U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE FOR 5-YEAR REVIEW DETERMINATION

KUENZLER'S HEDGEHOG CACTUS

CURRENT CLASSIFICATION Endangered

5-YEAR REVIEW DETERMINATION _____ Delist __X__ Endangered to Threatened

_____ Threatened to Endangered ____ No Change

APPROPRIATE LISTING/RECLASSIFICATION NUMBER ____4____

REVIEW CONDUCTED BY Region 2 Regional Office and NM Ecological Services Field Office

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Susan MacMullin Date 5/23/05

Do Not Approve _____ Date _____

Lead Regional Director, U.S. Fish and Wildlife Service

Concur Larry E. Bell acting Date 6/7/05

Not Concur _____ Date _____

U.S. FISH & WILDLIFE SERVICE
5-YEAR REVIEW

KUENZLER'S HEDGEHOG CACTUS
***Echinocereus fendleri* Englemann var. *kuenzleri* (Castetter, Pierce & Schwerin) L. Benson**

METHODOLOGY USED TO COMPLETE THIS 5-YEAR REVIEW

This review was a team effort comprised of biologists from the U.S. Fish and Wildlife Service (FWS) Region 2 Regional Office, the New Mexico Ecological Services Field Office, the New Mexico State Forestry Division, and the University of New Mexico. Robert Sivinski, Botanist for the New Mexico State Forestry Division, was contracted through a Section 6 grant to gather the relevant information and prepare a draft of the review. The preliminary draft was reviewed by Phil Tonne, University of New Mexico Natural Heritage program, for scientific accuracy. The FWS team then met with the contractor to discuss the draft and formulate a recommendation. The final review was prepared by a FWS Regional recovery biologist.

FR Notice:	Vol. 66, No. 139; Wednesday, July 21, 2004; 43621-43622
Lead Region:	Region 2, Southwest Contact: Stuart Leon, Chief Threatened and Endangered Species 505-248-6920
Lead Field Office:	New Mexico Ecological Services Field Office Contact: Lyle Lewis, Endangered Species Branch Chief 505-761-4714
Names of Reviewers:	Wendy Brown, Recovery Coordinator, FWS-Region 2 RO 505-248-6664
	Julie McIntyre, SCEP Biologist, FWS-Region 2 RO 505-248-6507
	Tracy Scheffler, Recovery Biologist, FWS-Region 2 RO 505-248-6665
	Steve Chambers, Senior Scientist, FWS-Region 2 RO 505-248-6658
	Susan Jacobsen, Listing Coordinator, FWS-Region 2 RO 505-248-6641
	Melissa Kreutzian, Wildlife Biologist, NM Ecological Services Field Office (505)346-2525 ex. 4728

BACKGROUND

1. Existing Recovery Priority Number: 3

   Recovery Priority Number = 3. At the time of listing, Kuenzler hedgehog cactus was recognized as the species *Echinocereus kuenzleri*; however, a taxonomic revision was in press to reclassify this plant as the variety *Echinocereus fendleri* var. *kuenzleri*. Less than 200 individual plants were known in the wild, which were in great demand by cactus collectors when listed as endangered. Therefore, the degree of threat and recovery priority was considered to be 'High'. This priority number has not been revised since the original listing in 1979 (USFWS 1979).

2. Most recent Species Status as reported to Congress in the Biennial Report:

   Species Status: S = Stable.
   No recent reports of extirpations or serious population declines.

   Recovery achieved: 2 = 26%-50% of species recovery objectives achieved (USFWS 2002).

   Surveys for this cactus have been accomplished in most suitable habitats on lands in Federal and some State of New Mexico jurisdictions. Within the past 5 years, surveys have located additional populations, increasing the overall range and abundance of the species. Although threats of grazing and fire may still exist, the increase in populations and individual numbers proportionally diminishes the impact of the threats. Research on the effects of fire have begun on USDA-Forest Service lands and are currently proposed on USDI-BLM lands.

3. Listing History:

   3.A. Original Listing:

   FR Vol. 44, No. 209; Friday, October 26, 1979; 61924-61927.

   3.B. Revised Listing:

   None.

4. Associated Listings:

   None.

5. Review History:

   FR, Vol. 41, No 117, Wednesday, June 16, 1976. Proposed Endangered Status for Some 1700 U.S. Vascular Plant Taxa.

6. Recovery Plan or Outline:

Recovery Plan for *Echinocereus fendleri* var. k*uenzleri*. Prepared by Reggie Fletcher, USDA-Forest Service, Region 3 for U.S. Fish & Wildlife Service, Region 2. Adopted 3/28/85. Not revised since adoption in 1985, when only two populations with a total of less than 500 plants were known. No critical habitat was designated due to threat of collection.

7. Reference Point Documents:

Biological Opinion for Determining the Effects of Prescribed Fire on Kuenzler's Hedgehog Cactus. July 14, 2003 and November 19, 2003 Memoranda from State Supervisor, U.S. Fish & Wildlife Service, NM Ecological Services Field Office to Field Manager, Bureau of Land Management, Carlsbad Field Office. Cons. #2-22-03-F-0078.1 and Cons. # 2-22-03-F-0078.2.

