

Bakersfield cactus
(*Opuntia treleasei* = *Opuntia basilaris* var. *treleasei*)

5-Year Review:
Summary and Evaluation



Bakersfield cactus at Hart Park Unit, Bakersfield, California.
Photo by Joseph D. Terry, Sacramento Fish and Wildlife Office, May 2006.

U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
Sacramento, California

September 2011

5-YEAR REVIEW

Bakersfield cactus (*Opuntia treleasei* = *Opuntia basilaris* var. *treleasei*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

As summarized in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* for this species (Recovery Plan; (Service 1998)), Bakersfield cactus is a succulent low growing member of the cactus family (Cactaceae). It generally forms fleshy, flattened green beavertail-like pads (flattened stems) 3 to 4 inches wide by 5 to 7 inches long that produce showy magenta flowers. The eye-spots on the pads contain spines in addition to bristles. Soils supporting Bakersfield cactus typically are sandy with little silt and clay, low in organic material, and cobbles or boulders also may be present. The species occurs on flood plains, ridges, bluffs and rolling hills in saltbush scrub plant communities, and occasionally in blue oak woodland or riparian woodland at elevations from 460 to 1,800 feet. Although the historical distribution was never estimated, photographs and reports show that populations of Bakersfield cactus were more or less continuous east of Bakersfield (Britton and Rose 1920; Benson 1982). Currently, it is restricted to a limited area of central Kern County near Bakersfield in the Southern San Joaquin Valley, California. The remaining Bakersfield cactus occurrences can be grouped into eleven general areas with only four core areas containing populations of greater than 1,000 clumps. Urban sprawl and the conversion of native habitat into agriculture have left the remaining populations small and highly fragmented. About one-third of the historical occurrences of Bakersfield cactus have been eliminated (Service 1998).

Methodology Used to Complete This Review:

This review was conducted by staff biologists within the Sacramento Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service), using the Recovery Plan (Service 1998), California

Natural Diversity Database (CNDDDB), a statewide data base maintained by the California Department of Fish and Game (CDFG), NAIP imagery (2005), office files, agency reports, unpublished data, interviews with the species experts, and maps of the current distribution of the species and landownership. Other than the Recovery Plan, there is little recent published literature on the species.

Contact Information:

Lead Regional Office: Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants, Pacific Southwest Region; (916) 414-6464.

Lead Field Office: Josh Hull, Recovery Division Chief, Sacramento Fish and Wildlife Office; (916) 414-6600.

Federal Register (FR) Notice Citation Announcing Initiation of This Review: On March 22, 2006, the Service published a notice in the Federal Register that announced initiation of the 5-year review for Bakersfield cactus and asked for information from the public regarding the species' status (71 FR 14538). On April 3, 2006, a corrected announcement was issued to correct contact information for Service field offices (71 FR 16584). We received no information in response to this notice.

Listing History:

Original Listing

FR Notice: 55 FR 29361

Date of Final Listing Rule: July 19, 1990

Entity listed: Species – Bakersfield cactus (*Opuntia treleasei*), a listed plant species

Classification: Endangered

State Listing

Bakersfield cactus was listed by the State of California as endangered in 1990.

Review History: No status reviews have been conducted for this species since it was listed.

Species' Recovery Priority Number at Start of Review: The recovery priority number for Bakersfield cactus is 3C according to the Service's 2010 Recovery Data Call for the Sacramento Field Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a variety that faces a high degree of threat and has a high potential for recovery. The "C" after this number indicates conflict with construction or other development projects or other forms of economic activity.

Recovery Plan or Outline

Name of Plan or Outline: *Recovery Plan for Upland Species of the San Joaquin Valley, California*

Date Issued: September 30, 1998

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) policy

The Endangered Species Act of 1973, as amended, defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as a distinct population segment to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the application of the DPS policy to the species listing is not addressed further in this review.

Recovery Criteria

Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

In the Recovery Plan, the narrative discusses a recovery strategy and presents tables describing downlisting and delisting criteria with a step-down narrative.

Adequacy of Recovery Criteria.

Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

Yes
 No

The recovery criteria do not reflect the best available and most up-to-date information on the biology of the species and its habitat. The recovery strategy mentions that unoccupied habitat within metapopulations should also be protected to facilitate the movement of pollinators and seed dispersers. However, the recovery criteria only call for the protection of occupied habitat. The recovery criteria call for monitoring in specified recovery areas to show that populations are stable or increasing in all protected areas. However, the Recovery Plan, within the species recovery strategy section, does state that land should be protected in blocks of at least 40 acres and preferably in blocks of 160 acres. Surveys will be necessary to determine the size of natural populations in several of the target areas and the amount of existing occupied habitat.

Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

 Yes

 X No. All of the 5 listing factors that are relevant to the species are addressed in the recovery criteria. However, there are new threats (see II FACTOR E for discussion).

List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the 5-listing factors are not relevant, please note that here.

The recovery goal stated in the Recovery Plan is “to maintain self-sustaining populations in protected areas representative of the former geographic and topographic range of the taxon and in a variety of appropriate natural communities” (Service 1998). At this time, the remaining populations occur in areas sufficiently representative of the former range to achieve this goal (Service 1998; CNDDDB 2010); however, very little additional loss can be accommodated without compromising the long-term existence of the species. The downlisting and delisting criteria for Bakersfield cactus, taken from the Recovery Plan, are described below.

Downlisting Criteria

Reclassification to threatened status needs to be evaluated when the species is protected in specified recovery areas from incompatible uses, management plans have been approved and implemented for recovery areas that include survival of the species as an objective, and population monitoring indicates that the species is stable or increasing. Downlisting criteria include:

- 1) *Secure and protect specified areas from incompatible uses*
 - A) *95 percent of occupied habitat on public lands; 75 percent of Bakersfield cactus clumps and 75 percent of occupied habitat in the Caliente-Bena Hills, Comanche Point, Kern Bluff, Sand Ridge, and Wheeler Ridge areas (addresses Listing Factor A);*
- 2) *A management plan has been approved and implemented for the recovery areas that includes survival of the species as an objective (addresses Listing Factors C and E);*
- 3) *Population monitoring in specified recovery areas shows: stable or increasing populations at all protected sites for a 5-year period (addresses Listing Factor E).*

The minimum block size recommended for protected lands stated in the recovery strategy for Bakersfield cactus (40 acres) is smaller than for other listed plant species (160 acres) in this Recovery Plan; many of the areas are already so fragmented by development that larger blocks no longer exist (Service 1998).

* A) Present or threatened destruction, modification or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

1. Secure and protect specified areas from incompatible uses.

The location, status, and size of the known Bakersfield cactus occurrences are summarized in Figure 1 and Table 1 (CNDDDB 2010). The approximate location of the recovery sites is indicated by the green font on Figure 1. At most of the sites, population surveys have not been conducted since 1989 (Cooley 1995; CNDDDB 2010). Although a status survey is currently being conducted, we do not have detailed results yet. As of October 2010, three populations had been visited and their status evaluated (Cypher and Tennant 2010).

Bakersfield cactus occurs primarily on private lands. The total presumed extant occurrences of Bakersfield cactus occupy 1,432.14 acres. Approximately 220 acres, or 15.3 percent, are located on public lands (CNDDDB 2010). An occurrence as defined by the CNDDDB is a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies. Approximately 1068.40 acres (74.6 percent) of occupied presumed extant Bakersfield cactus habitat is on private land that is not protected. About 144.35 acres (10.1 percent) of occupied presumed extant Bakersfield habitat is on private land that is protected.

We recommended securing and protecting 95 percent of the occupied habitat on public lands except for Department of Water Resources (DWR) lands at Wheeler Ridge and Kern County lands at Kern Bluff, which need to be protected at 90 percent instead of 95 percent. Currently, approximately 48 percent of the occupied habitat on public lands is protected [(total acres of occupied protected Bakersfield cactus (104.37 acres) divided by total public lands (220 acres)]. The amount of occupied habitat on public land and location of protected lands containing Bakersfield cactus are summarized in Table 2.

We conducted a GIS analysis using information from the Kern County Assessor – GIS Parcel Data (Kern County Assessors Office 2009) and the CNDDDB (2010) information on Bakersfield cactus to determine the amount of occupied Bakersfield cactus habitat by land owner. The public lands that Bakersfield cactus occur on include Kern County lands, California Department of Water Resources lands, State of California lands, and possibly on the Sequoia National Forest lands. The identification of the plant on the Sequoia National Forest is still being determined. Not all of the public lands are considered to be protected because of incompatible land uses (discussed further under FACTOR A). We then categorized the land as to whether the primary purpose of the land was for the survival of Bakersfield cactus. For instance, the parcels that have been acquired through the Metropolitan Bakersfield Habitat Conservation Plan that have occupied habitat for Bakersfield cactus were categorized as protected (these are included under the State of California lands in Table 2). County land that the primary purpose of the land is not for the survival of Bakersfield cactus is not considered protected (see FACTOR A). Occupied habitat on the Tejon Ranch (within Caliente-Bena Hills and Comanche Point recovery sites) is not yet considered protected due to phasing of protection (see FACTOR A). We also determined the amount of protected and unprotected occupied habitat by recovery site. The recovery sites are the localities mentioned in Table 4 and Table 5 of the Recovery Plan and denoted by the green font on Figure 1 of this document.

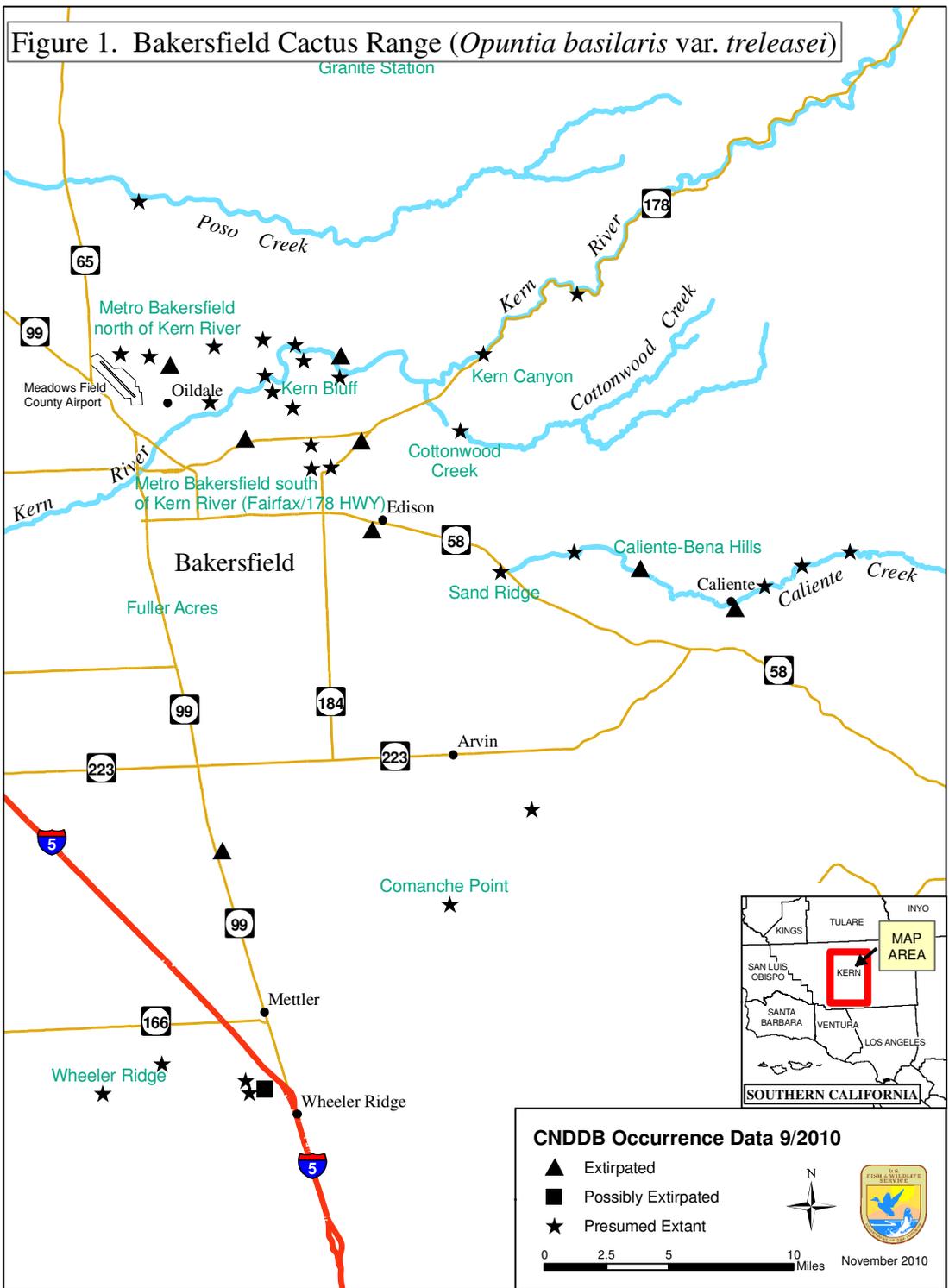


Table 1. Number of Bakersfield cactus occurrences and acreage by recovery site.

