticipated that more populations will be discovered as surveys of the rugged, isolated crest of the southern Sierra Nevada continue (Shevock, et al., 1989).

There is no information on the population sizes of this plant (CDFG, 1997) and such information would be very difficult to obtain given the plants clonal nature and matted habit, with much reproduction being vegetative (Shevock; pers. comm., 1997). Distinguishing one individual from another except by electrophoresis, or other laboratory methods, may not be possible.

Threats Analysis:

No immediate threats to this species are listed with the California Natural Diversity Data Base (CDFG, 1997), and long-term threats are not obvious. Because all three populations occur on remote federal lands, there are no known threats to the habitat or range of the species caused by urban or private development or road maintenance. The rugged terrain and limited access to the occupied sites almost eliminates the potential threats from off highway vehicles. There are no known threats from mineral exploration and development, animal grazing, or water developments and impoundments.

There are no known threats from disease or predation, but these issues have not been studied. The greatest threat to this species is apparently its vulnerability to stochastic extinction events because only three distinct, highly restricted and small populations apparently exist (CDFG, 1997).

Genetic swamping is a potential threat from apparent hybridization with *M. linoides* ssp. *linoides* and *M. odoratissima* ssp. *pallida* (Shevock, et al., 1989). Hybridization is probably only a threat if it is being caused by some recent human disturbance of the habitat and not if it is due to naturally occurring conditions. If the species have been in contact for hundreds of years, or millennia, but have maintained their distinctness under natural conditions, then there is no reason to anticipate that sweet-smelling monardella will be genetically swamped by it's congeners in the foreseeable future.

There are currently no existing regulatory mechanisms protecting the sweet-smelling monardella. It has not been afforded protection under state or federal laws. However, all of the known populations are on federal lands and thus receive a degree of protection not afforded plants on private lands.

Biological Standards:

The most important consideration in attempting to maintain the long term viability and evolutionary potential of sweet-smelling monardella is to protect the known population sites and the areas supporting potential habitat from whatever future threats may arise. The immediate prerequisite for the effective management of this species is the comprehensive survey of all potential habitat areas to determine its precise status and distribution. While it is anticipated that more populations will be discovered as surveys of the southern Sierra Nevada continue (Shevock, et al., 1989), whether that is true will only be known after such surveys have actually been conducted. It is entirely possible (though unlikely) that, contrary to expectations, we presently know every existing population of the species. Until the distribution and ecology of this species are better understood, we must assume that the total extent of this species is these three populations, and formulate management plans accordingly.

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TRIPLE-RIBBED MILKVETCH
Astragalus tricarinatus Gray

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Management Status: Federal: Endangered (listed October 6, 1998)
California: S1.2, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-1-3 (Skinner and Pavlik, 1994)

General Distribution:

Triple-ribbed milkvetch is endemic to California and is restricted to the dry slopes and canyons around the head of the Coachella Valley (Spellenberg, 1993; Munz, 1974; Barneby, 1964). It is primarily known from the vicinity of Whitewater Canyon (the type locality) and from Dry Morongo Canyon along Hwy. 62, as well as from scattered occurrences farther east in the Little San Bernardino Mountains, including an anomalous, relatively high elevation, site at Key's Ranch in Joshua Tree National Park (JTNP). Relatively recently, the species has been collected in the Martinez Canyon area in the Santa Rosa Mountains on the SW side of the Coachella Valley (*J. Stewart 8507, 16 March 1985*, UCR). This collection suggests the possibility that this plant also occurs in the rugged canyons of the San Jacinto and Santa Rosa Mountains between Whitewater Canyon and Martinez Canyon. However, extensive botanical survey of the Deep Canyon watershed above Palm Desert in the Santa Rosa Mountains has not revealed the species (Zabriskie, 1979).