New Mexico Rare Plant Technical Council. 1999. New Mexico Rare Plants. Albuquerque, NM: New Mexico Rare Plants Home Page. http://nmrareplants.unm.edu (Version 15 March 2002).

Virginia Tech. 1996. Endangered Species Information System: Fish and Wildlife Information Exchange, Species Id ESIS702025. http:fwie.fw.vt.edu?WWW/esis/lists/e702025.htm

DeBruin, E.A. 1993. *Echinocereus fendleri* var. *kuenzleri*: Status Summary of Known Populations. Submitted to U.S. Fish & Wildlife Service, Region 2, Albuquerque, NM. Reports that field surveys have located several additional populations on the east slope of the Sacramento Mountains and gives the first report of a Guadalupe Mountains location that extends the range of this cactus to the southeast of its previously known range. The total number of cacti on BLM and Forest Service lands in the Sacramento Mountains portion of its range is estimated to be between 3,000 and 4,500. This report results in additional field surveys being undertaken in the Guadalupe Mountains.

Wagner, W.L. and D.G. Sabo. 1977[?]. Status Report for *Echinocereus fendleri* var. *kuenzleri*. Submitted to U.S. Fish & Wildlife Service, Region 2, Albuquerque, NM. Surveyed the single known population on the east slope of the Sacramento Mountains in New Mexico. Recommended a status of 'Endangered'. This report is not dated, but the attached data sheet for the population and habitat assessment is dated 7/16/77. This cactus was listed as 'Endangered' in 1979.

REVIEW ANALYSIS

8. Application of the 1996 Distinct Population Segment (DPS) Policy to DPS-listings made prior to the enactment of the policy.

Not Applicable.

9. New Information: Improved Analysis

Geographic Information Systems (GIS) that provide mapping layers for geology, soils, vegetation, and elevation have been useful for identifying focus areas of potential habitats for field surveys (Chauvin et al. 2001). This has led to the identification of additional populations, and provided a basis for gross estimates of populations in unsurveyed areas.

10. New Information: Biology and Habitat

10.A. Is there relevant new information regarding the species' abundance, population trends, demographic features, or demographic trends?

Yes. Kuenzler's hedgehog cactus is more abundant and its range is more widespread than known when listed as endangered in 1979. DeBruin (1993) and Chauvin et al. (1998) documented 1,611 sightings of individual cacti on federal lands on the east-slope of the Sacramento Mountains. Additional populations in highway rights-of-way have been found on the west slopes of the Sacramento Mountains near Carrizozo for an additional 98 cacti (Bleakly 2001, Knight 1999). Sivinski (1996) observed 68 cacti on Lincoln National Forest in the Guadalupe Mountains and an additional 100 in 1999 (Sivinski 1999). Guadalupe Mountains surveys of BLM jurisdictions found 191 cacti (Ladyman et al. 1998, Chauvin et al. 2001). Subsequent surveys in 1998, 2001 and 2002 by USDA-Forest Service contractors counted 365 new cacti in previously unsurveyed areas (USDA-Forest Service 1998, 2001, 2002). Dr. David Wester found 594 previously undocumented cacti on BLM lands in the Fort Stanton area in 2003, another 231 cacti in 2004, and an additional 18 on BLM land in the Guadalupe Mountains (USDI-BLM 2003, 2004). In total, botanists have found at least 3,276 Kuenzler's hedgehog cacti during inventories from 1978-2004 of federal lands (and a few acres of private land near the type locality).

All surveyors for this cactus state that the numbers of sightings under-represent the current numbers of cacti present in the survey areas. DeBruin (1993) thought it reasonable to estimate that there are at least twice as many, or 3,000 plants, in all Sacramento Mountains survey areas, and possibly up to 4,500 plants. After a subsequent 2003 survey, Dr. David Wester estimated a total of 4,148 cacti in the Fort Stanton area alone (USF&WS Cons. #2-22-03-F-0078.2). Survey intensity affects the multiplier used for a reasonable estimate. For instance, Sivinski (1996) found 44 cacti (all adults) on a single ridge in the Guadalupe Mountains with two people randomly walking back and

forth across the ridge for one day. He estimated this area contained from 100-200 cacti. Only three years later, Sivinski returned to the same ridge to survey with a four-man team that carefully walked at fixed intervals across the entire area for two days (Sivinski 2004). The second, more intensive survey counted 144 cacti (143 adults and 1 seedling), which is 3.3 times greater than the number located by the previous two-man survey. Some cacti (especially non-flowering individuals) were undoubtedly missed in the second survey as well due to the cryptic nature of non-flowering individuals and possible gaps in survey areas.

Significant portions of the federal jurisdictions within the range of Kuenzler's hedgehog cactus have been surveyed, usually within the most suitable habitats. Large areas of state and private lands and Mescalero Apache reservation may contain potentially suitable habitats that have not been, and may never be, surveyed for the presence of this cactus. It is reasonable to estimate that only about half of the potential habitat has been surveyed for the presence of this cactus, based on a comparison of areas surveyed versus areas not surveyed but containing similar elevations and habitats where the cactus could be found.