Recovery Site Name	Number of Occurrences				Total Occupied Acres		
	Total	Presumed extant	Potentially Extirpated	Extirpated	Presumed extant	Potentially Extirpated	Extirpated
Caliente-Bena Hills	6	4	0	2	530.47	0.00	17.66
Comanche Point	1	1	0	0	4.94	0.00	0.00
Kern Bluff	4	4	0	0	186.62	0.00	0.00
Sand Ridge	1	1	0	0	210.83	0.00	0.00
Wheeler Ridge	5	4	1	0	212.55	6.11	0.00
Cottonwood Creek	1	1	0	0	5.24	0.00	0.00
Fuller Acres	0	0	0	0	0.00	0.00	0.00
Granite Station	0	0	0	0	0.00	0.00	0.00
Kern Canyon	1	1	0	0	24.56	0.00	0.00
MBSKR	5	3	0	2	63.05	0.00	2041.34
MBNKR	8	7	0	1	166.50	0.00	6.62
SUBTOTAL	32	26	1	5	1404.76	6.11	2065.62
Other (outside of Recovery site names)	6	3	0	3	27.38	0.00	2216.54
TOTAL	38	29	1	8	1432.14	6.11	4282.16

MBSKR = Metropolitan Bakersfield South of the Kern River

MBNKR = Metropolitan Bakersfield North of the Kern River

Table 2. Occupied Bakersfield cactus on public lands and protected private lands.

Element Occurrence Number	Owner	Acres Protected Public lands	Acres Unprotected Public lands	Acres Protected Private lands	Recovery Site
25	Kern County		9.497		Caliente-Bena Hills
15	Kern County		0.086		Kern Bluff
15	Kern County		0.012		Kern Bluff
15	Kern County		1.204		Kern Bluff
15	Kern County		3.224		Kern Bluff
11	Kern County		0.992		Kern Bluff
2	Kern County		1.823		Metro Bakersfield n of Kern River
2	Kern County		1.780		Metro Bakersfield n of Kern River
3	Kern County		1.068		Sand Ridge
3	Kern County		2.036		Sand Ridge
3	Kern County		1.959		Sand Ridge
3	Kern County		2.197		Sand Ridge
3	Kern County		1.046		Sand Ridge
49	California DWR		4.980		Wheeler Ridge
36	California DWR		65.620		Wheeler Ridge
51	U S A-USNF		3.010		Not within a recovery site - ID? ¹
51	U S A-USNF		8.030		Not within a recovery site - ID? ¹
51	U S A-USNF		6.470		Not within a recovery site - ID? ¹
32	State of California	3.657			Cottonwood Creek
15	State of California	18.880			Kern Bluff
15	State of California	15.843			Kern Bluff
15	State of California	11.012			Kern Bluff
2	State of California	40.935			Metro Bakersfield n of Kern River
2	State of California	14.023			Metro Bakersfield n of Kern River

Element Occurrence Number	Owner	Acres Protected Public lands	Acres Unprotected Public lands	Acres Protected Private lands	Recovery Site
3	State of California	0.016			Sand Ridge
3	State of California	0.004			Sand Ridge
3	CNLM			9.257	Sand Ridge
3	CNLM			30.504	Sand Ridge
3	CNLM			54.732	Sand Ridge
44	Wildlands Conservancy			40.707	Wheeler Ridge
44	Wildlands Conservancy			9.148	Wheeler Ridge
	Total Occupied Acres	104.371	115.035	144.348	

California DWR = California Department of Water Resources

CNLM = Center for Natural Lands Management

USNF = United States National Forest

¹ ID? = uncertain species identification

We recommended securing and protecting 75 percent of Bakersfield cactus clumps and 75 percent of occupied habitat in the Caliente-Bena Hills, Comanche Point, Kern Bluff, Sand Ridge, and Wheeler Ridge recovery sites. We don't have any current information on the number of existing clumps for any of these areas. The percent protected habitat for Caliente-Bena Hills, Comanche Point, Kern Bluff, Sand Ridge, and Wheeler Ridge are approximately 0, 0, 25, 45, and 24 percent respectively. In summary, the downlisting criteria that 95 percent of the occupied habitat on public lands; and 75 percent of Bakersfield cactus clumps and 75 percent of occupied habitat in the regions of *Caliente-Bena Hills, Comanche Point, Kern Bluff, Sand Ridge, and Wheeler Ridge* areas be secured and protected from incompatible uses has not been met. None of these sites have achieved the percent of occupied habitat recommended in our recovery criteria (see Table 3 and Table 4).

2. Management plans

The downlisting criteria include the requirement that for each recovery area a management plan be approved and implemented that includes the survival of Bakersfield cactus as an objective. None of the Bakersfield cactus recovery areas have such a management plan (E. Cypher, CDFG, *in litt.* 2006; G. Warrick, CNLM, pers. comm., 2006). Therefore, this criterion has not been met.

The Sand Ridge Preserve lacks sufficient endowment for management (Warrick pers. comm. 2006). Neither the CDFG lands nor the Sand Ridge Preserve are currently managed to control nonnative plants except for Sahara mustard (*Brassica tournefortii*) at Sand Ridge Preserve. The CDFG lands north of the county airport (within the Metropolitan Bakersfield north of Kern River area) are currently degraded by trash, ORV use, and sheep grazing, but CDFG has fenced off the area (Cypher *in litt.* 2006; E. Cypher, CDFG, pers. comm. 2010). The Kern County lands are subject to disturbance by oil drilling activities, residential development, and the expansion of airport and landfill facilities (Cypher *in litt.* 2006). The management and protection of the DWR lands at Wheeler Ridge have not been formalized.

3. Population stability

This criterion has not been met. The population status of Bakersfield cactus at most sites has not been monitored since 1989. Preliminary research at the Sand Ridge Preserve, however, reported that from February 2002 to May 2004, there was a net decline in the number of cactus pads by 20 percent (Cypher and Fiehler 2006; E. Cypher, CDFG, pers. comm. 2006). Cactus pads are fleshy flattened green stems which will develop roots once detached from the plant if sufficient water is available. Groups of pads rooted at the same point are considered a cluster and are used as the counting unit for describing population size (Brown and Cypher 2006). By May 2005, Bakersfield cactus had completely died out on five of the study plots that were not managed to control nonnative grasses. The mortality of Bakersfield cactus and low vegetative and sexual reproduction rates were attributed to competition for water with nonnative annual grasses (Cypher and Fiehler 2006; Cypher pers. comm. 2006).

Table 3. Amount of protected and unprotected occupied Bakersfield habitat by recovery site.

Recovery Site Name	Protected Acres			Unprotected Acres				Total
	Percent Protected	Protected Acres Public	Protected Acres Private	Unprotected Acres Private	USNF	DWR	County	
Caliente-Bena Hills	0.00	0.00	0.00	520.98	0.00	0.00	9.50	530.47
Comanche Point	0.00	0.00	0.00	4.94	0.00	0.00	0.00	4.94
Kern Bluff	24.51	45.74	0.00	135.36	0.00	0.00	5.52	186.62
Sand Ridge	44.83	0.02	94.49	108.01	0.00	0.00	8.31	210.83
Wheeler Ridge	23.46	0.00	49.85	92.10	0.00	70.60	0.00	212.55
Cottonwood Creek	69.83	3.66	0.00	1.58	0.00	0.00	0.00	5.24
Fuller Acres	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Granite Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kern Canyon	0.00	0.00	0.00	24.56	0.00	0.00	0.00	24.56
MBSKR	0.00	0.00	0.00	63.05	0.00	0.00	0.00	63.05
MBNKR	33.01	54.96	0.00	107.93	0.00	0.00	3.60	166.50
SUBTOTAL	17.71	104.37	144.35	1058.51	0.00	70.60	26.93	1404.76
Other (outside of Recovery site names)								
	0.00	0.00	0.00	9.89	17.50	0.00	0.00	27.38
TOTAL	17.37	104.37	144.35	1068.40	17.50	70.60	26.93	1432.14

Table 4. Status of Downlisting Recovery Progress

Recovery Plan Site Name	Amount Recommended	Progress	Management Plan?	Population Stability
Occupied habitat on public land	95 percent	Currently, about 48 percent secured from incompatible uses (104.37 acres of protected occupied habitat) with an unknown number of clumps.	No	Not monitored
Caliente-Bena Hills	75 percent of clumps and occupied habitat	Currently no occupied habitat is secured. Unknown number of clumps, less than 2 percent of habitat is public, but it is not protected (County landfill buffer). Tejon Ranch Corporation (TRC) has committed to phased setting aside of lands that include part of Caliente-Bena Hills.	No	Not monitored
Comanche Point	75 percent of clumps and occupied habitat	TRC has committed to phased setting aside of lands that include the Comanche Point occurrences.	No	Not monitored
Kern Bluff	75 percent of clumps and occupied habitat	Approximately 24 percent of occupied habitat protected, with an unknown number of clumps	No	Not monitored
Sand Ridge	75 percent of clumps and occupied habitat	Approximately 45 percent of habitat is protected with an unknown number of clumps. At time of last reported survey in 1981 there were at least 10,000 plants (CNDDDB 2010).	No	Preliminary research indicates that from February 2002 to May 2004, there was a net decline in the number of cactus pads by 20 percent.
Wheeler Ridge	75 percent of clumps and occupied habitat	Approximately 24 percent of the occupied habitat is secured and protected with an unknown number of clumps. Contains Wind Wolves Preserve. (DWR Aqueduct and adjacent easement)	No. The management and protection at DWR has not been formalized.	Not monitored

Summary

The downlisting criteria for Bakersfield cactus include the protection of 95 percent of occupied habitat on public land and 75 percent of Bakersfield cactus clumps and 75 percent of occupied habitat in the Caliente-Bena Hills, Comanche Point, Kern Bluffs area, Sand Ridge, and Wheeler Ridge. No management plans have been prepared that include Bakersfield cactus management as an objective. Bakersfield cactus numbers appear to be declining at the only site that has been recently monitored.