There is one uncertain location that cannot be found on current maps. The problem is a collection in the Pomona College Herbarium (POM) with the following label data: "29 Palms Canyon, 1300 ft., *Hulda Crooks 352*, 15 April 1946". This probably refers to the vicinity of the mouth of Dry Morongo Canyon as the elevation is about right and the highway to Twentynine Palms from the coast (Crooks was a Loma Linda resident) passes through this canyon. It is possible that some people called this canyon leading to Twentynine Palms by the name used by Crooks. It is also remotely possible, however, that "29 Palms Canyon" was used to refer to a canyon closer to the town of Twentynine Palms and hence closer to the anomalous Key's Ranch locality. For example, this could have been an error based on Fortynine Palms Canyon. Strong evidence against this possibility is the given elevation of 1300 ft. (400 m), which is several hundred to more than a thousand feet lower than any possible site near Twentynine Palms. The city itself is at 2000 ft. (610 m) and all the canyons are in the mountains above that.

Distribution in the West Mojave Planning Area:

Most of the populations of this species appear to be just south of the WMPA boundary in the eastern end of the San Bernardino Mountains and at the western end of the Little San Bernardino Mountains, but some populations do occur at three locations in the WMPA: Little San Bernardino Mountains in JTNP (perhaps at Key's Ranch only), Big Morongo Canyon at the Riverside/San Bernardino counties line (several collections and observations), and in Dry Morongo Canyon just N of the San Bernardino County line (several collections). Much of the suitable habitat along the southern margin of the WMPA is rugged and poorly explored and so it is possible that additional populations occur within the planning area in the upper reaches of Mission, Dry Morongo and Big Morongo Creeks, as well as in the western lobe of JTNP.

Natural History:

Triple-ribbed milkvetch is a somewhat bushy herb, generally described as a perennial, but apparently more commonly behaving as an annual. At best, it is a short-lived perennial persisting for about 3-5 years.

Mature plants are usually 12-20 in. (30-50 cm) tall and the stems are erect or ascending. Older perennating plants show a somewhat woody lower stem and tap root. The leaves are ca. 6-8 in. (15-20 cm) long and are markedly bicolored with the lower leaflet surfaces green and the upper surfaces distinctly whitened by dense, flattened, appressed hairs ca. 0.012 in. (0.3 mm) long. The leaflets vary from 0.1-0.56 in. (4-14 mm) long and from 0.1-0.26 in. (2.5 -6.5 mm) broad and are elliptical or ovate (larger leaflets) to almost circular (smaller leaflets) in outline. They typically number between 15 and 31 per leaf. Leaflet tips are commonly slightly notched (emarginate). The leaflets are quickly deciduous, but the petioles and rachis are persistent on the plant; on older plants the old leaf bases from last year generally clothe the bases of the stems bearing the leaves of the current year.

The erect racemose inflorescence bears 10-15 widely spaced flowers, which are ochroleucous to light yellow and dry to a light brown. The inflorescence is ca. 8-14 in. (20-35 cm) long. The pedicels are 0.08-0.12 in. (2-3 mm) long in flower and elongate to ca. 0.16 in. (4 mm) in fruits. Based on specimen records, the species flowers from 12 Feb. through 6 April, but the true range doubtless extends a few days beyond these dates. The flowers are ca. 0.5 in. (12 mm) long and the banner and wings are about equal in length. The calyx is ca. 0.25 in. (6 mm) long and about half of that length consists of the slender lobes. The hairs on the calyx are generally like those of the leaves and stems, but are generally dark brown in color, rather than whitish. A small percentage of them are the same color as the leaf hairs. The hairs of the supporting pedicel are the same color as those of the calyx. The hairs of the stem are like those of the leaves, but are sparse and so the stems appear green.

Fruits appear as early as mid March and are present until at least early May. The pods are sharply triangular in cross section, and seem tardily dehiscent; they appear, in fact, to open only toward the tip (distal end) and perhaps the seeds are shaken out gradually by wind or other disturbance after the pods have dried. The pods are 1-1.5 in./mostly 1.2-1.4 in. (25-38/mostly 30-35 mm) long and 0.16-0.2 in. (4-5 mm) broad. Shape varies from almost straight to moderately curved with the dorsal suture on the inside of the curve. The pod walls are tough and leathery and the dorsal suture forms a tough cord-like ridge, while the lower suture is inconspicuous except that it folds inward to form a partition that divides the pod into two longitudinal cells. The base of the pod narrows to a short stipe ca. 0.8-0.12 in. (2-3 mm) long. The seeds are brown, smooth, flattened and rounded-triangular in outline, except for a deep notch at the hylum. There are ca. 25-30 ovules in a typical well-formed ovary (12-15 per cell), but the number that typically mature into seeds is unknown. The pod is similar to that of Morongo milkvetch

(*A. bernardinus*) which occurs in the same general region, but apparently not in the same habitats.

