GENERAL RARE PLANT SURVEY GUIDELINES

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All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the California Native Plant Society (2001). Some of the requirements specified in the standardized guidelines are that surveys must be conducted during the appropriate season and be floristic in nature. Thus, surveys should not target a single species but should aim to identify any and all rare species and rare plant communities in the area. The guidelines also provide information on selecting a qualified botanist and providing appropriate documentation of surveys. Additional considerations for conducting rare plant surveys are described by Nelson (1987). Permission of the landowner or land-management agency is required for both site access and plant collection. In addition, federal and/or state permits are necessary to collect specimens of plants listed as endangered, threatened, or rare.

The species-specific methods presented below are intended as a supplement to the basic guidelines. They describe the conditions under which the potential for discovering each listed plant species in the survey area will be maximized. Multiple visits to a site may be necessary to ensure that survey conditions have been appropriate for all potentially-occurring rare plant species.

Certain methods are common to all of the following species-specific survey guidelines; similar methods may be employed for species not covered herein. In the southern San Joaquin Valley, many of the listed plants are small and easily obscured by dense vegetation. Thus intensive, systematic surveys are recommended to detect rare plant species in this region. Biologists should walk parallel transects spaced 5 to 10 meters (16 to 33 feet) apart throughout the entire site, regardless of subjective habitat evaluations. Transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen the target species growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys. Project-area surveys are valid only for those species that are evident during the survey period. Prior to conducting surveys in a given year, at least one member of the survey crew should visit known populations of the target species that occur in areas similar in elevation, latitude, vegetation, and topography to the survey area. Such visits will determine whether precipitation has been adequate for germination and growth, as well as confirm current phenology of the target species. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of the target

species at that time, plus the date of the survey, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines. Information on the locations of known populations may be obtained from agency biologists, the California Natural Diversity Data Base, or local chapters of the California Native Plant Society (see below). The current status and abundance of any known populations visited as well as any new populations discovered also should be reported to the California Natural Diversity Data Base.

Surveys can confirm the presence of rare plants on a site, but negative results do not guarantee that rare plant species are absent. However, for practical purposes, surveys that adhere to the attached species-specific guidelines provide reasonable evidence that the specified plant taxa do not occur in the survey area. Surveys that employ methods or timing other than those recommended herein may be used as evidence of the presence (but not absence) of rare plant species.

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SUPPLEMENTAL SURVEY METHODS FOR SAN JOAQUIN WOOLLY-THREADS

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Literature review

San Joaquin woolly-threads [*Monolopia congdonii* (Gray) B.G. Baldwin] is an annual herb of the aster family (Asteraceae). When first described (Gray 1883), this species was included in the genus *Eatonella*; Greene (1897) later transferred it to *Lembertia.* The name *Lembertia congdonii* (Gray) Greene was in use for many years, but a recent revision based on phylogeny (Baldwin 1999) changed the scientific name to *Monolopia congdonii* (Gray) B.G. Baldwin. San Joaquin woolly-threads is federally listed as an endangered species (U.S. Fish and Wildlife Service 1990).

The plant size and habit of San Joaquin woolly-threads are influenced by associated vegetation. On sparsely-vegetated sites, individuals generally are 2 to 7 centimeters (0.8 to 2.8 inches) tall, erect, and single-stemmed, whereas individuals in tall, dense vegetation may have many decumbent stems up to 45 centimeters (17.7 inches) long (Cypher 1994). In years of below-average precipitation, few seeds of San Joaquin woolly-threads germinate (Twisselmann 1967, Taylor 1989), and those that do typically produce tiny plants (E. Cypher personal observation). Phenology also varies with location and weather conditions. Seed germination may begin as early as November (Taylor 1989) but usually occurs in December and January (Lewis 1993, E. Cypher unpublished data). San Joaquin woolly-threads typically flowers between late February and early April (Taylor 1989), but flowering may continue into early May if conditions are optimal (B. Delgado personal communication). Populations in the northern part of the range flower earlier than those on the Carrizo Plain (Mazer and Hendrickson 1993, Cypher 1994). Small, vegetative individuals closely resemble *Eriogonum* species, but flowering individuals are readily distinguishable (E. Cypher personal observation).