Delisting Criteria

Delisting will be considered when, in addition to the criteria for downlisting, all of the following criteria have been met:

- 1) 90 percent of existing clumps and occupied habitat in the areas specified in the downlisting criteria (i.e. Caliente-Bena Hills, Comanche Point, Kern Bluffs, Sand Ridge, and Wheeler Ridge areas) and in the Fuller Acres, Cottonwood Creek, Granite Station, and Kern Canyon populations are protected (as defined in the downlisting criteria);*
- 2) 100 or more clumps each in other populations north and south of the Kern River are protected;*
- 3) A management plan exists for all protected areas identified as important to the continued survival of the species; and*
- 4) All protected populations show evidence of reproduction.*

1. Habitat Protection

Due to the lack of protection of sufficient habitat in Caliente-Bena Hills, Comanche Point, Kern Bluffs, and Wheeler Ridge, the downlisting criteria for Bakersfield cactus have not been met. Therefore, the delisting criteria for Bakersfield cactus habitat protection in those areas have also not been met. The current status of Bakersfield cactus habitat protection efforts in Caliente-Bena Hills, Comanche Point, Kern Bluffs, Sand Ridge, and Wheeler Ridge is noted in Table 4. The percentage of protected occupied habitat is listed in Table 3. The percent protected habitat for Caliente-Bena Hills, Comanche Point, Kern Bluffs, Sand Ridge, and Wheeler Ridge, Fuller Acres, Cottonwood Creek, Granite station, and Kern Canyon are approximately 0, 0, 25, 45, 24, 0, 70, 0 and 0 percent respectively.

2. 100 or more clumps each in other populations north and south of the Kern River are protected.

225 clumps have been protected in the Bakersfield north of the Kern River recovery site (E. Cypher, CDFG, *in litt* 2008) therefore, this criterion is partially met.

3. Management plans

None of the recovery areas have a management plan that has been approved and implemented that includes the survival of Bakersfield cactus as an objective. Therefore, this criterion has not been met.

4 Population stability

This criterion has not been met. The population status of Bakersfield cactus at most sites has not been monitored since 1989, and to our knowledge monitoring has not occurred over a 5-year period.

Summary

With the exception of 225 clumps having been protected north of Kern River, none of the other goals for the amount of clumps and occupied habitat have been achieved. None of the recovery areas have a management plan that has been approved and implemented that includes the survival of Bakersfield cactus as an objective and only preliminary monitoring has occurred for the Sand Ridge recovery site.

Information on the Species and its Status

Species Biology and Life History

Bakersfield cactus is a perennial. The life span of wild plants has not been determined, but clumps in cultivation at the Rancho Santa Ana Botanic Garden in Claremont, California, survived for 48 years, until extremely wet winter weather caused the pads to rot (R. van de Hoek pers. comm. date unknown). Bakersfield cactus typically flowers in May (Munz and Keck 1959). Reproductive biology of this taxon has not been studied, but certain other *Opuntia* species require cross-pollination for seed-set and many are pollinated by bees (Benson 1982; Spears 1987; Osborn et al. 1988). One potential pollinator of Bakersfield cactus is the native solitary bee *Diadasia australis* ssp. *california*, which is known to occur in Kern County and which specializes in collecting pollen from *Opuntia* species (R.W. Thorp *in litt.* 1998). Verne Grant also identified *Diadasia rinconis* as a pollinator (Grant and Grant 1979). It is known that many species of bee pollinators have declined significantly, both nationwide and in California (National Research Council 2006; Nielsen 2006).

Vegetative reproduction, which is the production of new plants from sources other than seed, is typical in Bakersfield cactus and several related species (Benson 1982). Fallen pads root easily if sufficient water is available (Twisselmann 1967; Benson 1982; Mitchell 1988), but Bakersfield cactus does not survive prolonged inundation (ESA Planning and Environmental Services 1986). Bakersfield cactus produces seeds infrequently. Van de Hoek (pers. comm.) noted that the frequency of seed set in extant populations is similar to the proportion of seeds he observed in herbarium specimens. Cactus seeds require warm, wet conditions to germinate, a combination which is extremely rare in the Bakersfield area (Benson 1982). Pads may be dispersed by flood waters (ESA Planning and Environmental Services 1986), but seed dispersal agents are unknown. Impacts to pollinators may play a part in the low levels and infrequency of seed set observed in the wild, and declines of the Bakersfield cactus.

Recent population studies at Sand Ridge Preserve show a decline in the number of cactus pads and low rates of reproduction likely due to competition with nonnative grasses for water (Cypher and Fiehler 2006; Cypher pers. comm 2006). No population surveys have been recently

conducted in any of the other recovery areas; therefore, the rates of reproduction at these sites are unknown.

Spatial Distribution

The distribution of Bakersfield cactus was not estimated historically. Based on written descriptions (Twisselmann 1967), historical photographs (Britton and Rose 1920; Benson 1982), topography, and deductions from plant morphology, the populations were likely more or less continuous east of Bakersfield (Service 1998). According to Twisselman (1967), Bakersfield cactus “once grew in dense almost impenetrable colonies on the mesas east of Bakersfield.” Densely-spaced clumps of Bakersfield cactus once covered about two square miles from the Caliente Creek floodplain onto Sand Ridge.

As of 1987, the northern, southern, eastern, and western limits of the known range respectively were Granite Station, Comanche Point, Caliente, and Oildale (Service 1998). At the time of listing, we mentioned that the colonies could be divided into five general population areas: The oilfields northeast of Oildale, Kern River Bluffs, and rolling hills west and north of Caliente Creek east of Bakersfield, Comanche Point on the Tejon Ranch southeast of Arvin, and northwest of the community of Wheeler Ridge.

Of the 38 reported occurrences reported in CNDDDB, 8 are extirpated and 1 is potentially extirpated, (Moe 1989, Cooley 1995; Service 1998; Cypher pers. comm 2006; CNDDDB 2010); thus only 29 presumed extant occurrences exist. The identity of one of these occurrences is in question. The remaining distribution of Bakersfield cactus is highly fragmented into eleven general areas: (1) Caliente-Bena Hills, (2) Comanche Point, (3) Cottonwood Creek, (5) Kern Bluffs – Hwy 178 Area, (6) Kern Canyon, (7) North of Airport Area, (8) Oildale Area, (9) Poso Creek, (10) Sand Ridge, and (11) Wheeler Ridge (Moe 1989; Service 1998; CNDDDB 2010). Currently, the range of Bakersfield cactus consists of scattered fragments of once larger populations (Cypher and Tennant 2010).

Abundance

The total population of Bakersfield cactus was not estimated historically. Densely-spaced clumps of cactus once covered an estimated area of 2 square miles from the Caliente Creek flood plain onto Sand Ridge (Service 1998). When known sites were last inventoried, fewer than 20,000 clumps of Bakersfield cactus were estimated to remain. Only four areas had populations of 1000 clumps or more: Comanche Point, Kern Bluff, Sand Ridge, and the area north of Wheeler Ridge (Service 1998).

At most of the sites, population surveys for Bakersfield cactus have not been conducted since 1989 (Cooley 1995; CNDDDB 2010). However, a status survey is currently ongoing. The study consists of conducting surveys to determine the current state of the historical occurrences of Bakersfield cactus throughout its range. Currently, three populations have been visited and their status evaluated (Cypher and Tennant 2010).

From 2002-2005, Bakersfield cactus population trends were monitored at Sand Ridge Preserve in a study analyzing the effects of grass clipping and Fusilade II (a grass-specific herbicide) treatments on Bakersfield cactus survival, flower production, and recruitment (Cypher and Fiehler 2006; Cypher pers. comm. 2006). The number of cactus pads in control plots decreased by 20 percent from February 2002 to May 2004. Bakersfield cactus died out completely in five of the control plots by May 2005. The decline in Bakersfield cactus on the control plots was attributed to reduction in soil moisture storage by nonnative annual grasses during years with below normal precipitation. The rates of both vegetative and sexual reproduction were reportedly low. In contrast to the control plots, within the treatment areas, the number of cactus pads in the clipped plots increased by 28.1 percent between February 2002 and May 2004. The number of cactus pads in the herbicide-treated plots increased by 42.7 percent between March 2003 and May 2004. Despite the observed decline in Bakersfield cactus on the control plots, Bakersfield cactus plants were reported to be widespread at Sand Ridge Preserve in 2006 (Warrick *in litt.* 2006).

Habitat or Ecosystem

Bakersfield cactus generally occurs on sandy soils, although gravel, cobbles, or boulders also may be present (Service 1998). Known populations occur on floodplains, ridges, bluffs, and rolling hills (ESA Planning and Environmental Services 1986; CNDDDB 2010). Bakersfield cactus is a characteristic species of the Sierra-Tehachapi Saltbush Scrub plant community (Holland 1986; Griggs et al. 1992), but populations near Caliente are in Blue Oak Woodland and the Cottonwood Creek population is in riparian woodland (ESA Planning and Environmental Services 1986; Service 1998). Many Bakersfield cactus sites support a dense growth of red brome and other annual grasses (Cypher 1994). Sand Ridge is characterized by sparse vegetation (ESA Planning and Environmental Services 1986; Cypher 1994) and a preponderance of native species such as California filago (*Filago californica*) and yellow pincushion (*Chaenactis glabriuscula*)

Change in Taxonomic Classification or Nomenclature

Bakersfield cactus was listed as *Opuntia treleasei* in the Federal Register notice announcing the endangered status of the species (55 FR 29361). In the most recent treatment (Parfitt and Baker 1993), the scientific name of Bakersfield cactus is given as *Opuntia basilaris* var. *treleasei*. However, some experts consider Bakersfield cactus to be a full species (C. Bowen, Bowen's Biological Services, *in litt.* 1987; R. van de Hoek pers. comm. to E. Cypher, 2006). The Recovery Plan lists Bakersfield cactus as *O. basilaris* var. *treleasei* (Service 1998).

Grants

In 2009, the Endangered Species Recovery Program (ESRP) received a grant from the Central Valley Project Conservation Program to document the presence or absence of Bakersfield cactus at reported CNDDDB occurrence locations and to conduct a status survey.

A section 6 proposal to conduct a genetic study of Bakersfield cactus was also funded in 2009. This project is expected to provide information on the genetic structure of the Bakersfield cactus

metapopulation. This information could be used to identify appropriate locations for potential translocations of cactus for the purpose of establishing new populations (Cypher pers. comm. 2010).

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification or Curtailment of Habitat or Range

When Bakersfield cactus was listed as endangered in 1990, agricultural land conversion, oil development, sand mining, urbanization, off-road vehicle use, proposed flood control basins, telecommunication and electrical lines construction, and perhaps wildfires were identified as threats to its habitat (Service 1990).

Agricultural Conversion and Urbanization

The loss and modification of habitat due to agricultural conversion and urban development remain the largest threats to Bakersfield cactus. As discussed in the final listing rule (55 FR 29361), 96 percent of the native habitats of the valley floor had been lost primarily to urbanization and agricultural land conversion by 1987. The 1998 Recovery Plan estimated the conversion to be 98 percent in 1996.

The primary threats to Bakersfield cactus over its entire habitat range continue to be residential development and conversion to agriculture. Continuing threats to localized populations that were identified in the listing rule include urbanization events such as; road expansion and maintenance (Oildale Area (within the MBNKR Recovery Site), Wheeler Ridge, and Sand Ridge), expansion of the Kern River Power Plant (Kern Canyon), the county airport (MBNKR), and the Bena landfill (Caliente-Bena Hills); as well as oil and gas development (Oildale Area (within the MBNKR) and Wheeler Ridge), Off road vehicle use (MBNKR and Cottonwood Creek), sand and gravel mining (Sand Ridge) and California Aqueduct right-of-way maintenance (Wheeler Ridge) (Cypher pers comm. 2010). All of these activities continue to threaten Bakersfield cactus by the modification of its habitat, the removal of Bakersfield cactus clumps, and the further fragmentation of existing populations. Table 2 summarizes land ownership and protected status.