The total number of Kuenzler's cactus is impossible to obtain because they are difficult to detect when not flowering, many habitats are inaccessible, and populations may fluctuate over time. However, it is reasonable to estimate several thousand cacti exist within the known range of this taxon. Researchers have actually observed approximately 3,300 individual cacti. Most field botanists indicate that this number should be at least doubled (to 6,600) because many cacti are missed during surveys. Then, because only about half the suitable habitat has been searched, that number could reasonably be doubled again to an estimated 13,200 individuals. This extrapolated number for total plants is a gross estimate that could be more or less than the actual number of plants for a variety of reasons, such as local land management practices, climate fluctuations, fire regimes, etc. Although now known to be more widespread and abundant than previously thought, Kuenzler's hedgehog cactus remains an uncommon plant within this limited geographic range. Populations are generally small and scattered and some habitat that appears suitable is presently unoccupied.

The number of discrete populations of Kuenzler's hedgehog cactus is uncertain. If small groups of cacti separated by canyons or just one-half mile from their nearest neighbor groups are considered to be populations, then there are literally dozens of populations. A more realistic assessment would be the number of populations defined by general locations separated by several miles of unsuitable, or unoccupied habitats. In this case, there are a total of 11 population centers for Kuenzler's hedgehog cactus. There are two in the Guadalupe Mountains (mid-range and north range). Another eight population centers occur in the Sacramento Mountain range within the region beginning north of Carrizozo, east to near Tinnie, then south to Cuervo Canyon area (DeBruin 1993, Knight 1999, USF&WS 2003). Tonne (2000) observed Kuenzler's cactus on state land in the low hills north of the Guadalupe Mountains and east of the Sacramento range, which is not near any previously known location.

Population trends have not been adequately assessed because all attempts at monitoring programs by state and federal agencies have lasted only three to five consecutive years, and monitored few individual plants.

10.B. Is there relevant new information regarding the species' genetics, genetic variation, or trends in genetic variation?

Yes. The most recent discoveries of new *E. fendleri* var. *kuenzleri* locations were on the west foot slope of the Sacramento Mountains north and east of Carrizozo, at the edge of the cactus' known range (Bleakly 2001, Fletcher 2002, Knight 1999). Although no genetic analysis has been performed, most of the plants in these locations have adult morphology of variety *kuenzleri*, as originally described (Castetter et *al*. 1976). However, a small portion of this population has the adult spination and stem morphology of variety *fendleri*. Variety *fendleri* occurs in the adjacent Tularosa Basin and apparently meets *kuenzleri* at this location. The existence of individuals with *kuenzleri* characteristics, individuals with variety *fendleri* characteristics, and cacti with intergradations between these two phenotypes may reflect genetic variation. Varieties of the same species are capable of crossing to produce fertile offspring and should be expected to interbreed where their ranges overlap.

10.C. Is there relevant new information regarding taxonomic classification or changes in nomenclature?

Yes. At present, this taxon is controversial. As background, in 1976, this hedgehog cactus, in its New Mexico and Mexico locations, was proposed as endangered under the name *Echinocereus hempelii* (USFWS 1976). Later in 1976, *Echinocereus kuenzleri* was scientifically described as a new species specifically for the New Mexico population of what had previously been called *E. hempelii*. *Echinocereus hempelii*, presently referred to as *E. fendleri* var. *hempelii* (also taxonomically uncertain at this time), is known only from a few locations in Chihuahua, Mexico. Kuenzler's hedgehog cactus was originally listed in 1979 as the endangered species *Echinocereus kuenzleri*. Lyman Benson subsequently reduced it to infraspecific rank as *E. fendleri* var. *kuenzleri* in 1982.

As discussed below, current opinions differ among taxonomists as to whether *E. fendleri* var. *kuenzleri* is: an infraspecific taxon representing a discrete geographic lineage worthy of nomenclatural recognition; the same variety as *E. fendleri* var. *fendleri*; or, a trivial variant that should not have taxonomic status within the broader suite of unnamed varieties and falls under the species *E. fendleri* (USFWS 1979, Anderson 2001, Zimmerman and Parfitt 2003). *Echinocereus fendleri* var. *fendleri* exhibits variation throughout its range and occurs in scattered populations that are widespread but not abundant. It is known throughout the western portion of New Mexico, into Arizona, Colorado, and Texas, and in northern Mexico (Chihuahua, Sonora) (Zimmermann and Parfitt 2003).

The taxonomic standing of a named variety depends upon a consensus of opinion and the informed judgment of those taxonomists who publish their opinions. Anderson's (2001) publication on the cactus family contains the comment "*E. fendleri* var. *kuenzleri* is listed as endangered in the U.S. Endangered Species Act though it seems uncertain whether this variety should be recognized taxonomically." This publication is the first to submerge variety *kuenzleri* into synonymy with *E. fendleri* var. *fendleri*. Another cactus taxonomist, Allen Zimmerman, sent a 1995 letter to the Lincoln National Forest that said, "Variety *kuenzleri* is so very closely related to typical *E. fendleri*, it's just barely a valid taxon." He postulated that variety *kuenzleri* is simply a neotenous form of *E. fendleri* that retains juvenile stem and spination characteristics into adulthood. Zimmerman suspected this distinction may be the genotypic expression of "perhaps as little as a single gene". He further pointed to the possible parallel evolution of the same trait in *Echinocereus "hempelii"* of central Chihuahua, which he considered another neotenous variant of *E. fendleri.* Zimmerman and Parfitt (2003) published this opinion in their Flora of North America treatment of the genus *Echinocereus* and also reduced variety *kuenzleri* to a synonym of the common and widespread *E. fendleri* var. *fendleri*. A complete synonymy of these reclassifications has not been published, leaving the taxonomy open to varying interpretations. Their opinion is based upon field and greenhouse observations of this species, but has not been substantiated by molecular analysis of genetic variation of phenotypes.