The historical range of this species included Fresno, Kern, Kings, San Benito, San Luis Obispo, Santa Barbara, and Tulare Counties (Taylor 1989, Tibor 2001). San Joaquin woolly-threads occurs in a number of the plant communities described by Holland (1986), including Non-native Grassland, Valley Saltbush Scrub, Interior Coast Range Saltbush Scrub, and Upper Sonoran Subshrub Scrub (Cypher 1994). However, this species typically occupies portions of the habitat with less than 10% shrub cover and may occur in association with cryptogamic crust (Taylor 1989, Cypher 1994). Occurrences have been reported at elevations ranging from as low as 60 m (190 feet) on the San Joaquin Valley floor up to 838 meters (2,750 feet) in the Inner Coast Ranges of San Luis Obispo and Santa Barbara counties (Lewis 1993, California Natural Diversity Data Base 2002).

San Joaquin woolly-threads occurs on soils of alluvial origin that are neutral to subalkaline (Taylor 1989, Lewis 1993). On the San Joaquin Valley floor, this species typically is found on sandy or sandy loam soils, particularly those of the Kimberlina series (Taylor 1989, Taylor and Buck 1993), whereas on the Carrizo Plain it occurs on silty soils (Lewis 1993). San Joaquin woolly-threads frequently occurs on sand dunes and sand ridges (Taylor 1989, California Natural Diversity Data Base 2002) as well as along the high-water line of washes and on adjacent terraces (Lewis 1993, E. Cypher personal observation). Populations of this species have been documented in previously cultivated lands, heavily grazed pastures, and remnant habitat in oil fields (Taylor 1989, Lewis 1993, Taylor and Buck 1993).

Survey guidelines

All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the Califomia Native Plant Society (2001). The species-specific methods presented below are intended as a supplement to those standardized guidelines.

Systematic surveys are recommended to detect presence and determine distribution of San Joaquin woolly-threads within the survey area. For systematic searches, biologists should walk parallel transects spaced 5 to 10 meters (16 to 33 feet) apart throughout the entire site, regardless of subjective habitat evaluations. However, transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen San Joaquin woolly-threads growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys.

Prior to beginning surveys in a given year, at least one member of the survey crew should visit one or more known locations of San Joaquin woolly-threads to verify that precipitation has been adequate for germination and to determine current phenology. The known locations should be as similar as possible to the survey area in elevation, habitat, and topography. Species-specific surveys should not be attempted if San Joaquin woolly-threads is not seen at known locations, the densities are very low relative to normal years, or the plants are inconspicuous. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of San Joaquin woolly-threads at that time, plus the date of the survey, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines. The typical survey period for San Joaquin woolly-threads is March and April.

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SUPPLEMENTAL SURVEY METHODS FOR KERN MALLOW

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Literature review

The taxonomy of Kern mallow (*Eremalche kernensis* C.B. Wolf) is somewhat controversial. At issue are the taxonomic rank and the circumscription of Kern mallow in relation to Parry's mallow [*Eremalche parryi* (Greene) Greene]. Kern mallow was first described as *Eremalche kernensis* (Wolf 1938) but also has been included in the genus *Malvastrum* (Munz and Keck 1959). The most recently-published treatments of this complex (Bates 1992, Bates 1993) assign Kern mallow the name *Eremalche parryi* (Greene) Greene ssp. *kernensis* (Wolf) Bates, and Parry's mallow the name *E. parryi* ssp. *parryi*. Other combinations have been suggested (Leonelli 1986) but have not been validly published. After consultation with species experts, the U.S. Fish and Wildlife Service made the decision to continue using the original name and circumscription for Kern mallow (Medlin in litt. 1995). Kern mallow is federally listed as endangered (U.S. Fish and Wildlife Service 1990). In terms of status, its rank is irrelevant because subspecies also are protected under the federal Endangered Species Act (U.S. Fish and Wildlife Service 1992). Throughout this document, "Kern mallow" refers to *Eremalche kernensis* in the strict sense.