Formal consultations conducted pursuant to section 7 of the Act that have addressed effects to Bakersfield cactus include residential, infrastructure, oil and gas development, and utility operations and maintenance projects. The biological opinion for the Federal Energy Regulatory Commission (FERC) Kern River and Mojave Pipeline, Westside and Eastside Lateral Pipelines, Kern County (Service 1987) authorized the permanent and temporary disturbance of 8.2 and 266.1 acres of Bakersfield cactus habitat, respectively. The compensation for these activities was 3:1 (24.6 acres for 8.2 acres) for permanent disturbance and .04:1 (10.6 acres for 266.1 acres) for temporary disturbance. In the biological opinion for the Southern California Gas

Pipelines (Service 1996), the amount of disturbance of Bakersfield cactus habitat was not quantified. A third biological opinion addressed an oil pipeline from Emidio, Kern County, to a refinery in Los Angeles that bisected two colonies of Bakersfield cactus north of Wheeler Ridge (Service 1997). Disturbance of Bakersfield cactus was minimized but the potential threat from an oil spill remains. The Service works with Federal, State, and local agencies, and with private project proponents, to minimize effects to listed species, and to compensate for the loss of habitat through preservation of appropriate habitat elsewhere and through creation (or restoration) of an equal acreage of habitat.

The Metropolitan Bakersfield HCP (MBHCP) (City of Bakersfield and County of Kern 1994; Service 1994) covers development activities in an area of 408 square miles around Bakersfield, California. The MBHCP allows the permanent disturbance of 15,200 acres of natural lands (meaning land generally in grazing and with original soils and topography intact) or 43,000 acres of open lands (which includes natural lands as well as areas of intensive agriculture within the permit area). Compensation of impacts to natural lands is provided at a ratio of 3 acres of replacement habitat for every acre that is impacted, while compensation for impacts to agricultural lands is one acre of replacement habitat for every acre impacted. A compensation ratio of 3:1 holds losses to 25 percent. A compensation ratio of 1:1 results in a loss of 50 percent. However, the MBHCP does not explicitly state that impacts to a listed species must be mitigated for by the acquisition of lands that support the species. It is not known at this time how much of the habitat acquired as mitigation through the MBHCP supports Bakersfield cactus.

Loss of up to 1,440 acres of lands supporting Bakersfield cactus can occur with habitat loss from the MBHCP (City of Bakersfield and County of Kern 1994). The biological opinion on the MBHCP states that mitigation for impacts to Bakersfield cactus would be the acquisition of 500 to 1,000 acres of habitat in northeast Bakersfield (Kern Bluffs area) (City of Bakersfield and County of Kern 1994; Service 1994). Bakersfield cactus populations included within the jurisdiction of the Metro Bakersfield HCP are the Kern Bluffs, Metropolitan Bakersfield north of Kern River, Metropolitan Bakersfield south of Kern River, Kern Canyon, Fuller Acres, and Cottonwood Creek recovery sites. Thus far, 354.76 acres of Bakersfield cactus habitat loss has occurred through the MBHCP, with 656.59 acres of Bakersfield cactus habitat acquired for protection as compensation (Metropolitan Bakersfield Habitat Conservation Plan Implementation Trust Group 2010). Of the Bakersfield cactus compensation lands set aside, about 272 acres occur in northeast Bakersfield. It is unlikely that more Bakersfield cactus habitat will be acquired and preserved within northeast Bakersfield due to the high cost and desirability of land for development (Cypher *in litt.* 2006). Instead, the Metro Bakersfield HCP trust group has acquired lower quality Bakersfield cactus habitat outside of the Kern Bluffs Metropolitan Bakersfield north of Kern River population within the North of Airport area.

One of the biggest threats to Bakersfield cactus populations in the Kern Bluffs Area of northeast Bakersfield is residential development. Over 11,000 homes covering roughly 6.5 square miles are in some stage of planning in areas along Highway 178 in northeast Bakersfield. These homes could bring over 30,000 residents to the northeast Bakersfield area (Williams 2006). City planners and developers say that in the coming decades thousands of more houses could follow. A developer states that Rio Bravo has an additional 5,000 acres of land for 8,000 to 12,000

homes that could be built in the next 20 to 25 years (Williams 2006). Many of these homes could be built on Bakersfield cactus habitat.

Development in northeast Bakersfield, however, has proceeded more slowly than in other parts of the city due to difficulties of bringing waterlines and other infrastructure to the area, combined with a number of environmental lawsuits. Additionally, the rough terrain of northeast Bakersfield makes the area more costly to develop (Williams 2006).

The proposed Canyons Development Project would construct 1,289 single-family homes and 120 multi-family homes on its 890-acre residential development located just south of Hart Memorial Park (Michael Brandman Associates 2006). The proposed development would share a boundary with the Hart Park Unit preserve acquired through the MBHCP and managed by CDFG for Bakersfield cactus. The preserve and adjacent lands contain the largest population of Bakersfield cactus in the area (occurrence # 15, CNDDDB 2010). The upstream two-thirds of the Bakersfield cactus population is likely to lose a few hundred cacti to direct impacts from a soccer park to be constructed in the bottom of the ravine and the filling in of the top of the ravine for building houses (Cypher *in litt.* 2006). Other potential impacts from the development include proposed grading and filling of intermittent drainages and canyons, project-related erosion, changes in hydrology, introduction of nonnative plant species, and human-induced impacts including increased vandalism and ORV use (W.E. Loudermilk, Regional Manager, CDFG, *in litt.* 2006a). The indirect effects of increased runoff, vandalism, and human traffic on both the private land and the preserve, because CDFG cannot realistically exclude the effects from their land (Cypher *in litt.* 2006). Currently, this project is being litigated and is in bankruptcy.

Other proposed residential developments in the area include the Riverview Development Project and the Watermark Development Project. The two projects are located near the junction of Highway 178 and Highway 184 less than four miles southeast of the Canyons Development Project. The Riverview Development Project consists of 3,535 dwelling units on 634 acres (RBF Consulting 2006a). The adjacent Watermark Development Project consists of 2,850 dwelling units on 638 acres (RBF Consulting 2006b). At this time, it is not known whether any Bakersfield cactus plants occur within the proposed sites, but if built, the proposed developments would likely degrade potential Bakersfield cactus habitat. Additionally, the proposed developments would indirectly affect Bakersfield cactus by increasing human traffic and promoting further growth in northeast Bakersfield resulting in further modification, disturbance, and fragmentation of important Bakersfield cactus populations within the Kern Bluffs – Hwy 178 Area (Loudermilk *in litt.* 2006b,c).

Other threats to Bakersfield cactus habitat include urban sprawl, oil development activities, ORV use, and trash dumping (CNDDDB 2010). Kern County owns several parcels in the area containing Bakersfield cactus. However, the cactus are not protected, as the county lands are subject to degradation from oil and gas drilling activities (P.A. Cross, Service, *in litt.* 2006; Loudermilk *in litt.* 2006d); ORV and equestrian trails (Service 1998, CNDDDB 2010, Cypher *in litt.* 2006); indirect effects from residential development; and the expansion of airport and landfill facilities (Cypher *in litt.* 2006).

The Pacific Gas and Electric (PG&E) San Joaquin Valley Operations and Maintenance Program Habitat Conservation Plan (HCP) is a multi-species, 30-year plan that covers operations and maintenance activities on PG&E's existing facilities and utility right-of-ways in the San Joaquin Valley, as well as certain minor construction activities (Service 2007).

Within the 276,350-acre action area, there are 14 presumed extant occurrences of Bakersfield cactus in existing PG&E right-of-ways (CNDDDB 2007). All of these occurrences are located in the Kern County portion of the action area. These 14 occurrences occupy approximately 30 acres of existing PG&E right-of-ways within the 276,350-acre action area (CNDDDB 2007). Pacific Gas and Electric estimated that ground-disturbing covered-activities implemented within the existing right-of-ways of the action area and the "minor construction" covered activities (outside the existing right-of-ways) would permanently remove 1.5 acres of occupied Bakersfield cactus habitat over the 30-year term of the Permit. Although PG&E will avoid Bakersfield cactus occupied-habitat to the maximum extent practicable, some adverse effects to occupied habitat may result from covered activities. Compensation will be based on the actual acres of occupied plant-habitat directly and indirectly affected. The HCP's compensation ratios will be applied: 3:1 for permanent loss of occupied habitat, and 0.5:1 for temporary loss of occupied habitat. We anticipate that the combined direct and indirect effects of most ground-disturbing covered-activities would result in a permanent loss of occupied habitat for Bakersfield cactus. Therefore, PG&E may provide 4.5 acres of Bakersfield cactus compensation over the 30-year Permit term (Service 2010).

The Department of Water Resources has applied for an incidental take permit to address potential impacts of the operation, maintenance, and use of the California Aqueduct right-of-way and pumping plants within the San Joaquin Field Division. If the Department of Water Resources HCP is implemented and approved, another 80.55 acres of Bakersfield cactus habitat near Wheeler Ridge would be protected (DWR, in prep.).

Oil and Gas Extraction and Conveyance

Oil and gas extraction and conveyance continue to threaten Bakersfield cactus. Adverse effects of oil and gas development on Bakersfield cactus include the loss of habitat, change in habitat quality, destruction of individuals or populations and their seedbank, habitat fragmentation, and increased competition from nonnative plant species due to habitat degradation.

According to our HCP database (Service 2010), there is one HCP that covers oil and gas production that includes Bakersfield cactus as a covered species. The Nuevo Energy Company and Torch Operating Company (Nuevo/Torch) HCP was permitted in 1999 for a 30-year permit term. The project size is 21,800 acres with 1,700 acres impacted. The mitigation includes 800 acres to be created, enhanced, or restored, and 840 acres to be protected.

Approximately 1,328 acres of the total 21,900 acres in the Nuevo/Torch Plan Area may be suitable for Bakersfield cactus (Nuevo/Torch 1999). Only those Nuevo/Torch lands east of Highway 99 overlap with reported occurrences of Bakersfield cactus. Bakersfield cactus has a limited range and is only found in western Kern County. Therefore Nuevo/Torch proposed avoidance and minimization measures are particularly important for this species.

Oil and gas development is often limited and linear in nature in terms of well pads and pipeline construction but where oil and gas fields are developed into production sites, the cumulative impact can be large. Three of the five largest U.S. oil fields are in Kern County and span more than one million acres.

Conservation Efforts

The Nature Conservancy doubled the size of the Sand Ridge Nature Preserve to 275 acres in 1990 by acquiring a remnant of the Caliente Creek wash at the eastern base of the ridge. The preserve was transferred to the Center for Natural Lands Management in 1998 (CNLM 2004).

Several colonies of Bakersfield cactus have been acquired since 1993 through the implementation of the Metropolitan Bakersfield Habitat Conservation Plan (E. Cypher, CDFG, *in litt.* 2010). The Implementation Trust for the Metropolitan Bakersfield Habitat Conservation Plan has protected portions of occurrences within the Kern Bluffs and Sand Ridge recovery sites.

The Wind Wolves preserve covers approximately 100,000 acres and is owned and run by the Wildlands Conservancy. The Wind Wolves preserve is located at the very southern end of the San Joaquin Valley. The Wildlands Conservancy's dual mission is to fund free education programs to teach children about nature and to preserve the beauty and bio-diversity of the earth (Deutsche 2007). Approximately 50 acres of presumed occupied Bakersfield cactus habitat occurs on the Wind Wolves preserve within the Wheeler Ridge recovery site.