The above description is largely drawn from herbarium specimens and hence is modified from the major published sources (Spellenberg, 1993; Isely, 1986; Barneby, 1964). There has been periodic confusion of this species with *A. bernardinus* Jones (e.g., UC SMASCH database, 1998; Jepson, 1936), and occasionally with other species, making the above amplified description seem warranted.

Triple-ribbed milkvetch appears most closely related to *A. bernardinus* , the only other member of Subsect. Tricarinati (Barneby, 1964), but has been confused (based only on flower similarity) with *A. pachypus* Greene and thus mistakenly reported from the south end of the San Joaquin Valley in Kern Co. (but, see: Barneby, 1964). It may in fact be related to both bush milkvetch (*A. pachypus*) and to the locally endemic Lane Mountain milkvetch (*A. jaegerianus* Munz), of the central Mojave Desert, though it placed in a different Subsection (Barneby, 1964).

Pollinators, germination requirements, seed longevity, and most other aspects of the biology of this species are unknown. The color and form of the flowers suggest that this species may be bee pollinated, as many legumes are, but this appears never to have been observed.

Habitat Requirements:

Triple-ribbed milkvetch is known to be restricted to sandy or gravelly soils in arid canyons at the edge of the desert, but otherwise its habitat requirements are very poorly described. Plants are most commonly found along washes on canyon bottoms and on the alluvial fans below, or as small populations or solitary individuals on decomposed granite slopes in canyons. It appears that no well-established permanent population of any size has ever been found. The largest population recorded was a transitory one on the bottom of Big Morongo Canyon. This numbered ca. 120 individuals in 1991 but had shrunk to a more normal 6-8 by 1997 (G. Helmkamp, pers. comm., 1997). All populations found to date appear marginal or transitory. The species appears to require open soil and is somewhat tolerant of, or may even require, soil disturbance, either natural or man made. It may benefit by the open loose soils left by flooding or construction activities. Labels variously record the habitat as: “gravelly S-slope”, “sandy moist wash”, “desert wash”, “dry sandy wash”, “wash edge at base of hill” and “roadside on canyon bottom”. It is apparent that this species is most commonly collected along washes and on canyon bottoms, but whether this represents the preferred habitat of the species or is simply the place that people collect, and hence find waifs, is yet to be determined. Given the small size of most populations and the instability of the habitats occupied, it is difficult to see how this species can maintain itself if washes truly are its main habitat. With every flood, seeds and plants will be destroyed or washed downstream out of the habitat area. If there is not a substantial population, some of which will escape destruction, or a permanent population in areas not subject to scouring, it is difficult to see how a scarce fugitive can maintain itself at all. Seed longevity should be investigated to determine if seeds are able to survive prolonged burial in sand following a flood so that they might wait for many years until another flood again exposes them and makes open habitat available. There is a great need for careful and thorough surveys of the slopes above the washes where this species is usually found. If there are no “permanent” populations found there, then it should be concluded that this species is in fact a wash inhabitant and that the plants are few in number and their status precarious indeed.

Populations occur at elevations between 1300 and 4000 ft. (400-1220 m) but, except for the one site at Key’s Ranch, all are below 2000 ft. (610 m). There are many collections at 1500-1800 ft. (450-550 m), and that may be the preferred elevation range of the species. In Big Morongo Canyon, the species occurs in the middle part of the canyon, near the county line, but is rarely or never found above or below this area. The plants there are mostly found on the canyon bottom at the place where a large tributary from the east joins the canyon -- the drainage of this tributary should be searched to determine whether seeds are being carried down into Morongo Canyon from populations above.