The circumscription debate centers around the gender, size, and color of flowers to be included in each taxon. Certain populations in the Kern/Parry's mallow complex exhibit a condition known as gynodioecy, meaning that some of the plants have only bisexual flowers and other plants in the same population have only pistillate flowers. Bisexual flowers have both male and female parts; these flowers also are known as perfect or hermaphroditic. Pistillate flowers have only female parts; these flowers also are known as male-sterile. Pistillate flowers have shorter petals than bisexual flowers in the same population (Bates 1992, Bates 1993, E. Cypher unpublished data) (Table 1). Experts agree that Kern mallow is gynodioecious. However, any gynodioecious population in the complex keys to *Eremalche parryi* ssp. *kernensis* in Bates (1993), including those that species experts consider to be Parry's mallow (Taylor and Davilla 1986, E. Cypher unpublished data). Other populations in the Kern/Parry's mallow complex consist only of plants with bisexual flowers; these populations key to *Eremalche parryi* ssp. *parryi* (Bates 1993) and are indisputably Parry's mallow. Parry's mallow is generally accepted to have larger flower parts than Kern mallow (Table 1) (Munz and Keck 1959, Bates 1992, Bates 1993, E. Cypher unpublished data).

Gynodioecious populations in the Kern/Parry's mallow complex may have a mixture of flower colors. Kern mallow flowers may be either white or pale lavender, regardless of gender (Wolf

Table 1. Comparison of morphological characters (ranges) of three *Eremalche* species. Compiled from Abrams (1951), Munz and Keck (1959), Bates (1992, 1993), Stebbins et al. (1992), and E. Cypher (unpublished data).

Character	*exilis* (bisexual only)	*kernensis*		*parryi* [1]	
		pistillate flower	bisexual flower	pistillate flower	bisexual flower
Petal color	white, pinkish, or pale lavender	white or pale lavender	white or pale lavender	mauve, purple, or rose-pink, rarely white or lavender	mauve, purple, or rose-pink, rarely white or lavender
Petal length	3-6 mm	2.5-8.5 mm	3.5-10.5 mm	4.5-11 mm	5-19 mm
Calyx length	3-7 mm	2.5-7 mm	3-8 mm	3.5-9 mm	5-10 mm
Calyx lobe width	1.5-2.5 mm	1-3.5 mm	1-3.5 mm	1-4 mm	1.5-4 mm
Shape of sepal tip	acute	gradually tapering [2]	gradually tapering [2]	abruptly acuminate [2]	abruptly acuminate [2]
Bractlet length	3-7 mm	2-6 mm	2-6 mm	3-7 mm	3-9 mm
Filament length	equal to styles	-	shorter than styles	-	shorter than styles
Anther position	even with stigmas	-	below stigmas	-	below stigmas
Number of carpels	9-13	9-19	7-14	11-23	8-24
Number of rays per stellate hair	?	5-7 [2]	5-7 [2]	10-20 [2]	10-20 [2]

[1] Measurements obtained from plants in Kern, Tulare, and San Luis Obispo counties only.
[2] Not differentiated by flower gender.

1938, Munz and Keck 1959, E. Cypher unpublished data). Parry's mallow typically has mauve to purple flowers (Bates 1992), but white or pale lavender flowers are observed occasionally (Taylor and Davilla 1986, E. Cypher unpublished data).

Another source of confusion is that the closely-related desert mallow (*Eremalche exilis*) co-occurs with Kern and Parry's mallows in western Kern County. Desert mallow plants have only bisexual flowers that are similar in size to the pistillate flowers of Kern mallow (Table 1). Despite the gender difference, the bisexual flowers of desert mallow are easily mistaken for the pistillate flowers of Kern mallow due to their size and the fact that the anthers of the former are not easily distinguished from the stigmas (Andreasen et al. in press). Desert mallow is known to grow sympatrically with Kern mallow in the Lokern area but occupies a much broader range overall (Twisselmann 1956, Twisselmann 1967, Hoover 1970, Bates 1993, Andreasen et al. in press). Although Mojave desert populations of desert mallow typically have trailing stems, those in western Kern County and San Luis Obispo County may have either trailing stems or robust, upright stems. Numerous populations attributed to Kern mallow in the past actually consist of desert mallow (Andreasen et al. in press). Due to their morphological similarity, close inspection is required to differentiate the two species.