Between 2006 and 2008, the Tejon Ranch Corporation (TRC) negotiated with national conservation groups (California Audubon, Sierra Club, Natural Resources Defense Council, and others) on a far-reaching preservation agreement (TRC 2008a, b). Under the agreement, which was executed on June 17, 2008, the TRC committed to placing 178,000 acres through a combination of dedicated and designated project open spaces and allowing the conservation organizations to purchase up to an additional 62,000 acres at State-appraised cost. The TRC has agreed to dedicate conservation easements over 135,000 of the 178,000 acres in six phases as the TRC receives development approvals, with all dedications to occur within 30 years from final approval of the first development project. An additional 33,000 acres of open space areas within the permitted project areas would be designated as part of the project development process and 10,000 acres would be dedicated for realignment of the Pacific Crest Trail through the Tejon Ranch (TRC 2008a, b). The TRC would develop three projects: a 23,000-home development in Los Angeles County; a 3,500 home and resort development in Kern County; and a retail/commercial development in the San Joaquin Valley. The conservation easement established through the agreement would result in the permanent conservation of almost 90 percent of the Ranch while allowing TRC to continue historical activities and some new development (TRC 2008a,b).

Summary

Approximately 1068.40 acres (74.6 percent) of occupied presumed extant Bakersfield cactus habitat is on private land that is not protected from agricultural conversion, urbanization, oil and gas development, and off road vehicle use. About 144.35 acres (10.1 percent) of occupied presumed extant Bakersfield habitat is on private land that is protected. About 115.03 acres (8 percent) of presumed extant Bakersfield cactus habitat is on public land that is not protected from oil and gas development, off road vehicle use, and utility operation and maintenance; 104.37 acres (7.3 percent) is on protected public lands.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

At the time of listing we stated that many cacti are collected and cultivated by plant collectors, or offered for sale or trade by cactus growers. Although there have been no reports of such trade in Bakersfield cactus, the species may still be collected and cultivated (Service 1990). Currently, we have no evidence whether this has occurred. Currently, the lack of monitoring means that we probably would not detect collection or vandalism, especially on private land.

FACTOR C: Disease or Predation

At the time of listing, we did not identify disease or predation to be threats to Bakersfield cactus (Service 1990). To our knowledge disease or predation are still not threats to Bakersfield cactus currently.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

In the final listing rule, we identified the inadequacy of the California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA) to adequately protect listed plants. We noted although both statutes prohibited the “take” of State listed plants that State law appears to exempt taking of plants via habitat modification or land use change by the landowner (Service 1990). Additionally, we mentioned the lack of real protection through CITES due to the lack of commercial trade of Bakersfield cactus (Service 1990).

There are several State and Federal laws and regulations that are pertinent to federally listed species, each of which may contribute in varying degrees to the conservation of federally listed and non-listed species. These laws, most of which have been enacted in the past 30 to 40 years, have greatly reduced or eliminated the threat of wholesale habitat destruction, although the extent to which they prevent the conversion of natural lands to agriculture is less clear.

State Laws

The State’s authority to conserve rare wildlife and plants is comprised of four major pieces of legislation: the California Endangered Species Act, the Native Plant Protection Act, the California Environmental Quality Act, and the Natural Community Conservation Planning Act.

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA): The CESA (California Fish and Game Code, section 2080 *et seq.*) prohibits the unauthorized take of State-listed threatened or endangered species. The NPPA (Division 2, Chapter 10, section 1908) prohibits the unauthorized take of State-listed threatened or endangered plant species. The CESA requires State agencies to consult with the California Department of Fish and Game on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. The Bakersfield cactus was officially listed as endangered by the State of California in January 1990. The CESA prohibits the unauthorized take of State-listed threatened or endangered species. Unlike the take prohibition in the Endangered Species Act of 1973, as amended (Act), the State prohibition includes plants, although landowners may destroy a plant on his property that is listed as threatened or endangered under CESA when it is incidental to a properly permitted surface mining operation, incidental to routine and ongoing agricultural activities that occur while specified management practices are followed. (California Department of Justice, Office of the State Attorney General 1998).

Furthermore, with regard to prohibitions of unauthorized take under NPPA, landowners are exempt from this prohibition for plants to be taken in the process of habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify the California Department of Fish and Game 10 days in advance of changing land use in order to allow salvage of listed plants. We do not consider salvage to provide adequate protection for this species because transplanting often results in failure due to unknown reproduction and survival requirements of the species and inappropriate or inadequate reintroduction sites.

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

Natural Community Conservation Planning Act: The Natural Community Conservation Program is a cooperative effort to protect regional habitats and species. The program helps identify and provide for area wide protection of plants, animals, and their habitats while allowing compatible and appropriate economic activity. Many Natural Community Conservation Plans (NCCPs) are developed in conjunction with Habitat Conservation Plans (HCPs) prepared pursuant to the Federal Endangered Species Act.

Federal Laws

Endangered Species Act of 1973, as amended: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for Bakersfield cactus. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the “take” of federally-endangered wildlife, however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation, or in the course of any violation of a state criminal trespass law. Section 9 also makes illegal the international and interstate transport, import export and sale or offer for sale of endangered plants and animals. The protection of Section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation. Federally listed plants may be incidentally protected in areas where they co-occur with federally listed wildlife species. In some cases, federally listed plants are included as covered species in habitat conservation plans (HCPs) prepared by non-Federal applicants as part of the terms and conditions for issuance of an incidental take permit for federally listed wildlife under section 10(a)(1)(B). Except for a population of uncertain number and with uncertain species identification on 1,000 acres of the Sequoia National Forest, there are no extant populations of Bakersfield cactus on Federal lands (CNDDDB 2010).

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq.*) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

The Bakersfield City Council recently revised a 1999 ordinance that provides guidelines for development in northeast Bakersfield. The new ordinance strengthens the original one by ensuring that homes be built on stable hillsides and not be visible from major roadways. The ordinance will help prevent development on steep slopes in the Kern Bluffs area; however, it will provide little additional protection to the main populations of Bakersfield cactus, which are in flatter areas and on the bottom of ravines (Cypher *in litt.* 2006; Burger 2006).

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1990. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

FACTOR E: Other Natural or Manmade Factors Affecting its Continued Existence

Natural or manmade threats to Bakersfield cactus listed in the final listing rule included competition from invasive nonnative annual grasses and increased fire frequency (Service 1990). The Recovery Plan included additional threats from loss of genetic diversity, flooding, and air pollution (Service 1998). New potential threats to Bakersfield cactus have also been identified including reproductive threats such as pollinator loss, elevated nitrogen deposition and climatic change, and dust. Of these, the most significant immediate threat is from competition with nonnative annual grasses.

Nonnative annual grasses and increased fire frequency

Nonnative annual grasses directly threaten the survival of mature cactus plants and hinder the establishment of new plants (ESA Planning and Environmental Services 1986; Mitchell 1988). In 2002-2004, mortality of Bakersfield cactus clumps and low rates of vegetative and sexual reproduction at Sand Ridge Preserve were attributed to competition with nonnative annual grasses for water during years with below-average precipitation (Cypher and Fiehler 2006; Cypher pers. comm. 2006).

Nonnative annual grasses also indirectly affect Bakersfield cactus in three ways. First, indirect effects from nonnative annual grasses include increased fire frequency (Service 1998; Brooks 1999; Brooks and Pyke 2001; Brooks 2003), damage from insects (Burger and Louda 1994), and rot of cactus pads during wet years (Service 1998). Fire suppression has allowed the extensive growth of nonnative grasses in some areas to the detriment of Bakersfield cactus (Moe 1989). Also, nonnative annual grasses, which are adapted to fire, increase the fuel load in fire-intolerant saltbush (*Atriplex* sp.) habitat, where Bakersfield cactus is found, resulting in an increase in fire frequency (Brooks 1999; Brooks and Pyke 2001; Brooks 2003). Although the effect of repeated fires on Bakersfield cactus has not been determined, the survival of Bakersfield cactus plants was monitored following single fire events at Sand Ridge (R. Hewett, Sand Ridge Preserve Manager, *in litt.* 1987) and near the Rio Bravo Hydroelectric Power Plant in Kern Canyon (Lawrence 1987; George Lawrence and Associates 1988). All of the Bakersfield cactus clumps survived the fires at both sites, despite wilting and browning of the pads. During the following spring, Bakersfield cactus plants that were subjected to low-intensity flames flowered; however, those subjected to moderate-intensity flames produced only vegetative growth. Second, dense grass also may harbor insects that damage cactus, as was observed with related species of *Opuntia* in Nebraska grasslands (Burger and Louda 1994), but not yet studied in Bakersfield cactus. Third, the dense grass cover creates a moist microclimate which may promote the growth of decay organisms and cause cactus pads to rot more in years of above-average precipitation (Service 1998).

Loss of genetic diversity

The destruction of Bakersfield cactus habitat by agriculture and urban sprawl has left the remaining populations highly fragmented and small. The small size of many of the populations (Moe 1989; CNDDDB 2010), presumed lack of gene flow between populations, and infrequent sexual reproduction (Menges 1986) may result in a lack of genetic diversity (Service 1998)

although this has not been tested in Bakersfield cactus. Populations that are low in genetic variation are more vulnerable to diseases and parasites (Burdon and Marshall 1981) and to chance events, including environmental fluctuations, catastrophes, and genetic drift (Menges 1991). Several of the occurrences have few individuals (CNDDDB 2010) and could be subject to loss of genetic diversity.

Flooding

Bakersfield cactus populations located in floodplains are threatened by flooding. Bakersfield cactus plants cannot survive long periods of inundation (ESA Planning and Environmental Services 1986; Service 1998). Populations within the Caliente Creek floodplain have been extirpated due to flooding, and flooding continues to be a threat for the Caliente - Bena Hills populations (Service 1998; CNDDDB 2010).

Populations of Bakersfield cactus within the California Aqueduct right-of-way are also potentially threatened by flooding. Kern County identified earthquakes as highly significant hazard to all regions of Kern County. Large earthquakes can cause secondary hazards including landslides, fire, and flooding. The California Aqueduct crosses the White Wolf Fault at Wheeler Ridge and parallels the San Andreas Fault within 25 miles for most of its length in Kern County (Kern County Fire Department Office of Emergency Services 2005). The largest concentration of clumps in the Wheeler Ridge population is located adjacent to an overflow drain for the Aqueduct, which could lead to flooding if an earthquake occurred anywhere along its length (Service 1998).

Air pollution

Foliar injury

The Recovery Plan cites Messick (1987) as stating that air pollution is suspected to have contributed to the decline of Bakersfield cactus. Messick noted that populations of Bakersfield cactus appeared to be reproducing less and losing vigor and that soft tissues may be adversely affected by acid deposition or ozone. He suggested that study of possible air pollution effects was needed.

Sulfur oxides (SO_x), ozone, and nitrogen air pollutants are components of air pollution which have been found to negatively affect plants. Olszyk and Bytnerowicz (1987) found that *Opuntia basilaris* pads that had just recently fully expanded showed signs of visible injury in the form of white necrotic banding when exposed to 2.0 microliter (2 millionths of a liter) per liter SO₂ (sulfur dioxide) in acute greenhouse experiments; however, no visible injury from SO₂ was observed in chronic field exposures. In 2005, emissions of SO_x were estimated at 9.8 tons/day (27,750 liters per day) for the San Joaquin Valley portions of Kern County (California Air Resources Board 2006); however, no data are available on the concentrations to which Bakersfield cactus were exposed or the ambient concentrations which would cause injury. The largest source of SO_x was from oil and gas production (California Air Resources Board 2006).