Local experts, some of whom have been conducting field research on this subspecies for decades, are concerned that these recent taxonomic treatments may have overlooked important local variation. The latest assessment of *E.f. kuenzleri* occurred during the March, 2005, meeting of the Rare Plant Technical Council of New Mexico. State botanists acknowledged that within one of the 11 known populations, *E.f. kuenzleri* individuals occur along with variety *E.f. fendleri* (Rare Plant Technical Council of New Mexico 2005). Here, at the northwest edge of *E.f. kuenzleri's* distribution, where the range of *E.f. fendleri* begins, intergradations between both varieties can be found. However, because the remaining 10 populations located more toward the center of *E.f. kuenzleri's* known distribution exhibit consistently reliable traits unique to this variety, the species warrants future study to verify a change in its taxonomic status (Rare Plant Technical Council of New Mexico 2005).

10.D. Is there relevant new information regarding the species' spatial distribution, trends in spatial distribution, or historic range?

Yes. Kuenzler's hedgehog cactus was known from a single location on the east slope of the Sacramento Mountains in New Mexico (Chaves and Otero counties) when listed as 'Endangered' in 1979. Subsequent field surveys have expanded the Sacramento Mountain east-slope range of this plant 10 miles to the west in Otero County and 40 miles north in Lincoln County (DeBruin 1993). Numerous new locations within this range place it within USDA-Forest Service and USDI-BLM jurisdictions as well on private and state lands. It has also been found on the west side of the Sacramento Mountains in Lincoln County (Knight 1999). In addition, this cactus has been found on USDA-forest

Service and USDI-BLM lands in the northern Guadalupe Mountains in Eddy and Otero Counties (Chauvin et al. 2001, Sivinski 1996). The range of this cactus extends southeast approximately 100 miles from its northwestern-most location in Lincoln County to its southeastern-most location in the Guadalupe Mountains of Eddy County. Populations are not continuous within this range, but are patchy, scattered, and rare.

10.E. Is there relevant new information addressing habitat or ecosystem conditions?

No.

11. New Information: Threats

11.A. Is there relevant new information regarding the magnitude or imminence of previously identified threats to the species?

Yes. Kuenzler's hedgehog cactus was known from a single population of approximately 200 plants when listed in 1979. When the Recovery plan was adopted in 1985, it was known from only two locations with a total of less than 500 plants. Described in 1976 (Castetter et *al.* 1976), this was a new taxon and in great demand by cactus collectors. Therefore, unauthorized collection (poaching) of this rare cactus from its natural habitats was identified as the primary threat. Some illegal collections have been witnessed. In September 1998, a few monitored cacti near the type locality were taken from their habitat during the interval of the Labor Day weekend (Barker, phone conversation, August 2004).

Cactus poachers usually focus their illegal activities in and around the type locality of a taxon. Therefore, the Kuenzler's hedgehog cactus population near Elk, New Mexico is likely to be the most impacted by illegal collection. The more recently discovered populations in Guadalupe Mountains and near Carrizozo are less well known and, in some cases, more remote and difficult to access. The Fort Stanton and Guadalupe Mountains populations consist of small groups of plants scattered throughout large areas. No poaching has been documented at these locations. A few cacti may be taken from localized areas, but it is unlikely that poachers would mount enough effort to significantly impact these relatively widespread populations.

There is still a black market for endangered cacti, but it is likely small and confined to a few specialized collectors and growers who wish to obtain breeding stock. Some collectors still illegally dig cacti for their personal use, but they usually take only one or a few plants rather than commercial quantities. Cactus hobbyists can obtain plants through legal channels from reputable growers and are probably doing so. Kuenzler's hedgehog cactus is now readily available on the open market from commercial growers with CITES certificates. A brief search on the Internet found several growers offering Kuenzler's hedgehog cactus plants or seeds at reasonable prices (3 in USA; 7 in Europe; 2 in Japan). Local populations, especially near the type locality, may continue to be impacted by

occasional poaching from growers and hobbyists, however, this taxon is unlikely to be seriously threatened in most of its range by cactus collectors.

Only two individual plants of Kuenzler's hedgehog cactus have been legally collected under permit for the purpose of vouchering new locations since this taxon was listed as endangered (Sivinski, unpublished data). A prescribed fire study on BLM proposed to burn 13 cacti in the Guadalupe Mountains and 96 cacti in the Fort Stanton area during the course of experimental research. The USFWS issued a non-jeopardy biological opinion on the effects of this research (Consultation #2-22-03-f-0078.1 and Cons. #2-22-03-F-0078.2). Therefore, scientific research has had little impact on this taxon.