Widely varying geographical ranges have been reported for Kern mallow due to the unresolved taxonomic problems and misidentifications of desert mallow. Kern mallow in the strict sense occurs only in the Lokern area of Kern County (Wolf 1938, Munz and Keck 1959, Taylor and Davilla 1986, Tibor 2001, Andreasen et al. in press). Plants reported from elsewhere in Kern County or from San Luis Obispo, Santa Barbara, and Tulare counties (Hoover 1970, Leonelli 1986, Taylor and Davilla 1986, Olson and Magney 1992, Stebbins et al. 1992, California Natural Diversity Data Base 2002, E. Cypher personal observations) are referable either to Parry's mallow or desert mallow (Andreasen et al. in press). These erroneous locations include Buena Vista Valley, Carrizo Plain, Cuyama Valley, Elk Hills, Elkhorn Plain, Fellows, Lost Hills, Maricopa, McKittrick Hills, Panorama Hills, Pixley, Telephone Hills, and the Temblor Range. The distribution map in the recovery plan for Kern mallow (U.S. Fish and Wildlife Service 1998) has been invalidated by the recent research of Andreasen et al. (in press).

As with many desert annuals, the height, habit, density, and phenology of Kern mallow vary greatly depending on precipitation. Kern mallow may not germinate in dry years (Twisselmann 1956, Bates 1992). True Kern mallow typically flowers in March and early April, although flowers may be present in late February or into May if weather conditions are favorable (Taylor and Davilla 1986, E. Cypher unpublished data). The majority of Kern mallow flowers open in late morning (approximately 10:00 am standard time) and wither by late afternoon (approximately 3:00 pm standard time) of the same day. Desert mallow in Lokern begins flowering somewhat earlier in the season and flowers are open only for a few hours at mid-day (E. Cypher personal observation).

Kern mallow occurs primarily in the Valley Saltbush Scrub plant community (cf. Holland 1986) and its ecotones with Valley Sink Scrub and Non-native Grassland (Taylor and Davilla 1986, California Natural Diversity Data Base 2002, E. Cypher unpublished data). This species typically grows in areas where shrub cover is less than 25%. However, much of the Kern mallow habitat in Lokern is shrubless due to repeated fires, which type-converted the areas from

shrubland to grassland. Herbaceous cover in occupied habitat is variable depending on rainfall; it has ranged from 48% to 97% between 1993 and 2001, but a lower cover probably would be optimal (Taylor and Davilla 1986, Cypher 1994, Anonymous 1997, Anonymous 1998, Anonymous 1999, Anonymous 2000, Anonymous 2001). Elevations at true Kern mallow locations range from 84 to 275 meters (275 to 900 feet) (California Natural Diversity Data Base 2002). The primary soil type supporting Kern mallow is Kimberlina sandy loam, followed by Kimberlina fine sandy loam and Panoche clay loam (E. Cypher unpublished data). Kern mallow occasionally has reinvaded disturbed sites when existing populations remained in adjacent areas to provide sources of seed (Mitchell 1989, E. Cypher unpublished observation).

Survey guidelines

All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the California Native Plant Society (2001). The species-specific methods presented below are intended as a supplement to those standardized guidelines.

Systematic surveys are recommended to detect presence and determine distribution of Kern mallow within the survey area. For systematic searches, biologists should walk parallel transects spaced 5 to 10 meters (16 to 33 feet) apart throughout the entire site, regardless of subjective habitat evaluations. However, transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen Kern mallow growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys. The identity of each population discovered must be confirmed by a botanist familiar with both Kern mallow and desert mallow. Any non-flowering *Eremalche* populations that are observed during surveys must be revisited when the flowers are open to confirm their identity.

