Kuenzler Hedgehog Cactus

(Echinocereus fendleri var. *kuenzleri)*

5-Year Status Review:

Summary and Evaluation

U.S. Fish and Wildlife Service

New Mexico Ecological Services Field Office

Albuquerque, New Mexico

8/31/2023

5-YEAR REVIEW

Kuenzler Hedgehog Cactus (Echinocereus fendleri* var. *kuenzleri)

1.0 GENERAL INFORMATION

1.1 Listing History

Species: Kuenzler hedgehog cactus
Date listed: November 28, 1979
FR citation(s): 44 FR 61924 61927 listed as endangered; 83 FR 21928 reclassified as threatened.
Classification: Threatened species

Critical habitat/4(d) rule/Experimental population designation/Similarity of appearance listing: Not applicable

1.2 Methodology used to complete the review:

In accordance with section 4(c) (2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a 5-year review is to assess each threatened species and endangered species to determine whether its status has changed and it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology and status of the Kuenzler hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*) as part of both a Species Status Assessment (SSA) and Recovery Plan to inform this 5-year review.

The U.S. Fish and Wildlife Service (Service) most recently evaluated the biology and status of the Kuenzler hedgehog cactus as part of a status review conducted on December 2, 2021. We examined whether new information was available and whether that new information would alter or affect analyses and conclusions made in the previous status review. Data for this current review were solicited from interested parties through a Federal Register notice announcing the review on January 11, 2023. We also contacted the U.S. Forest Service (USFS), Bureau of Land Management (BLM), species experts, and universities to request any data or information we should consider in our review. Additionally, we conducted a literature search and a review of information in our files.

1.3 FR Notice citation announcing the species is under active review:

88 FR 1602, Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 31 Species in the Southwest; January 11, 2023.

2.0 REVIEW ANALYSIS

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species meets the definition of "endangered species" or "threatened species." The Act defines an "endangered species" as a species that is "in danger of extinction throughout all or a significant portion of its range," and a "threatened species" as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The Act

requires that we determine whether a species meets the definition of "endangered species" or "threatened species" due to any of the five factors described below.

Section 4(a) of the Act describes five factors that may lead to endangered or threatened status for a species. These include: A) the 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) the inadequacy of existing regulatory mechanisms; or E) other natural or manmade factors affecting its continued existence.

The identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an "endangered species" or a "threatened species." In assessing whether a species meets either definition, we must evaluate all identified threats by considering the expected response of the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Service recommends whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and in the foreseeable future.

2.1 Distinct Population Segment (DPS) policy (1996):

Not applicable

2.2 Updated Information and Current Species Status

2.2.1 Biology and Habitat:

Echinocereus fendleri var. *kuenzleri* is one of four infraspecific taxa of the species *Echinocereus fendleri*. The other three taxa include *E. fendleri* var. *fendleri*, *E. fendleri* var. *rectispinus*, and *E. fendleri* ssp. *hempelii*. Morphological differences and geographical information have been the basis for identifying the different cacti in the *E. fendleri* complex. Recent genetic research (Beck et al. 2023: entire) has provided new information on the genetic relationships within the *E. fendleri* complex. Between 2018-2021, Beck et al. (2023: 2) collected a total of 283 individuals from 48 populations, representing seven Echinocereus species including three of the four E. fendleri s.l. subspecific taxa. They analyzed one population of *E. fendleri* var. *kuenzleri* within each of the three geographic core sites forming the current distribution: the Fort Stanton population found in the Northern Sacramento Mountains, the Elk population in the Southern Sacramento Mountains, and the Texas Hill population in the Guadalupe Mountains. There are two other populations, Bullis and Prude, within the Guadalupe Mountains core site that were not analyzed.

Beck et al. (2023: 9) found that *E. fendleri* var. *kuenzleri* were not monophyletic and that they appear as two separate clades: one clade containing the Fort Stanton population and the other containing Elk and Texas Hill populations. This suggests that the extreme var. *kuenzleri* morphology (very few, very thick spines; few ribs) may have arisen two separate times in the evolutionary history of *E. fendleri*. Beck et al. (2023: entire) suggests that *E. fendleri* var. *kuenzleri* may be restricted to the Elk and Texas Hill populations, and that the *E. fendleri* var. *kuenzleri* at Fort Stanton may be more closely related to *E. fendleri* var. *fendleri* found further north and west. However, because some populations from the southernmost part of the *E. fendleri* var. *kuenzleri* and *E. fendleri* var. *fendleri* range were not analyzed in this study, there continues to be a need for further research to clarify the genetic limits of *E. fendleri var. kuenzleri*.