Population Status:

Triple-ribbed milkvetch is known from scattered populations, but the factors that control the distribution and size of these populations are not understood. Known populations are few, small and highly unstable. Plants can flower the first year from seed and resulting populations are very unstable, behaving like annuals and shrinking and growing rapidly in response to rainfall and other environmental conditions. During some seasons, the species is difficult to find, while in other years it may be relatively common at some sites. At the Big Morongo Canyon site, where the species can usually be found, populations have varied from 6-120 individuals over just 6 years (G. Helmkamp, pers. comm.). The year (ca. 1991) when then were 120 was a season following heavy rains when the bottom of the canyon was scoured by floods and the plants appeared on the open canyon bottom. The plants did not persist and such numbers have not appeared in the years since, nor had so many been seen at that locality previously (G. Helmkamp, pers. comm.).

If the species is in fact largely restricted to canyon bottoms and wash margins, then it is an extremely rare species and somewhat vulnerable as a result. Even at two of the localities where it has been most regularly collected, Dry Morongo Canyon and Whitewater Canyon, the plants are extremely scarce and difficult to find. The only place where plants can be found with any regularity is in the middle stretch of Big Morongo Canyon, and even there the plants are few in most years. Generally only a handful of individuals can be found. Since habitat modification within its range has not been extensive, is does not appear likely that human activity has been a significant factor in its present scarcity. It is probable that some individuals were eliminated, along with some habitat, when the highway up Dry Morongo Canyon was constructed. Since that time, however, the highway has probably had only a minimal impact on remaining plants.

The Key’s Ranch area was visited in November of 1997 and no plants of this species were found in the area, despite extensive searching both there and in the nearby Barker Dam area. If the species is still present within that area of JTNP, it must be extremely rare.

Threats Analysis:

Current threats to this species do not appear serious, but are not well documented because the species has never been intensively studied and often cannot be found when sought. It is fortunate that much of the area occupied is extremely rugged and not subject to much development pressure. If the species is restricted to wash margins, then there is some magnitude of a threat to the species by off highway vehicles, which typically use such washes as access routes in rugged landscapes. There is no significant grazing in the areas occupied, so that is not a threat. In addition, the palatability or possible toxicity of this species appears unknown, though some milkvetches are known to be toxic to livestock (Barneby, 1989). There is some disturbance due to pipeline construction or maintenance, but this is a mixed effect. Some individuals have been destroyed by the maintenance of the pipeline road down Morongo Canyon, but about 6 others appeared on soil freshly disturbed by pipeline construction there (G. Helmkamp, pers. comm., 1997). There is no significant mining activity within the range of the species, but there is a substantial amount of potentially minable gravel in Whitewater Canyon, and the threat of future mining thus exists. There is a small amount of scattered rural residential housing construction in the Morongo Valley area, but this is mostly on ridge and hilltops, and so until it has been demonstrated that this species occurs in those areas, any threats from these activities will remain indirect or theoretical. Road widening along Hwy. 62 could pose a future threat to the population in Dry Morongo Canyon, but such a threat does dot appear imminent.

Biological Standards:

The important issues in the maintenance of this species are poorly understood. The range is not well defined and areas of major populations have not been clearly identified. It appears that the one site where the species is more or less continuously present, if only in small numbers, is Big Morongo Canyon. This is one of the most regularly visited sites within the range of the species, because of the presence of the Big Morongo Preserve at the head of the canyon, and hence observations there are expected to be more frequent, even if populations are equivalent to other sites. The immediate need is for extensive surveys throughout the range of the species that clearly delimit the extent and size of populations, as well as the habitat preferences of the species. Obviously, any projects within the general range of the species (e.g., road widening in Dry Morongo Canyon) should be preceded by careful and thorough surveys of the affected areas for the presence of this species in the areas to be disturbed.