11.B. Is there relevant new information regarding new threats to the species?

Yes. Kuenzler's hedgehog cactus habitats are predominantly arid grassland and piñon-juniper savanna. These cacti usually occur in grass-covered areas and are susceptible to fire. Prescribed fire has become a frequently used land management tool on federal lands throughout the range of this cactus. Sivinski (1999) studied the effects of a 1993 natural wildfire that burned within a Kuenzler's hedgehog population in the Guadalupe Mountains on the Lincoln National Forest. Seven years after the fire, this population was found to have only one-third the numbers of cacti within the burned area as compared to a similar area of adjacent unburned habitat. Fire mortality was apparently severe and regeneration of the burned population segment was slow. Given that this species reproduces only from seed, depletion of the seed bank from burning may require several reproductive seasons to replenish the seed bank and recolonize the area (Sivinski 1999). Once germination has occurred, it takes 4-5 years for a plant to reach reproductive capabilities (USDI-BLM, CFO 2003). Therefore, frequent prescribed fires could have significant impacts on this cactus, and other cactus species. Additional fire-impact research has been initiated by USDI-BLM to determine which fire intensity and seasonality has the least effect on Kuenzler's hedgehog cactus. Kuenzler's hedgehog cactus individuals involved in the study are located in Lincoln and Eddy counties, and are associated with the Fort Stanton and South Texas Hill populations, respectively (USDI-BLM, CFO 2003). The results of this study are not yet available.

12. New Information: Conservation Efforts

12.A. Is there relevant new information regarding implementation of conservation measures that benefit the species?

Yes. Lincoln National Forest and the USDI-BLM Roswell District have conducted numerous field surveys for Kuenzler's hedgehog cactus within their jurisdictions. These surveys have resulted in discovery of numerous new locations of this cactus. The NM State Highway and Transportation Department (NMSHTD) and the State Land Office have also conducted surveys on rights-of-way and state trust lands, both of which have located new populations. New findings from these surveys have been incorporated into

this report. The BLM and a student from University of Texas at Austin have also begun a research program to study the effects of fire on Kuenzler's cactus. Results from this study are not yet available.

12.B. Is there relevant new information regarding the effectiveness of the conservation measures being implemented?

Yes. Known habitats of Kuenzler's hedgehog cactus on the Lincoln National Forest and USDI-BLM lands have been managed to avoid serious impacts to these cacti. Livestock grazing regimes have been reduced on the BLM Fort Stanton allotment and prescribed fire activities on USDA-Forest Service lands in the Guadalupe Mountains have avoided known populations of this cactus. Cacti found in State Highway rights-of-way have been avoided by earth-moving activities or cacti have been transplanted to safer locations.

13. New Information: Application of the DPS policy

Not Applicable

14. New Information: Other

None.

15. Using Recovery Criteria

15.A. Does the species have a recovery plan that was written in accordance with recovery planning guidance and that has up-to-date recovery criteria that address biological factors, conservation measures and threats to the species?

No. There is a 1985 Recovery Plan that was developed according to guidance at the time, which includes biological factors, conservation measures, and threats. However, this Recovery Plan does not have up-to-date recovery criteria and does not conform to all current standards and guidance for recovery planning.

The single criterion for downlisting to 'Threatened' in Part II, Recovery, of the Recovery Plan is "to secure and maintain a wild population level of 5,000 individual plants for a period of 5 consecutive years". It further elaborates the foundations of this criterion to be the need for USFWS to develop policy for commercially propagated cacti and the introduction of 10,000 artificially propagated Kuenzler's hedgehog cacti into the commercial market.

The plan did not establish delisting criteria, and does not provide a reason. The plant was only known from two small population centers at the time the plan was written. The plan

states that a review of the status of the cactus will be made at the time that downlisting criteria have been met, in order to establish delisting criteria.

16. Synthesis

16.A. **Biological Assessment:** Given the updated information, particularly information presented in question 10, summarize the biological status of the species.

The primary concern for the current status of this cactus is the validity of *E. fendleri* var. *kuenzleri* as a taxon. The most recently published taxonomic opinions suggest that it is not valid. If this is accepted, Kuenzler's hedgehog cactus would not be a "species" under the Endangered Species Act and, as such, would not be threatened nor in need of recovery. However, we do not yet have agreement among taxonomists or an acceptable level of scientific data to support delisting on this basis. The species, *Echinocereus fendleri,* is known to exhibit variation throughout its range; however, there is no definitive scientific evidence demonstrating that *E.f* .var. *kuenzleri* is an invalid taxon. Morphologically, *E.f.* var. *kuenzleri* and *E.f.* var. *fendleri* are similar, yet distinctions are consistent. Studies conducted by the Natural Heritage Program at the University of New Mexico have found greenhouse grown *E.f.* var. *kuenzleri* seed to produce *E.f.* var. *kuenzleri* plants (Tonne, conversation, September 2004). This suggests that traits are stable and inheritable from a unique genotype, yet it does not rule out the plant's ability to express a variation of phenotypes on the periphery of its range.