Within the San Joaquin Valley portions of Kern County, ozone and nitrogen air pollutants are more common air pollutants than sulfur oxides. Numerous studies have documented the

negative effects of ozone on plants such as pronounced foliar injury and growth reduction (e.g., Miller 1992; Grantz and Yang 1996; Bytnerowicz 2002), but no studies have been performed on Bakersfield cactus. The U.S. Environmental Protection Agency (EPA) monitors ozone levels through out the country and reports these measures as an 8-hour average ozone concentration in parts per million (O_3 ppm). The EPA regards 8-hour ozone values of 0.085 ppm as the average value for the nation and 8-hour ozone values higher than 0.085 ppm as unhealthy for humans, animals and plants (National Association of Clean Air Agencies 2008). The California Air Resources Board (2006) reported in nearby Bakersfield, Kern County, as many as 116 days per year that were above the national 8-hour average ozone concentration standard of 0.085 ppm during the period 2002-2005. No data are available on possible exposure damage to Bakersfield cactus.

Elevated nitrogen deposition

Elevated atmospheric N deposition (as nitrites and nitrates, ammonia and ammonium ions) is particularly harmful to N-limited ecosystems such as Bakersfield cactus habitat in the arid southern San Joaquin Valley where it leads to increases in nonnative annual grasses which outcompete the native flora (Fenn *et al.* 2003). Weiss (1999) found that dry N deposition from smog in the San Francisco Bay Area has enabled the invasion of nonnative annual grasses into native grasslands on nutrient-poor, serpentinitic soils resulting in the loss of habitat for the federally-threatened bay checkerspot butterfly (*Euphydras editha bayensis*). Other researchers found that increased levels of soil N from elevated atmospheric N deposition in the Mojave Desert could increase the dominance of nonnative annual grasses and thereby raise the frequency of fire, an impact on Bakersfield cactus mentioned in the final listing rule (Brooks 1999; Brooks and Pyke 2001; Brooks 2003). Other potential effects of elevated atmospheric N deposition to plants in sandy N-limited ecosystems (Wolkowski *et al.* 2008), such as that in which the Bakersfield cactus grows, include decreased diversity of mycorrhizal communities (Egerton-Warburton and Allen 2000; Sigüenza 2000). Mycorrhiza form a mutualistic relationship with plants including cactus in which in exchange for carbohydrates from the plant the mycorrhiza increase nutrient uptake of water and minerals from the soil, and increase the plants resistance to disease (Campbell *et al.* 1987). Increased N deposition can also predispose plants to other environmental stresses such as elevated concentrations of ozone, drought, frost, or insect attacks (Bytnerowicz 2002; Jones *et al.* 2004).

In addition to foliar injury, N air pollutants affect plants by increasing soil N levels. Dry N deposition estimates for Bakersfield are 10 to 20 kilograms nitrogen per hectare per year (Blanchard *et al.* 1996). Nitrogen-limited ecosystems of the Western United States, such as Bakersfield cactus habitat, are affected by N deposition as low as 3 to 8 kilograms nitrogen per hectare per year (Fenn *et al.* 2003). The majority of airborne N in the San Joaquin Valley is in reduced form as NH_3 (ammonia) and particulate NH_4^+ (ammonium ion), primarily from the dairy, poultry, and beef industries (Gaffney and Shimp 1999, California Air Resources Board 2006). Predicted NH_3 emissions in 2010 for the San Joaquin Valley Air Basin are 465.4 tons per day (San Joaquin Valley Air Pollution District 2003). Nitrogen oxides (NO_x) are another significant source of elevated N deposition in the southern San Joaquin Valley. In 2005, NO_x emission rates in the San Joaquin Valley portion of Kern County were 123.7 tons per day; 46 percent of the NO_x emissions were from stationary fuel combustion sources (primarily food and agricultural processing, manufacturing and industrial activities, and oil and gas production), 32

percent were from on-road motor vehicles (primarily heavy duty diesel trucks), and 21 percent were from other mobile sources (off-road equipment and trains) (California Air Resources Board 2006). About 76 percent of NO_x emissions in Kern County are deposited through atmospheric N deposition (Holmes 1996). Nitrogen deposition rates dramatically increase in fog as typical of the radiation fog events in the southern San Joaquin Valley during the winter (Pandis 1990; Fenn *et al.* 2000). Radiation fog is typically generated at night as heat is radiated away from the ground allowing condensation of water droplets in air near the ground (Underwood *et al.* 2004)

Excessive dust

An additional potential threat to the Bakersfield cactus is excessive dust. Dust may affect photosynthesis, respiration, and transpiration and allow the penetration of phytotoxic gaseous pollutants (Farmer 1993). However, no research has specifically analyzed the effects of dust on Bakersfield cactus or related species. From 1996-2005, Bakersfield on average surpassed the state of California 24-hour PM₁₀ (particulate matter with an aerodynamic diameter of 10 microns or less) standard 170 days per year and surpassed the national 24-hour PM_{2.5} (particulate matter with an aerodynamic diameter of 2.5 microns or less) standard 16 days per year (California Air Resources Board 2006). Dust levels in excess of state standards may negatively affect Bakersfield cactus. In 2005, the primary sources of particulate matter (PM₁₀ and PM_{2.5}) in Kern County were farming operations, road dust, and fugitive windblown dust (California Air Resources Board 2006). Fugitive windblown dust increases result in part from the reduction of shrub and bunchgrass cover and increases in low growing annual vegetation and bare ground in rangelands (Mansell *et al.* 2006).

The impacts of poor air conditions in the San Joaquin Valley on native plants have been little studied but warrant greater consideration in the future. Nonetheless, compared to the ongoing threat of habitat loss and fragmentation, we consider atmospheric pollution affects on natural landscapes a lesser threat to Bakersfield cactus in terms of magnitude (severity) and imminence.

Reproductive threats

Reproduction of Bakersfield cactus may be threatened by the loss of pollinators. The reproductive biology of Bakersfield cactus has not been studied, but other *Opuntia* species are known to require cross-pollination for seed-set and many are pollinated by bees (Benson 1982; Spears 1987; Osborn *et al.* 1988; Thorp *in litt.* 1998). Pollinators are threatened by the use of both regulated (e.g., malathion) and unregulated pesticides (e.g., pyrethroids) (Service 2000; DPR 2006; Keith 2006). Malathion, a broad spectrum insecticide, has been used to control the beet leaf-hopper (*Circulifer tenellus*) in rangeland habitat, fallow fields, oil fields, and cultivated areas on both public (BLM) and private lands in the San Joaquin Valley, and in adjacent valleys and foothills. Increasingly, malathion is used to kill agricultural pests and mosquitoes, which are documented as vectors of the West Nile Virus. Its application therefore, is not limited to agricultural areas but includes residential and commercial zones thereby increasing the regional areas in which it is used. Hymenopterans (ants, wasps, bees, etc.) are particularly susceptible to malathion exposure (Dobroski and Lambert 1984).

Climatic change

Climatic change may impact Bakersfield cactus, which is already confined to small isolated populations due to significant habitat loss from agricultural development and urban sprawl. Bakersfield cactus evolved under a unique set of geographic and climatic conditions that occur only in the southern San Joaquin Valley of California. The southern San Joaquin Valley is more arid than areas farther north. Bakersfield has an average annual precipitation of only 6.2 inches compared to 20 inches in the northern San Joaquin Valley (Western Regional Climate Center 2006). This arid environment makes the southern San Joaquin Valley floristically more similar to the Mojave Desert than the more mesic grasslands of the northern San Joaquin Valley. The southern San Joaquin Valley, however, differs climatologically from the Mojave Desert due to its unique location where it is susceptible to winter fog and rain but isolated from the monsoonal air masses that bring summer thunderstorms to the Mojave. The southern San Joaquin Valley is also at a lower elevation than the Mojave Desert.

Climate models predict for California an overall warming of 1.7 degrees to 5.8 degrees Celsius (3.0 degrees Fahrenheit to 10.4 degrees Fahrenheit) by 2100 (Cayan *et al.* 2006), but they vary in their predictions for precipitation. VanRheenen *et al.* (2004) predict a decrease in precipitation in the southern San Joaquin Valley. Bakersfield cactus seeds require warm, wet conditions to germinate (Benson 1982). Therefore, a sufficient decrease in precipitation could hinder Bakersfield cactus growth by sexual reproduction. Additionally, studies at Sand Ridge Preserve revealed increases in Bakersfield cactus mortality and lowered rates of vegetative and sexual reproduction in years of below-average precipitation due to competition for water with nonnative annual grasses (Cypher and Fiehler 2006; Cypher pers. comm. 2006). Conversely, increases in annual precipitation would possibly promote the growth of decay organisms resulting in the rot of cactus pads (Service 1998). Bakersfield cactus cannot tolerate prolonged periods of inundation as observed in the Caliente Creek floodplain (ESA Planning and Environmental Services 1986; Service 1998; CNDDDB 2010). The effect of such changes in climate on nonnative species and parasites is unknown, but could accelerate their establishment in Bakersfield cactus habitat. If such changes in climate occur, and the resulting changes in precipitation occur, Bakersfield cactus could be extirpated with no available refugia.

In summary, the threats attributable to Factor E, competition from nonnative grasses, flooding and the emerging threats from elevated nitrogen deposition, excessive dust, loss of pollinators, and climatic change are landscape level threats. The imminence of these threats to Bakersfield cactus is not well understood; however, due to the landscape level effects likely to result from nonnative grasses, air pollution including nitrification, and climate change, these threats should be considered large in magnitude.

Synthesis

When Bakersfield cactus was listed as endangered 1990 (Service 1990), we did not quantify how many occurrences or populations of Bakersfield cactus were extant. Currently, approximately 1068.40 acres (74.6 percent) of occupied presumed extant Bakersfield cactus habitat is on private land that is not protected; 144.35 acres (10.1 percent) of occupied presumed extant Bakersfield habitat is on private land that is protected. About 115.03 acres (8 percent) of presumed extant

Bakersfield cactus habitat is on public land that is unprotected; 104.37 acres (7.3 percent) is on protected public lands (Kern County Assessor's Office 2009; CNDDDB 2010). The populations that have been protected do not yet have management plans written or implemented that achieve the recovery plan's criteria.

The occurrences on public lands are protected from the direct effects from urbanization and agricultural land conversion, but may still be subject to other threats including oil and gas exploration and conveyance, competition with nonnative grasses, and emerging threats from landscape nitrification and climate change. Approximately 75 percent of the presumed extant occupied Bakersfield cactus habitat is on private land that is not protected (Kern County Assessor's Office 2009; CNDDDB 2010).

Surveys for Bakersfield cactus have not been consistently performed throughout its range, and a majority of occurrences have not been surveyed for since 1989. A status survey is currently ongoing. To date, three populations have been visited and their status evaluated. Thus, reliable values for population sizes and trends do not exist for the overall distribution of this species.

When Bakersfield cactus was listed as endangered in 1990 (Service 1990), the major threats to the species included agricultural land conversion, oil development, sand mining, urbanization, off-road vehicle use, proposed flood control basins, telecommunication and electrical lines construction, aqueduct and transmission line maintenance and competition with nonnative, annual grasses.

The past extirpation of Bakersfield cactus from most of its historic range and the current threats to the species continue to endanger the survival and recovery of Bakersfield cactus. The threats today include residential and urban development, oil development, off road vehicle use, sand mining and competition from nonnative grasses. Climatic change, air pollution (including elevated nitrogen deposition), loss of pollinators, flooding and loss of genetic diversity have been identified as potential new threats.

In summary, based on the continuing threats to Bakersfield cactus from habitat conversion, oil and gas development, sand mining, competition with nonnative grasses; the new threats from climatic change, air pollution (including elevated nitrogen deposition), loss of pollinators, flooding and loss of genetic diversity we conclude that the species continues to meet the Endangered Species Act definition of endangered of extinction throughout all or a significant portion of its range. No status change is recommended at this time.