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WHITE-MARGINED BEARDTONGUE

Penstemon albomarginatus M.E. Jones

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Management Status: Federal: USFWS Species of Concern
California: S1.2, G2 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-2-2 (Skinner and Pavlik, 1994)

General Distribution:

White-margined beardtongue occurs in southern Nevada, western Arizona, and in the western Mojave Desert in San Bernardino County, California. It distribution in the western Mojave is restricted, occurring in a large four-mile long wash near Pisgah Crater and Lavic Lake, extending southwest from Sleeping Beauty Peak, crossing Interstate 40, and terminating in a flat spreading basin south of the freeway (CDFG, 1997b; Scogin, 1989). Plants are also found in another wash extending south southeast from the same peak for a shorter distance, not all the way to Interstate 40 at Argos, and at Lavic, north of Lavic Lake along Lavic Road (CDFG, 1997b). In western Arizona it is scattered over a plain that extends westward from the Hualapai Mountains, covering an area of approximately 100 square miles between Yucca and Dutch Flat (Button, 1991; Kearney and Peebles, 1964). There are also fifteen populations in southern Nevada, twelve from Clark County and three from Nye County.

Distribution in the West Mojave Planning Area:

All of the California occurrences described above occur within the WMPA.

Natural History:

White-margined beardtongue is an herbaceous perennial plant in the figwort family (Scrophulariaceae). The stems arise from a 12-48 in (30-120 cm) long taproot that is sunk deep in sandy soil, with the crown just above soil level. Stems reach heights of 6-12 in. (1.5-3 cm), are glaucous and glabrous, and bear entire spatulate leaves that are 0.4-1.2 in. (1-3 cm) long. These petioled, glossy, green leaves have entire margins, which are white and scarious, giving this plant its name of "white-margined" beardtongue. Flower calyces are also white-margined with narrow lance-shaped lobes, and are 0.1-0.2 in. (3-5 mm) long. The corolla is pink to lavender or white, tubular with spreading lobes, and glaucous except the hairy floor. The anthers are spread flat, and the staminode is glabrous (Hickman, 1993; Munz, 1974).

Flowers bloom from March to May (Munz, 1974), and the flowering does not always appear to be dependent on amount of rainfall. It is believed that established plants may bloom even in very dry years by utilizing water and food resources in the large taproot (Scogin, 1989). However, rainfall probably affects seedling germination and survival (Scogin, 1989), and in the California population, seedlings are more numerous south of the Interstate 40 where they most likely receive more accumulated rainfall runoff (Scogin, 1989). The showy flowers are visited by several insects, including small carabid beetles, large flies, and vespid wasps with orange abdomens. Pollen was observed on upper body surfaces of the vespids, making them the most likely pollinator (Scogin, 1989). An attempt was made to determine self-compatibility in this species by exclusion of insect vectors with wire mesh, but the mesh was removed during the study, and no conclusions could be drawn. Observations of very isolated plants that set seed suggests self-compatibility, and the pollen-ovule ratio approaches that of many facultatively out-crossing species (Scogin, 1989). The absence of this species in other drainages nearby might suggest that the seeds are not dispersed long distances, but more likely may be due to the fact that suitable stabilized deep sand habitat is not available at these other sites. The small seeds could possibly be scattered short distances by ants or rodents, or may get transported down the wash by water in very wet years. The tendency for plants to occur in scattered groups of up to 20 individuals, and the fact that young cuttings have been shown to produce adventitious roots in experiments at Rancho Santa Ana Botanic Garden (Scogin, 1989) suggest that vegetative reproduction may occur in this species in its natural habitat, even though attempts to propagate from cuttings at the garden failed (Scogin 1989). Genetic studies of clusters in the field could determine if each group was clonal.

Habitat Requirements:

In California, this plant occurs in fine alluvial sand in a wide canyon within a creosote bush scrub community . The sand is deep and stabilized, holding the long taproot in place. It is also present in wind-blown sand at the head of the canyon. It occurs at elevations from 2000-3000 ft. (700-1000 m.) in alkaline soil (Scogin, 1989). In Nevada, the plants prefer the base of hills and mountains in wind-blown sand dune-like areas, but are also found in deep loose sand in wash bottoms. In Arizona, it occurs in sandy loam uplands and sandy washes in a broad alluvial plain, but gravelly areas alternating with and interspersed with the sandy places do not support this species.