At the newly-discovered northwestern extent of *E.f.* var. *kuenzleri*'s range, where the *kuenzleri* and *fendleri* varieties appear to converge, cacti displaying *E.f.* var. *kuenzleri* characteristics, *E.f.* var. *fendleri* characteristics, and variant individuals expressing characters of both varieties are found. Although intergradation appears to be occurring here or occurred in the past, this mixing is localized and does not seem to be encroaching upon the other populations of *E.f.* var. *kuenzleri*. The remaining "pure" *E.f.* var. *kuenzleri* populations are separated from the overlapping aggregation by mountain ranges and significant distances. *Echinocereus.fendleri* var. *kuenzleri* appears to be incapable of self-pollination, depending on insect pollinators for seed set, and seed is distributed by rodents, wind, and water (USDI-BLM CRO 2003). Thus geographic conditions effectively act as barriers to seed and pollen dispersal between the single, northern-most population (consisting of 82 "*kuenzleri*" plants alone) and the remaining known populations (totaling 3154 counted plants over 25 years). Data on the proportions of *E.f.* var. *kuenzleri* and *E.f.* var. *fendleri* and their hybrids at this location are not yet available, however, it is possible that this has been a stable area of intermingling for a long time.

Kuenzler's hedgehog cactus is now known to range in New Mexico from the northwest side of the Sacramento Mountains in Lincoln County to middle of the Guadalupe Mountains in Eddy County. An estimate of 11 populations occur within this range, however, they are scattered and usually not abundant. Approximately half of the suitable habitats for this cactus have been searched for its presence or absence, so new locations will likely be found during future surveys. A great amount of time and effort has been

expended during the last 25 years by state and federal agency botanists to assess these populations. Approximately 3,300 plants have been documented. The number of plants in these survey areas is likely greater because non-flowering cacti are difficult to detect and survey intensity is less than 100% of the potentially occupied habitat. Therefore, it is reasonable to assume that there are several thousand more of these cacti than have been counted during field inventories. Population monitoring has not occurred on a routine basis, however, the presence of these cacti is usually reaffirmed during subsequent visits, even after intervals of many years. On the other hand, the total of 3,300 individuals represents each individual counted over a span of 25 years, since this surveying began. Although *E.f. kuenzleri* is a long-lived perennial, it is possible that some cacti counted in the last 25 years are no longer alive.

16.B.1. **Threats Assessment (5-Factor Analysis):** Given the updated information, particularly information presented in question 11, provide an analysis of the threats to the species in the context of the 5 listing factors.

a) The present or threatened destruction, modification, or curtailment of its habitat or range.

Habitat destruction by road construction and home building has affected a very small part of the areas occupied by Kuenzler's hedgehog cactus. At the present time, there are no significant mining or oil and gas production activities within the habitat of this cactus. Most of the known occupied habitats occur in relatively remote areas, which are unlikely to be converted to land uses other than open range for livestock grazing. There is some anecdotal evidence that livestock grazing may cause increased mortality of Kuenzler's cactus. A two-year study (1984-1985) by The Nature Conservancy found that during a year of cattle grazing with 65% forage utilization, cactus mortality outside a fenced exclosure was 12.4% while there was zero mortality inside the exclosure where no grazing had occurred (Bates 1985). Likewise, at a location with several dozen cacti within an ungrazed highway right-of-way, few mature cacti could be seen in the adjacent rangeland, which was identical, but heavily grazed, habitat (Sivinski, unpublished observation). Intensive livestock grazing can cause some mortality by trampling individual cacti. However, the indirect impacts of livestock grazing may be more significant for increased erosion and removal of insulating cover that may affect the success of seedling establishment.

b) Overutilization for commercial, recreational, scientific or educational purposes.

Illegal collection of Kuenzler's hedgehog cactus from its natural habitats has not had a significant observable impact on the known populations during recent years. Some illegal take has occurred and will likely continue, especially at the type locality and other well-known and easily accessible locations. However, most populations are relatively remote and less likely to be impacted by casual collectors. This plant is readily available from commercial growers, who are probably satisfying much of the demand from cactus hobbyists. There are no published data on the popularity of this cactus among hobbyists,

or its demand on the world market. Utilization for scientific or educational purposes is unlikely to have a significant impact on this taxon.

c) Disease and predation.

No significant outbreaks of disease or unnatural predation pressures have been documented during the 25 years this plant has been listed as endangered.

d) Inadequacy of existing regulatory mechanisms.

Like all federally listed threatened or endangered plants, Kuenzler's hedgehog cactus receives no legal protection on private, state or tribal lands from activities that do not spend federal money or require federal permits. The New Mexico Endangered Plant Species Act (NMEPSA), only provides protection from unauthorized collection and offers no protection from land-use impacts.

Most of the known populations of Kuenzler's hedgehog cactus occur on federal lands where they are afforded some consideration and protection from land-use impacts through the NEPA and the consultation requirements of the ESA. Both ESA and CITES restrict and regulate the commercial trade of this cactus. However, law enforcement is inadequate to detect illegal takings and commercial transaction of restricted plant materials.

e) Other natural and manmade factors affecting its continued existence.