Prior to beginning surveys in a given year, at least one member of the survey crew should visit one or more known locations of Kern mallow in the Lokern area to verify that precipitation has been adequate for germination and to determine current phenology. The known locations should be as similar as possible to the survey area in elevation, habitat, and topography. Species-specific surveys should not be attempted if Kern mallow is not seen at known locations, the densities are very low relative to normal years, or the plants are inconspicuous. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of Kern mallow at that time, plus the date of the survey, the diagnostic characteristics of any *Eremalche* populations discovered, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines. The typical survey period for Kern mallow is March and April.

Until biosystematic studies have been conducted to resolve the taxonomic issues, any gynodioecious or small-flowered *Eremalche* population west of the Sierra crest should be reported to the appropriate agency, regardless of flower color or apparent gender. The identity of populations to be acquired as mitigation for disturbance to known Kern mallow should be confirmed by a species expert.

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SUPPLEMENTAL SURVEY METHODS FOR CALIFORNIA JEWELFLOWER

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Literature review

California jewelflower [*Caulanthus californicus* (S. Watson) Payson] is a showy annual belonging to the mustard family (Brassicaceae). It was included previously in the genera *Stanfordia* (Watson 1880) and *Streptanthus* (Greene 1891). California jewelflower is both federally and state listed as an endangered species (U.S. Fish and Wildlife Service 1990, Tibor 2001).

As is typical of annuals, both the size of California jewelflower plants and population size may vary dramatically, depending on site and weather conditions. California jewelflower is most conspicuous during the flowering period, which can range from February into May (Taylor and Davilla 1986, E. Cypher unpublished data). Heights at flowering can range from less than 10 centimeters (4 inches) to 50 centimeters (20 inches) or more (Munz and Keck 1959, Mazer and Hendrickson 1993, Cypher 1994). Even in optimal years, California jewelflower colonies are very limited in extent due to the clumped distribution of plants (Taylor and Davilla 1986, Mazer and Hendrickson 1993).

Other species of *Caulanthus* resemble California jewelflower superficially. However, California jewelflower has smaller flowers and shorter, flatter fruits than Coulter's jewelflower (*C. coulteri* Watson) and desert candle *(C. inflatus* Watson) (Table 1). Depauperate individuals of desert candle may lack the characteristic inflated stems but can be identified by their lavender stigmas (Buck 1993, E. Cypher personal observation). The rosettes of California jewelflower can be confused with those of several other species in the mustard family and aster family (Asteraceae).

Historically, California jewelflower occurred in the San Joaquin Valley and the inner Coast Ranges from Fresno County south to Santa Barbara and Ventura Counties (Taylor and Davilla 1986). Populations have been reported from elevations ranging from approximately 75 to 945 meters (240 to 3,100 feet) and occur on level to gentle sloping (usually <25% slope) terrain. Soils at known locations are primarily subalkaline, sandy loams (Taylor and Davilla 1986, California Natural Diversity Data Base 2002, R. Lewis personal communication).

Plant communities (cf. Holland 1986) supporting extant California jewelflower populations include Non-native Grassland, Upper Sonoran Subshrub Scrub, and Cismontane Juniper Woodland and Scrub (E. Cypher unpublished data). Historical records suggest that California jewelflower also occurred in the Valley Saltbush Scrub plant community (California Natural

Table 1. Diagnostic characters of three *Caulanthus* species. Data from Buck (1993), Munz and Keck (1959), and E. Cypher (unpublished data).

Character	*C. californicus*	*C. coulteri*	*C. inflatus*
Filaments	distinct or 1 pair fused	1-2 pair fused	1-2 pair fused
Stem	not inflated	not inflated	usually inflated
Cauline leaf shape	ovate to rounded	oblong to ovate	oblong to ovate
Sepal length	4-10 mm	5-18 mm	8-10 mm
Petal length	6-11 mm	8-31 mm	8-14 mm
Stigma color	greenish	?	lavender
Mature fruit length	1-6 cm	4-13 cm	5-11 cm
Fruit cross-section	flattened perpendicular to septum	rounded or flattened parallel to septum	rounded to squarish
Seed shape	spheric	oblong	oblique-oblong

Diversity Data Base 2002). Herbaceous cover is dense at most locations except those in Santa Barbara County, where up to 50% of the surface is barren. Native plant species comprise a high proportion of the vegetation at many of the known locations (Taylor and Davilla 1986, Cypher 1994, R. Lewis personal communication).