III. RESULTS

III.A. Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

III.B. New Recovery Priority Number 3C

No change in Recovery Priority Number is necessary. The degree of threat and recovery potential remain high, and the species continues to conflict with construction or other development projects, or other forms of economic activity.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

The five highest priority actions to be implemented over the next 5 years to achieve progress toward recovery are as follows:

1. Protect populations within Bakersfield City limits in the Kern Bluff area and south of highway 178.
2. Work with willing land owners to establish a conservation easement or fee title to the property at the mouth of Kern Canyon.
3. Complete the draft Department of Water Resources Habitat Conservation Plan.
4. Conduct census of known populations and monitor the reproductive status of known populations
5. Determine suitable management methods for reducing nonnative annual grasses and increasing native perennials, including Bakersfield cactus, and communicate the benefits of such management to rangeland landowners.

Additional actions that will assist in achieving progress toward Bakersfield cactus recovery include.

Identify funding sources for rangeland management of nonnative species: Work through soil conservation agencies and mitigators to identify funding sources.

Research needs

- Identify pollinators and the effects of pesticide use.
- Study possible effects of air pollution

Completion of other draft HCPs and management plans: Work with proponents to complete the Kern County Valley Floor HCP, Sand Ridge Preserve management plan, and CDFG Bakersfield cactus preserves management plan.

Habitat acquisition:

- Acquire habitat near Caliente Creek (occurrences #22, #23, #24)

V. REFERENCES

- Benson, L.D. 1982. The cacti of the United States and Canada. Stanford University Press, Stanford, California.
- Blanchard, C.L., H. Michaels, and S. Tannenbaum. 1996. Regional estimates of acid deposition fluxes in California for 1985 – 1994. Final Report 93-332. California Air Resources Board, Sacramento, California.
- Britton, N.L., and J.N. Rose. 1920. The cactaceae. Carnegie Institute, Washington, DC, Publication 248, 1: 1-236.
- Brooks, M.L. 1999. Alien annual grasses and fire in the Mojave Desert. *Madroño* 46: 13-19.
- Brooks, M.L. 2003. Effects of increased soil nitrogen on the dominance of alien annual plants in the Mojave Desert. *Journal of Applied Ecology* 40: 344-353.
- Brooks, M.L. and D. Pyke. 2001. Invasive plants and fire in the deserts of North America. *Proceedings of the Invasive Species Workshop: The Role of Fire in the Control and Spread of Invasive Species Fire Conference 2000: the First National Congress on Fire, Ecology, Prevention and Management* (eds. K. Galley and T. Wilson), pp. 1-14 in *Miscellaneous Publications No. 11*. Tall Timbers Research Station, Tallahassee, Florida.
- Brown, N.L. and E.A. Cypher. 2006. Bakersfield cactus *Opuntia basilaris* var. *treleasei*. Endangered Species Recovery Program. California State University, Stanislaus, California. Available on the internet at <<http://esrpweb.csustan.edu/speciesprofiles/profile.php?sp=opba>>. Accessed October 18, 2006.
- Burdon, J.J. and D.R. Marshall. 1981. Biological control and the reproductive mode of weeds. *Journal of Applied Ecology* 18: 649-658.
- Burger, D. 2006. Council delays vote on hillside ordinance. *The Bakersfield Californian*. October 12, 2006. Bakersfield, California.
- Burger, J.C., and S.M. Louda. 1994. Indirect versus direct effects of grasses on growth of a cactus (*Opuntia fragilis*): insect herbivory versus competition. *Oecologia* 99: 79-87.

- Bytnerowicz, A. 2002. Physiological/ecological interactions between ozone and nitrogen deposition in forest ecosystems. *Phyton* (Austria) 42: 13-28.
- California Air Resources Board. 2006. 2005 Estimated Annual Average Emissions. Available on the internet at <<http://www.arb.ca.gov/maps/maps.html>>. Accessed November 2007.
- [CNDDDB] California Natural Diversity Database. 2007. Biogeographic Data Branch, California Department of Fish and Game.
- [CNDDDB] California Natural Diversity Database. 2010. Biogeographic Data Branch, California Department of Fish and Game. September 2010.
- [DWR} California Department of Water Resources. In preparation. Department of Water Resources Habitat Conservation Plan. California Department of Water Resources. Sacramento, California.
- California Department of Justice, Office of the State Attorney General. 1998. California Legal opinions of the Attorney General Office. Opinion no. 98-105. Available on the internet at <<http://ag.ca.gov/opinions/pdfs/98-105.pdf>>. Accessed July 30, 2010.
- Campbell, N.A., J.B. Reece, L.G. Mitchell, 1987. Page 724 in *Biology* (5th edition, 1999), Addison Wesley Longman, Inc, Menlo Park, California.
- Cayan, D., A.L. Luers, M. Hanemann, G. Franco, and B. Croes. 2006. Scenarios of Climate Change in California: An Overview. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-186-SF. Available on the internet at: <http://www.energy.ca.gov/2005publications/CEC-500-2005-186/CEC-500-2005-186-SF.PDF>. Accessed October 2006.
- [CNLM] Center for Natural Lands Management. 2004. Sand Ridge Preserve. Center for Natural Lands Management. Bakersfield, California. <http://www.cnlm.org/sandridge.html>. Accessed October 2006.
- City of Bakersfield and County of Kern. 1994. Metropolitan Bakersfield Habitat Conservation Plan. Bakersfield, California.
- Cooley, G. 1995. Unpublished report updating Bakersfield cactus occurrences. Bureau of Land Management, Bakersfield, California. Additional edits made on June 19, 2006, by E. Cypher, Department of Fish and Game, Fresno, California.
- Cypher, B and E. Tennant. 2010. Status surveys for endangered Bakersfield cactus. Agreement No. R09AC20030 (CESU #3FC810873). Progress report to the Central Valley Project Conservation Program. April – September 2010, Sacramento, California.
- Cypher, E. 1994. Demography of *Caulathus californicus*, *Lembertia congdonii*, and *Eriastrum hooveri*, and vegetation characteristics of endangered species populations in the southern

- San Joaquin Valley and the Carrizo Plain Natural Area in 1993. Final report to the California Department of Fish and Game, Sacramento, California.
- Cypher, E.A. and C. Fiehler. 2006. Control of Nonnative grasses enhances growth and survival of endangered Bakersfield cactus. Presented at the San Joaquin Natural Communities Conference, April 17, 2006, California State University Bakersfield.
- [DPR] Department of Pesticide Regulation. 2006. DPR orders data call-in to protect waterways. News release (06-15), September 1, 2006 news release. California Department of Pesticide Regulation. Sacramento, California. Available on the internet at: <<http://www.cdpr.ca.gov/docs/pressrls/2006/060901.htm>>. Accessed October, 2006.
- Dobroski, C.J. Jr. and W.P. Lambert. 1984. Malathion: a profile of its behavior in the environment. Submitted to U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. Contract 53-6395-1-151.
- Deutsche, C. 2007. Wind wolves preserve service trip. *The Survivor* 26: 9.
- Egerton-Warburton, L., and E.B. Allen. 2000. Shifts in arbuscular mycorrhizal communities along an anthropogenic nitrogen deposition gradient. *Ecological Applications* 10: 484-496.
- ESA Planning and Environmental Services. 1986. Caliente Creek stream group investigation. U.S. Army Corps of Engineers, Sacramento, California, Contract No. DACW05-85-0061, Unpublished Report.
- Farmer, A. M. 1993. The effects of dust on vegetation - a review. *Environmental Pollution* 79:63-75.
- Fenn, M.E., M.A. Poth, S.L. Schilling, D.B. Grainger. 2000. Throughfall and fog deposition of nitrogen and sulfur at an N-limited and N-saturated site in the San Bernardino Mountains, southern California. *Canadian Journal of Forest Research* 30: 1476-1488.
- Fenn M.E., Baron J.S., Allen E.B., Rueth H.M., Nydick K.R., Geiser L., Bowman W.D., Sickman J.O., Meixner T., Johnson D.W., Neitlich P. 2003. Ecological effects of nitrogen deposition in the western United States. *BioScience* 53: 404-420.
- Gaffney, P, and D. Shimp. 1999. Ammonia emission inventory development: needs, limitations, and what is available now. California Air Resources Board. Sacramento, California.
- George Lawrence and Associates. 1988. A biological assessment: Rio Bravo rare cactus report. U.S. Fish and Wildlife Service, Sacramento, California, Unpublished Report..
- Grant, V. and K.A. Grant. 1979. Pollination of *Opuntia [sic] basilaris* and *O. littoralis*. *Plant Systematics and Evolution* 132:321-325.

- Grantz, D.A., and S. Yang. 1996. Effect of ozone on hydraulic architecture in Pima cotton. I. Carbon allocation and water transport capacity of roots and shoots. *Plant Physiology* 112: 1649-1657.
- Griggs, F.T., J.M. Zaninovich, and G.G. Werschkull. 1992. Historic native vegetation map of the Tulare Basin, California. Pp 111-118 in *Endangered and sensitive species of the San Joaquin Valley, California: their biology, management, and conservation* (D.F. Williams, S. Byrne, and T.A. Rado, eds.). California Energy Commission, Sacramento, California.
- Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, California.
- Holmes, J.R. 1996. Acid deposition rates in California. Research Note 96-13. Air Resources Board. California Environmental Protection Agency. Available on the internet at <<http://www.arb.ca.gov/research/resnotes/notes/96-13.htm>> Accessed October 2006.
- Jones, M.E., Paine, T.D., Fenn, M.E., and M.A. Poth. 2004. Influence of ozone and nitrogen deposition on bark beetle activity under drought conditions. *Forest Ecology and Management* 200: 67-76.
- Keith, T. 2006. Suburban lawn run-off poisons aquatic life. *All Things Considered*. National Public Radio. October, 19, 2006.
<http://www.npr.org/templates/story/story.php?storyId=6160974>.
- Kern County Assessor's Office. 2009. Kern County GIS Tax Parcels 2009 Final. Publication date 06/28/2009.
- Kern County Fire Department Office of Emergency Services. 2005. Kern County, California multi-hazard mitigation plan. Developed in compliance with the Disaster Mitigation Act of 2000 with the professional planning services of Robert Olson Associates, Inc. and AMEC Earth and Environmental, Inc.
- Lawrence, G. 1987. A status report – Rio Bravo hydroelectric site grass fire impact on a rare cactus. Unpublished Report, Borcalli, Ensign, and Buckley, Consulting Engineers, Sacramento, California.
- Mansell, G.E., S. Lau, J. Russell, and M. Omary. 2006. Final report- fugitive windblown dust emissions and model performance evaluation, phase II. Prepared by ENVIRON International Corporation, Novato, California prepared for Western Governors' Association, Denver, Colorado..
- Menges, E.S. 1986. Predicting the future of rare plant populations: demographic monitoring and modeling. *Natural Areas Journal* 6:13-25.