Fires, whether wild or prescribed, within the grassland habitats of Kuenzler's hedgehog cactus are suspected to have serious, immediate impacts to small populations. Affected populations may be slow to recover and unable to withstand a fire frequency of short intervals. Prescribed fire is becoming a popular management tool on federal lands for the purpose of reducing the amount of woody vegetation on livestock rangelands. The optimal frequency and season of burning that will not jeopardize the continued existence of Kuenzler's hedgehog cactus have not been established for these habitats.

16.B.2. Describe any interactions, additive and/or synergistic effects of these threats.

Livestock grazing has had a significant effect on the frequency of natural fire within Kuenzler's hedgehog cactus habitats. Removal of fine fuels by grazing animals reduces the ability of a fire to start and carry through the landscape. Land managers have also followed an aggressive program of extinguishing most natural fires. The result is a disruption of the natural fire regime and an increase of woody vegetation in grassland and savanna habitats. Land managers presently see the need to reintroduce fire into these habitats for the purpose of restoring grasslands and increasing forage for livestock production.

16.C. **Conservation Efforts:** Given the updated information, particularly information in question 11, summarize the conservation efforts.

Commercial growers have significantly contributed to the conservation of Kuenzler's hedgehog cactus by offering greenhouse-grown plants and seeds to hobbyists who might otherwise obtain their plants or seeds from natural populations.

Federal land management agencies have inventoried most of the Kuenzler's cactus habitats within their jurisdictions in order to consult with the USF&WS and avoid serious impacts to occupied habitats. The effects of prescribed fire on this cactus are presently being studied on BLM lands.

17. Determination

17.A. Given your responses to questions 15.B. and /or 16.A.-16.C., does the 5-year review indicate that a change in classification is warranted.

Kuenzler's hedgehog cactus should be proposed for reclassification from endangered to threatened. The known range of this cactus consisted of a single population of approximately 200 individuals when listed as endangered. As such, it was perceived to be upon the brink of extinction. The most serious threat to such a small population would be the elimination of plants in the wild by commercial and hobbyist collectors. Subsequently developed information on the range and abundance of this cactus has significantly altered this perception. In reality, Kuenzler's hedgehog cactus exists across a much broader geographic range in several populations that total several thousands of individual plants and probably exceeds the 5,000 plants required for downlisting in the recovery plan. Protection under ESA has curtailed unauthorized take by collectors and lessened the impacts of land use within occupied habitats on federal lands. Therefore, it is no longer in danger of extinction in the foreseeable future.

Although now known to be more widespread and abundant than previously thought, Kuenzler's hedgehog cactus remains a relatively rare plant taxon. It occurs only on the lower slopes of Sacramento and Guadalupe mountain ranges and is an uncommon plant within this limited geographic range. Populations are generally small and scattered and some habitat that appears suitable is presently unoccupied. Threats remain related to its limited population numbers and distribution including wild or prescribed fires and trampling and erosion from livestock grazing and fire.

The controversy and lack of definitive data regarding the taxonomy of *E.f.* var. *kuenzleri*, combined with the limited distribution and actual population numbers, preclude a recommendation to delist based on taxonomic revision at this time. The recently published taxonomic determinations of *E.f* var. *kuenzleri*'s status represent broad-brushed approaches that may not adequately address local variation. To establish the taxonomic status of *E.f* var. *kuenzleri*, surveys are needed to determine the extent of interbreeding at the northern edge of the range and molecular research is needed to determine the genetic

variation within *E. fendleri*. Finally, a definitive assessment of population numbers, trends, and the effects of fire and livestock grazing are needed.

17.B. Based on this review indicate the appropriate Recovery Priority Number for the species.

The Recovery Priority Number for Kuenzler's hedgehog cactus should be revised to 12C. This number indicates a subspecies that is not immediately facing extinction, but is occupying habitats that are continuously subjected to a perceived threat. Recovery potential may be low at this time because the biological and ecological limiting factors and threats are poorly understood, and the management needed is unknown and still experimental. The suffix of 'C' indicates conflict with the economic activity of livestock production.

17.C. If applicable, indicate the Listing and Reclassification Number.

The Priority Number for reclassification from endangered to threatened is 4. Kuenzler's hedgehog cactus has a moderate impact on land management efforts and funding, and the reclassification is not the result of a petition action.

18. Recommendations for Future Actions

A standardized sampling strategy needs to be developed and implemented to give a clearer idea of the current abundance and overall range of *E.f.* var. *kuenzler*i. Further greenhouse experiments to verify breeding patterns of the variety may prove useful in determining the taxonomy and resolving the controversy. Molecular research on genetic variations within the species *Echinocereus fendleri* also may help clarify the taxonomic standing of *E.f.* var. *kuenzleri*.

If the species is reclassified as threatened, the next future action should be modification of the Kuenzler's hedgehog cactus Recovery Plan. The revised plan should focus upon the impacts of livestock grazing and the land management activities, such as prescribed fire, associated with this land use. Recovery criteria should be updated to reflect the current status and threats, and establish population targets for delisting.

REFERENCES

Anderson, E.F. 2001. The Cactus Family. Timber Press, Portland Oregon.