Survey guidelines

All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the California Native Plant Society (2001). The species-specific methods presented below are intended as a supplement to those standardized guidelines.

Systematic surveys are recommended to detect presence and determine distribution of California jewelflower within the survey area. For systematic searches, biologists should walk parallel transects spaced 5 to 10 meters (16 to 33 feet) apart throughout the entire site, regardless of subjective habitat evaluations. However, transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen California jewelflower growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys.

Prior to beginning surveys in a given year, at least one member of the survey crew should visit one or more known locations of California jewelflower to verify that precipitation has been adequate for germination and to determine current phenology. The known locations should be as similar as possible to the survey area in elevation, habitat, and topography. Species-specific surveys should not be attempted if California jewelflower is not seen at known locations, the densities are very low relative to normal years, or the plants are inconspicuous. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of California jewelflower at that time, plus the date of the survey, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines. The typical survey period for this species is March and April.

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SUPPLEMENTAL SURVEY METHODS FOR BAKERSFIELD CACTUS

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Literature review

The taxonomy of Bakersfield cactus has not been accepted universally, even though it was named over a century ago. Originally, Bakersfield cactus was treated as a full species, *Opuntia treleasii* Coulter (1896). Shortly thereafter, Toumey (1901) renamed Bakersfield cactus as a variety of the more widespread beavertail cactus (*Opuntia basilaris* Englemann and Bigelow), resulting in the combination *O. basilaris* var. *treleasii* (Coulter) Toumey for Bakersfield cactus. Griffiths and Hare (1906) considered Bakersfield cactus to be a distinct species and further subdivided it into two varieties, *O. treleasii* Coulter var. *treleasii* and *O. treleasii* Coulter var. *kernii* Griffiths and Hare. Britton and Rose (1920) corrected the spelling of the epithet to *treleasei* to be consistent with the name of the original collector, William Trelease. In the most recent treatment (Parfitt and Baker 1993), the scientific name of Bakersfield cactus was given as *Opuntia basilaris* var. *treleasei* (Coulter), which includes both varieties of the former *O. treleasei*. Some experts still consider Bakersfield cactus to be a unique species.

Bakersfield cactus differs from the common beavertail cactus (*O. basilaris* var. *basilaris*) in several key characters (Table 1). Bakersfield cactus is unique among the varieties of *O. basilaris* in that the eye-spots contain spines in addition to the bristles. Bakersfield cactus individuals from the type locality near Caliente in Kern County have spines less than 7 millimeters (0.3 inches) long, which may be shorter than the bristles (ESA 1986, R. van de Hoek personal communication). Most other populations of Bakersfield cactus have longer, more conspicuous spines. If the taxonomy of Griffiths and Hare (1906) is used, *O. treleasii* var. *treleasii* refers to the plants with short spines and *O. treleasii* var. *kernii* refers to the form with longer spines. Bakersfield cactus typically flowers in May (Munz and Keck 1959), and plants are less than 35 centimeters (1 foot) tall (Abrams 1951). It is federally and state listed as an endangered species (U.S. Fish and Wildlife Service 1990, Tibor 2001).

Bakersfield cactus is endemic to a limited area of central Kern County, ranging from Granite Station southeast to the Caliente Hills and south to Wheeler Ridge (Twisselmann 1967, U.S. Fish and Wildlife Service 1998, Tibor 2001). Only isolated remnants of the formerly extensive colonies remain (Twisselmann 1967, U.S. Fish and Wildlife Service 1990). Bakersfield cactus occurs on well-drained sandy, gravelly, or loamy soils on stream banks, ridges, bluffs, and rolling hills (ESA 1986, California Natural Diversity Data Base 2002). Historical records indicate that the majority of Bakersfield cactus occurred at elevations ranging from 88 to 396 meters (290 to 1,300 feet) with a few colonies, including the type locality, up to 550 meters

Table 1. Characters differentiating *Opuntia basilaris* var. *basilaris* from var. *treleasei*. Data from Coulter (1896), Griffiths and Hare (1906), Abrams (1951), and Benson (1969).