- Menges, E.S. 1991. The application of minimum viable population theory to plants. Pp 45-61, *in* Genetics and Conservation of Rare Plants (D.A. Falk and K.E. Holsinger, eds.). Oxford University Press, New York.
- Messick, T.C. 1987. Research needs for rare plant conservation in California. Pp. 99-108, *in* Conservation and management of rare and endangered plants: proceedings of a California conference on the conservation and management of rare and endangered plants (T.S. Elias, ed.). California Native Plant Society, Sacramento, California.
- Metropolitan Bakersfield Habitat Conservation Plan Implementation Trust Group. 2010. Combined annual year sixteen and quarterly report of the Metropolitan Bakersfield habitat conservation plan. Fiscal year 09/10. July 31, 2010.
- Michael Brandman Associates. 2006. Initial Study for The Canyons. Report prepared for City of Bakersfield. Michael Brandman Associates. Irvine, California..
- Miller, P.R. 1992. Mixed conifer forests of the San Bernardino Mountains, California. *in* (Olson, R.K., Binkley D., and Böhm M, eds.) The Responses of Western Forests to Air Pollution. Springer – Verlag, New York, New York.
- Minnich, R.A. and A.C. Sanders. 2000. *Brassica tournefortii* Gouan. pp. 68-72 *in* Invasive Plants of California's Wildlands (C.C. Bossard, J.M. Randall, and M.C. Hoshovsky, eds.) University of California Press, Berkeley, California..
- Mitchell, D. 1988. Petition to the State of California Fish and Game Commission to list Bakersfield cactus (*Opuntia treleasei*). California Department of Fish and Game, Sacramento, California. Unpublished Report.
- Moe, M. 1989. Report on field surveys of known occurrences of *Opuntia basilaris* var. *treleasei*. Unpublished Report, California State University, Bakersfield, California. 4 pp.
- Munz P.A. and D.D Keck. 1959. A California flora. University of California Press, Berkeley, California.
- National Association of Clean Air Agencies (NACAA). 2008. Air Quality Index. Available on the internet at: <<http://www.airnow.gov/index.cfm?action=health2.smog1#4>>. Accessed February 2008.
- National Research Council. 2006. Status of pollinators in North America. Report in Brief. October 2006. The National Academy of Sciences. http://dels.nas.edu/dels/rpt_briefs/pollinators_brief_final.pdf. Accessed October 2006.
- Nielsen, J. 2006. Declining bee population threatens major growers. All Things Considered. National Public Radio. October 19, 2006.

- [Nuevo/Torch] Nuevo Energy Company and Torch Operating Company. 1999. Habitat Conservation Plan, Final Draft. Bakersfield, California. February 1999.
- Olszyk, D.M. and A. Bytnerowicz. 1987. Sulfur dioxide effects on plants exhibiting Crassulacean Acid Metabolism. *Environmental Pollution* 43: 47-62.
- Osborne M.M., P.G. Kevan, and M.A. Lane. 1988. Pollination biology of *Opuntia polyacantha* and *Opuntia phaeacantha* (Cactaceae in southern Colorado. *Plant Systematics and Evolution* 159:85-94.
- Pandis, Spyros N. 1990. Studies of physicochemical processes in atmospheric particles and acid deposition. PhD dissertation. California Institute of Technology. Available on the internet at <<http://resolver.caltech.edu/CaltechETD:etd-05062004-154106>>. Accessed October 2006.
- Parfitt, B.D, and M.A. Baker. 1993. *Opuntia*. pp. 452-456, in (J.C. Hickman, ed.) *The Jepson Manual: Higher Plants of California*. University of California, Berkeley, California.
- RBF Consulting. 2006a. Initial Study/Environmental Checklist: Watermark Development Project. Prepared for City of Bakersfield by RBF Consulting, Irvine, California.
- RBF Consulting. 2006b. Initial Study/Environmental Checklist: Riverview Development Project. Prepared for City of Bakersfield by RBF Consulting, Irvine, California.
- San Joaquin Valley Air Pollution District. 2003. Draft 2003 PM10 Plan. Table 3-6. Summary of annual ammonia emissions.
<http://www.valleyair.org/workshops/postings/03-24-03/chapters/addendum%20-%20ch%203%20text%203-28.pdf>. October 2006.
- Sigüenza, C. 2000. Nitrogen deposition and soil microorganisms of *Artemisia californica* and exotic grasses in southern California. PhD dissertation. University of California, Riverside, California.
- Spears, E.E., Jr. 1987. Island and mainland pollination ecology of *Centrosema virginianum* and *Opuntia stricta*. *Journal of Ecology* 75:351-362.
- [TRC] Tejon Ranch Company. 2008a. Tejon Ranch Conservation and Land Use Agreement. Available on the internet at <<http://www.sec.gov/Archives/edgar/data/96869/000119312508138009/dex1028.htm>>. Accessed on November 10, 2010.
- [TRC] Tejon Ranch Company. 2008b. Protecting a California treasure. Available on the internet at <<http://www.tejonpreserve.com/summary.php>>. Accessed on November 10, 2010.

- Twisselmann, E.C. 1967. A flora of Kern County, California. *The Wasmann Journal of Biology* 25: 1-395.
- U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office. 2005. National Agriculture Imagery Program (NAIP) digital ortho photo image.
- [Service] U.S. Fish and Wildlife Service. 1987. Biological Opinion for the Federal Energy Commission Kern River and Mojave Pipeline, Westside and Eastside Lateral Pipelines, Kern County. Service File # 1-1-87-F-0036R. Sacramento, California.
- [Service] U.S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; determination of endangered or threatened status for five plants from the southern San Joaquin Valley. *Federal Register* 55:29361-29370.
- [Service] U.S. Fish and Wildlife Service. 1994. Biological Opinion for the Intra-Service formal section 7 consultation on issuance of a section 10(a)(1)(B) permit for the Metropolitan Bakersfield 2010 General Plan Area, Kern County. Sacramento, California.
- [Service] U.S. Fish and Wildlife Service. 1996. Biological Opinion for the Southern California Gas Pipelines in Fresno, Kings, Tulare, and Kern Counties. Service File # 1-1-96-F-0136. Sacramento, California.
- [Service] U.S. Fish and Wildlife Service. 1997. Biological Opinion for Pacific Pipeline Systems, Inc. oil pipeline from Emidio in Kern County to refineries in the Los Angeles area. Service File # 1-1-97-F-0024. Sacramento, California.
- [Service] U.S. Fish and Wildlife Service. 1998. Recovery plan for upland species of the San Joaquin Valley, California, Region 1, Portland, Oregon.
- [Service] U.S. Fish and Wildlife Service. 2000. Biological Opinion for formal section 7 consultation on renewal of a five-year pesticide use permit to the California Department of Food and Agriculture for use of malathion to control curly-top virus in Fresno, Kings, Kern, Los Angeles, Merced, Monterey, San Luis Obispo, San Joaquin, Santa Barbara, Stanislaus, Imperial, and Ventura Counties, California. Service File # 1-1-00-F-0212. Sacramento, California.
- [Service] U.S. Fish and Wildlife Service. 2007. Intra-Service Biological and Conference Opinion on Issuance of a Section 10(a)(1)(B) Incidental Take Permit to Pacific Gas & Electric Company (PG&E) for the San Joaquin Valley Operations and Maintenance Program Habitat Conservation Plan, for portions of Nine Counties in the San Joaquin Valley, California. Service File # 1-1-07-F-0445.
- [Service] U.S. Fish and Wildlife Service. 2010. Conservation Plans and Agreements Database. Available in the internet at https://ecos.fws.gov/conserv_plans/. Accessed October 4, 2010.

- Underwood, S.J. G.P. Ellrod, A.L. Kuhnert. 2004. A multiple-case analysis of nocturnal radiation-fog development in the Central Valley of California utilizing the GOES nighttime fog product. *Journal of Applied Meteorology* 43: 297-311.
- VanRheenen, N.T., A.W. Wood, R.N. Palmer, and D.P. Lettenmaier. 2004. Potential implications of PCM climate change scenarios for Sacramento-San Joaquin River Basin hydrology and water resources. *Climatic Change* 62: 257-281.
- Weiss, S.B. 1999. Cars, cows, and Checkerspot Butterflies: nitrogen deposition and management of nutrient-poor grasslands for a threatened species. *Conservation Biology*. 13: 1476-1486.
- Western Regional Climate Center. 2006. Monthly precipitation listings for Bakersfield WSO Airport, California. Available on the internet at <<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca0442>>. Access date October 2006.
- Williams, M. 2006. Northeast growing, slowly but surely. *The Bakersfield Californian*. October 12, 2006. Bakersfield, California.
- Wolkowski, R.P. K.A. Kelling, and L.G. Bundy. 2008. Nitrogen management on sandy soils. Available on the internet at <<http://learningstore.uwex.edu/pdf/A3634.pdf>>. Access date March 2008.

In Litt. References

- Bowen, C. 1987. Letter from Consultant, Bowen's Biological Services, Bakersfield, California to Jim Bartel, U.S. Fish and Wildlife Service, Sacramento, California.
- Cross, P.A. 2006. Comment letter regarding the Longbow, LLC Section 4 Project from Deputy Assistant Field Supervisor, Endangered Species Division, Sacramento Fish and Wildlife Office, Sacramento, California, to John Howe, Longbow, LLC, Bakersfield, California, Service File # 1-1-06-TA-1763. Sacramento, California.
- Cypher, E.. 2006. Electronic mail regarding Bakersfield cactus sites at Bena Hills, Sand Ridge, and the area north of the airport from Botanist, California Department of Fish and Game, Fresno, California, to Joseph D. Terry, Biologist, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.
- Cypher, E.. 2008. Electronic mail regarding Bakersfield cactus sites and development from Botanist, California Department of Fish and Game, Fresno, California, to Tim Kuhn, Biologist, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.
- Cypher, E. 2010. Electronic mail regarding California Department of Fish and Game acquisitions of Bakersfield cactus from Botanist California Department of Fish and

Game, Fresno, California, to Kirsten Tarp, Biologist, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

Hewett, R. 1987. Letter from Sand Ridge Preserve Manager, Weldon, California, to James J. McKevitt, U.S. Fish and Wildlife Service, Sacramento, California.

Loudermilk, W.E. 2006a. Comment letter regarding The Canyons Development Project Draft Environmental Impact Report from Regional Manager, California Department of Fish and Game, Fresno, California, to Jennie Eng, Planner, City of Bakersfield, California.

Loudermilk, W.E. 2006b. Comment letter regarding the Riverview Development Project Notice of Preparation for Draft Environmental Impact Report from Regional Manager, California Department of Fish and Game, Fresno, California, to Marc Gauthier, Principle Planner, City of Bakersfield, California,.

Loudermilk, W.E. 2006c. Comment letter regarding the Watermark Development Project Notice of Preparation for Draft Environmental Impact Report from Regional Manager, California Department of Fish and Game, Fresno, California, to Marc Gauthier, Principle Planner, City of Bakersfield, California.

Loudermilk, W.E. 2006d. Comment letter regarding the Longbow LLC Section 4 Project from the Regional Manager, California Department of Fish and Game, Fresno, California, to Linda Campion, Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Sacramento, California.

Thorp, R.W. 1998. Comment letter on Draft Recovery Plan for Upland Species of San Joaquin Valley, California.

Warrick, G. 2006. Electronic mail regarding Bakersfield cactus at the Sand Ridge Preserve from the Manager, Center for Natural Lands Management, Bakersfield, California, to Joseph D. Terry, Biologist, U.S. Fish and Wildlife Service, Sacramento, California.

Personal Communications and Observations

Cypher, Ellen A. 2006. Botanist. California Department of Fish and Game. Fresno, California. Conversation between Ellen Cypher and Joseph Terry, SFWO.

Cypher, Ellen A. 2010. Botanist. California Department of Fish and Game. Fresno, California. Conversation between Ellen Cypher and Kirsten Tarp, Sacramento Fish and Wildlife Office, Sacramento, California.

van de Hoek, R. No date. Personal communication with Ellen Cypher.

Warrick, Greg. 2006. Kern County Lands Manager. Center for Natural Land Management. Bakersfield, California.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Opuntia treleasei*=*Opuntia basilaris* var. *treleasei*

Current Classification Endangered

Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Review Conducted By Kirsten Tarp, Sacramento Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 8 Sept 2011