Baggao, Dan. USDI-BLM, Roswell District, Wildlife Biologist. Provided information for this review during a personal interview in August 2004.

Barker, Linda. Lincoln National Forest, Botanist. Provided information for this review during a phone conversation in August 2004.

Bates, J. 1985. Kuenzler's Hedgehog Cactus Monitoring Report 1984-1985. Unpublished report by The Nature Conservancy of New Mexico, Santa Fe.

Bleakly, D. 2001. Highway 54, Environmental Assessment, Biological Report. Prepared for NM Department of Transportation, Santa Fe.

Castetter, E.F., P. Pierce and K.H. Schwerin. 1976. A new cactus species and two new varieties from New Mexico. Cactus and Succulent Journal (U.S.) 48(2):77-78.

Chauvin, Y., A. Swineheart and J. Ladyman. 1998. Kuenzler Cactus Surveys. Prepared for Lincoln National Forest, Alamogordo, NM.

Chauvin, Y., A. Kennedy and K. Wild. 2001. Survey for Kuenzler's Hedgehog Cactus (*Echinocereus fendleri* var. *kuenzleri*). Prepared for BLM, Carlsbad Field Office, Carlsbad, NM.

Cully, Anne. USFWS Biologist. Provided information for this review during a personal interview in 1994.

DeBruin, E.A. 1993. *Echinocereus fendleri* var. *kuenzleri*: Status Summary of Known Populations. Submitted to U.S. Fish & Wildlife Service, Region 2, Albuquerque, NM.

Fletcher, R. 1985. Recovery Plan for the Kuenzler Hedgehog Cactus, *Echinocereus fendleri* var. *kuenzleri*. Prepared for U.S. Fish & Wildlife Service, Region 2, Albuquerque, NM.

Fletcher, R. 2002. Introduction to Kuenzler Hedgehog Cactus Surveys on the Lincoln National Forest. Prepared for Lincoln National Forest, Alamogordo, NM.

Knight, P. 1999. Highway 380, Environmental Assessment, Biological Report. Prepared for NM Department of Transportation, Santa Fe.

Ladyman, J., N. Monteith and P. Gegick. 1998. Survey for Kuenzler's Hedgehog Cactus (*Echinocereus fendleri* var. *kuenzleri*). Prepared for Bureau of Land Management, Carlsbad, NM.

Rare Plant Technical Council of New Mexico, March 2005 Meeting notes.
Sherman, John. USDI-BLM, Carlsbad District Office. Provided information for this review.

Sivinski, R.C. and A. Cully. 1991. Progress Report for Section 6, Segment 5 Grant. Submitted to U.S Fish & Wildlife Service, Region 2, Albuquerque, NM.

Sivinski, R.C. 1996. Guadalupe Mountains Survey for *Echinocereus fendleri* var. *kuenzleri*. Prepared for Lincoln National Forest, Alamogordo, NM.

Sivinski, R.C. 1999. Effects of a Natural Fire on a Kuenzler's Hedgehog Cactus (*Echinocereus fendleri* var. *kuenzleri*) and Nylon Hedgehog Cactus (*Echinocereus viridiflorus* var. *cylindricus*) Population in Southeastern New Mexico. Prepared for Lincoln National Forest, Alamogordo, NM.

Tonne, P. 2000. July – September surveys for rare and endangered plants on New Mexico State Trust Lands. Prepared for NM Forestry Division, Santa Fe.

Tonne, P. New Mexico Natural Heritage Program Botanist, University of New Mexico. Provided information for this review in conversations during June to September 2004.

USDA-Forest Service. 1998. Unpublished data at Lincoln National Forest, Alamogordo, NM.

USDA-Forest Service. 2001. Unpublished data at Lincoln National Forest, Alamogordo, NM.

USDA-Forest Service. 2001. Unpublished data at Lincoln National Forest, Alamogordo, NM.

USDI-BLM, Carlsbad Field Office. 2003. Biological Evaluation: Effects of fire on Kuenzler's Hedgehog Cactus (*Echinocereus fendleri* var. *Kuenzleri*), an endangered species in the northern Chihuahuan Desert. May, 2003.

USDI-BLM, Roswell Resource Area Office. 2003. Unpublished data.

USDI-BLM. Roswell Resource Area Office. 2004. Unpublished data.

USFWS. 1979. Federal Register Notice. Vol. 44, No. 209, p. 61924.

USFWS. 2002. Recovery Report to Congress: FY 2001-2002.

Wester, D.B. November 7, 2003 letter to Joy Nicholopoulos, USF&WS-NMESFO.

Zimmerman, A.D. February 11, 1995 letter to Linda Barker, Lincoln National Forest, from Drylands Institute, Tucson, AZ.

Zimmerman, A.D. and B.D. Parfitt 2003. Cactaceae: *Echinocereus*. In Flora of North America Editorial Committee, Flora of North America, Volume 4, pg. 164. Missouri Botanical Garden Press, St. Louis. (http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242415246)

A comprehensive database and mapping capability for Kuenzler hedgehog cactus locations resides at the University of New Mexico, Natural Heritage New Mexico Office. Contact: Phil Tonne, ptonne@unm.edu.