Population Status:

The location in California near Pisgah Crater probably constitutes a single extended population consisting of more than 450 plants spread out along a four mile long wash and sandy basin (Scogin, 1989). Population estimates are not available for the population at Lavic. In 1993, Bransfield and Rutherford found at least 200 plants along benches and terraces adjacent to the easternmost drainage in which plants were previously found. These plants also inhabited wind-blown sand deposits at the base of Sleeping Beauty Peak. It is unclear if Bransfield's and Rutherford's survey extends to the north the range previously recorded for this drainage. Arizona's population of white-margined beardtongue is the largest population known, but no total population estimate is available. It lies within a 100 mi^2 alluvial valley west of the Hualapai Mountains. The upper reaches of this valley with highest white-margined beardtongue densities are being purchased by the Bureau of Land Management. Nevada has twelve recently-discovered population in addition to the three that were previously known. Many of these populations have thousands of plants.

Threats Analysis:

In California, a freeway, a powerline, and three pipelines cross the wash in which the white-margined beardtongue occurs. Numerous utility access roads provide a means by which off highway vehicle (OHV) enthusiasts could get their vehicles into the wash. An established plant may survive occasional damage by tires due to the ability to resprout from the taproot (Scogin 1989). However, churning motions from tires could uproot the taproot (Scogin 1989), and it is possible that frequent damage or crushing of above-ground parts could soon use up the reserves in the taproot. It is also likely that seedlings and young plants in loose sand could be completely destroyed by tires. The remote location of the population and the scattered nature of the plants limits the amount of damage from OHVs at present, so it appears that white-margined beardtongue will not likely be extirpated from this area by recreational human activities in the near future. However, with increasing population growth in urban areas, off-road enthusiasts are traveling farther to find recreational opportunities in less crowded areas, so management steps must be taken to limit access to white-margined beardtongue habitat. The Mannix tank trail is in use as a corridor for the purpose of tank maneuvering between Twentynine Palms and Fort Irwin military bases (K. Waln, pers. comm., 1997). It runs from Mannix to Hector, and currently does not overlap with the range of this species. However, military units have been observed camping in areas where this species occurs, outside of the military base boundary, and military-issue debris has been observed in the area (Lands and Renewable Resources, 1988). There are currently some mining claims within the species' range, so the plant could have localized disruptions from future mining activities. It has been suggested that these plants might have potential for horticultural production (Button, 1991), but attempts to propagate them from cuttings have been unsuccessful, as have attempts at transplantation (Scogin, 1989). The Bureau of Land Management is attempting to acquire white-margined beardtongue habitat in Arizona. Currently the species' range is a checkerboard of BLM managed land, and land owned by a railroad. The land acquisition plan will allow the BLM to control fewer acres of total white-margined beardtongue habitat, but there will be an increase in the total acreage of BLM controlled habitat with high densities of this species. This area will be fenced to discourage vehicular travel and prevent habitat damage. The lower density habitat will then be in private hands, and will be sold as large rural residential lots. Button (1991) notes that white-margined beardtongue in Arizona readily colonizes areas within its habitat that were previously disturbed but where there is now limited vehicular use, such as pipeline routes. Grazing probably does not impact this species much, since it is found growing next to stock tanks in Arizona. The Nevada populations are mostly in Clark County, clustered near Las Vegas. The human population in Las Vegas is increasing dramatically, so there will probably be increased impacts to the white-margined beardtongue from people seeking outdoor recreational opportunities away from the city.

Biological Standards:

The most important management step that must be taken to insure continued survival of the WMPA population is active management of OHV usage. Recreational and military vehicular access to the wash and sandy basin should be severely restricted.

Constant vehicular travel by OHVs and tanks would most certainly uproot and destroy the plants. Scogin (1989) indicates that there is a parking area off the Interstate 40 frontage road that is heavily used by recreationists and possibly military vehicles. This area has the highest density of white-margined beard-tongue, and he suggests that a barrier be erected there to prevent access.

Monitoring of populations, including seed set, seedling counts, and flowering effort by established plants every year or two will help to indicate population health and fluctuation, establish the importance of effects of weather conditions on population size, and may help indicate if management strategies are successful. More propagation studies should be carried out to determine if seedlings, cuttings, or transplanted plants could be used for mitigation efforts.

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