Character	var. *basilaris*	var. *treleasei*
Joint (pad) shape	obovate to orbicular	obovate to narrowly elliptic
Joint base	flattened	terete
Areoles (eye-spots)	depressed	not depressed
Spine length	absent	4-38 mm

(1,800 feet) in elevation (California Natural Diversity Data Base 2002). Plant communities in which it grows include Sierra-Tehachapi Saltbush Scrub, Relictual Interior Dune Grassland, and Blue Oak Woodland (ESA 1986, Holland 1986, Griggs et al. 1992, California Natural Diversity Data Base 2002, R. van de Hoek personal communication). Beavertail cactus also is found in Kern County, occurring in the Mojave Desert and the western foothills of the Sierra Nevada and Tehachapi mountains (Twisselmann 1967). The ranges of Bakersfield cactus and beavertail cactus may overlap in the Caliente and Kern Canyon areas (Twisselmann 1967, E. Cypher personal observation). Cultivated prickly-pear cacti (*Opuntia* spp.) also have escaped in the vicinity of Bakersfield (E. Cypher personal observation).

Survey guidelines

All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the California Native Plant Society (2001). The species-specific methods presented below are intended as a supplement to those standardized guidelines.

Surveys for Bakersfield cactus are possible year-round because it is a perennial. However, vegetative individuals may be obscured by dense annual grasses, and thus plants are most conspicuous while they are in flower. Systematic surveys are recommended to detect presence and determine distribution of Bakersfield cactus within the survey area. For systematic searches, biologists should walk parallel transects spaced 5 to 15 meters (approximately 15 to 50 feet) apart throughout the entire site, regardless of subjective habitat evaluations. However, transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen Bakersfield cactus growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys.

Visits to one or more known locations of Bakersfield cactus are recommended to determine current phenology and observability. The known locations should be as similar as possible to the survey area in elevation, habitat, and topography. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of Bakersfield cactus at that time, plus the date of the survey, the diagnostic characteristics of any *Opuntia* populations discovered, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines.

Due to the difficulty of identifying short-spined populations of Bakersfield cactus, any wild *Opuntia* population in Kern County west of the Sierra crest should be reported to the appropriate agency. The identity of any such cactus populations outside of the range reported in the recovery plan (U.S. Fish and Wildlife Service 1998) should be confirmed by a species expert before being disturbed or acquired as mitigation for disturbance to known Bakersfield cactus.

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SUPPLEMENTAL SURVEY METHODS FOR HOOVER'S WOOLLY-STAR

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Literature review

Hoover's woolly-star [*Eriastrum hooveri* (Jepson) Mason] is an inconspicuous annual member of the phlox family (Polemoniaceae). It was named originally by Jepson (1943) as *Huegelia hooveri* Jepson but has been known as *Eriastrum hooveri* since Mason (1945) revised the genus. Hoover's woolly-star has small, white to pale blue flowers that are less than 5 millimeters (0.2 inches) long; the stamens are shorter than the corolla (Abrams 1951, Munz and Keck 1959, Patterson 1993). Many-flowered eriastrum [*Eriastrum pluriflorum* (Heller) Mason] frequently occurs in mixed populations with Hoover's woolly-star (Lewis 1992, Cypher 1994). Many-flowered eriastrum can be distinguished by its dark blue flowers that are 16 millimeters (0.6 inches) or more in length and stamens that protrude from the corolla (Abrams 1951, Munz and Keck 1959, Taylor and Davilla 1986, Patterson 1993). Hoover's woolly-star is federally listed as a threatened species (U.S. Fish and Wildlife Service 1990). It has been proposed for delisting (U.S. Fish and Wildlife Service 2001) but must be treated as a listed species until a final rule is published that officially delists this species.

The flowering period for Hoover's woolly-star occurs between March and June (Munz and Keck 1959, Lewis 1992, Cypher 1994), but phenology varies among sites and years. Unlike many other annual forbs, stems of *Eriastrum* species may persist for many months after the plants die. However, surveys outside of the flowering season are unreliable because dead stems do not always persist and even if they do, the plants are not identifiable to species unless the corollas remain attached (Taylor and Davilla 1986, Lewis 1992).

Differing rainfall and site conditions can affect the size of both individual plants and populations (Cypher 1994). The wiry stems of Hoover's woolly-star may be simple or branching and vary in height from 1 to 17 centimeters (0.4 to 6.7 inches) at flowering; similarly, single plants have been observed with as few as 1 and as many as 82 flowers (E. Cypher unpublished data). Densities may vary greatly within a single population (Cypher 1994).

Hoover's woolly-star is known to be extant from Fresno and San Benito Counties south to Kern and Santa Barbara Counties (U.S. Fish and Wildlife Service 1998, Tibor 2001); recently, two populations were discovered in the Antelope Valley of Los Angeles County (Boyd and Porter 1999). The species occurs in a wide variety of sites, from alkali sinks to ridgetops (Lewis 1992). Populations of Hoover's woolly-star have been reported from approximately 50 to 915 meters

(165 to 3,000 feet) in elevation (Danielson et al. 1994, California Natural Diversity Data Base 1995), but the majority of valley-floor populations have been extirpated due to agricultural conversion (Taylor and Davilla 1986).

A wide variety of plant communities support Hoover's woolly-star. Most are dominated by shrubs such as saltbush (*Atriplex* spp.), Mormon tea (*Ephedra* spp.), and iodinebush (*Allenrolfea occidentalis*), but other shrubs, herbs, or trees may dominate the landscape in some areas (Taylor and Davilla 1986, Danielson et al. 1994, California Natural Diversity Data Base 1995). Shrub cover in occupied habitats typically is less than 20% (Taylor and Davilla 1986, Cypher 1994). Features common to many Hoover's woolly-star sites are stabilized silty to sandy soils, a low cover of competing herbaceous vegetation, and presence of cryptogamic crust (Taylor and Davilla 1986, Lewis 1992). However, dense vegetation, other soil types, and lack of cryptogamic crust do not preclude the occurrence of Hoover's woolly-star (Cypher 1994, California Natural Diversity Data Base 1995). Hoover's woolly-star may reinvade disturbed soil surfaces (*e.g.,* well pads, dirt roads) if seeds remain in the vicinity (Lewis 1992, Danielson et al. 1994, Hinshaw et al. 1998, Holmstead and Anderson 1998).

Survey guidelines

All surveys for rare plants should be conducted in accordance with the standardized guidelines issued by the regulatory agencies (U.S. Fish and Wildlife Service 1996, California Department of Fish and Game 2000) and the California Native Plant Society (2001). The species-specific methods presented below are intended as a supplement to those standardized guidelines.

Systematic surveys are recommended to detect presence and determine distribution of Hoover's woolly-star within the survey area. For systematic searches, biologists should walk parallel transects spaced 5 to 10 meters (16 to 33 feet) apart throughout the entire site, regardless of subjective habitat evaluations. However, transects may be stratified by topography or plant community for convenience. Field survey crews should include at least one member who has seen Hoover's woolly-star growing in its natural habitat. Other team members may be trained using photographs and/or herbarium specimens but should be accompanied in the field by the experienced crew member during all surveys.

Prior to beginning surveys in a given year, at least one member of the survey crew should visit one or more known locations of Hoover's woolly-star to verify that precipitation has been adequate for germination and to determine current phenology. The known locations should be as similar as possible to the survey area in elevation, habitat, and topography. Species-specific surveys should not be attempted if Hoover's woolly-star is not seen at known locations, the densities are very low relative to normal years, or the plants are inconspicuous. Survey reports should document the known locations that were visited, the date of the visit, and the observability and phenology of Hoover's woolly-star at that time, plus the date of the survey, the abundance and distribution of all rare species in the survey area, and any other elements required by the agency guidelines. If *Eriastrum* stems are observed outside of the flowering season, the site should be treated as if a threatened species was present, and the population should be

revisited at the appropriate time to determine the identity of the plants. The typical survey period for Hoover's woolly-star is April and May.

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