Between 2019 and 2021, the BLM Pecos District established 14 permanent monitoring plots for E. fendleri var. kuenzleri as part of the Rare Plant Demographic Monitoring Program. Nine plots are found within the Fort Stanton-Snowy River Cave National Conservation Area between the Sacramento and Capitan Mountains (managed by the Roswell Field Office), and the other five plots are on the eastern escarpment of the Guadalupe Mountains west of Carlsbad (managed by the Carlsbad Field Office). The data collected from these monitoring plots will provide a long-term measure of growth, reproductive output, and herbivory, as well as rates of mortality and recruitment (BLM 2021: 13). The most recent report (BLM 2021: entire) shows that when compared to the Texas Hill population, the plants found within the Fort Stanton Population often have more stems, are more frequently healthier, have higher reproductive output, and have a higher density of stems. However, the Fort Stanton population also may have higher mortality and abortion rates than the Texas Hill population (BLM 2021: 21).

To date, surveys for *E. fendleri* var. *kuenzleri* have been conducted in suitable soil types and vegetation communities throughout most Federal and State lands in New Mexico. No new populations have been discovered since the 2021 Recovery Plan was published.

2.2.2 Threats Analysis (threats, conservation measures, and regulatory mechanisms):

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

Road Construction, Urban and Energy Development. Habitat destruction by road construction, home building, and development has affected a very small part of the areas occupied by *E. fendleri* var. *kuenzleri*. At the present time, there are no significant mining or oil and gas productions 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. Areas within occupied and suitable habitat have been examined for possible wind energy development. There are significant wind energy resources in the cactus' habitat (BLM 2005: B-89), and a wind project was proposed in the Texas Hill area (BLM 2007: 8) among others near the Elk population. To date, none of these wind projects have been

developed, and promotion of energy development in areas of the cactus have been abandoned. At this time, the threat of development is considered to be low for this cactus.

Livestock Grazing. There is some anecdotal evidence that livestock grazing may cause increased mortality of *E. fendleri* var. *kuenzleri*. A 2-year study (1984-1985) by The Nature Conservancy found that during a year of cattle grazing with 65 percent forage utilization, cactus morality outside a fenced exclosure was 12.4 percent while there was zero mortality inside the exclosure where no grazing had occurred (Bates 1985: 2). Likewise, several dozen cacti were observed in an ungrazed highway right-of-way while none were observed in the heavily grazed adjacent rangeland. 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 cover that may affect the success of seedling establishment. Because the threat of livestock grazing has been managed on public lands, where the majority of cacti occur, this threat is currently considered to be low.

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

Illegal collection of *E. fendleri* var. *kuenzleri* 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 form 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. Due to commercial availability of this cactus on the market in accordance with regulations, collection is no longer considered a threat to this species.

c) Disease and predation.

No significant outbreaks of disease or unnatural predation pressures have been documented during the 40 plus years this plant has been listed, however, there have been recent observation of cactus coreid nymphs (*Chelinidea vittiger*) on several individuals at the Fort Stanton population (BLM 2021: 24). This insect normally specializes on species of *Opuntia* but will opportunistically attack other species of cacti if they are available. They can open wounds in cacti and thus make the plant vulnerable to fungal infections. Further monitoring of their presence and the degree of their damage to *E. fendleri* var. *kuenzleri* is needed before identifying them as a threat.

d) Inadequacy of existing regulatory mechanisms.

Like all federally listed threatened or endangered plants, *E. fendleri* var. *kuenzleri* 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 Administrative Code (2006: 19.21.2) only provides protection from unauthorized collection and offers no protection from land-use impacts.

Most of the known populations of *E. fendleri* var. *kuenzleri* occur on federal lands where they are afforded some consideration and protection from land-use impacts through the National Environmental Policy Act (NEPA) and the consultation requirements of the Endangered Species Act (ESA). Federal land management agencies have inventoried most of the cactus habitats within their jurisdictions in order to consult with the Service and avoid serious impacts to occupied habitats. Both the ESA and Convention on International Trade in Endangered Species (CITES) restrict and regulate the commercial trade of this cactus. Although we consider illegal collection to be very minimal, based on the remoteness and low population density of humans in areas where the cactus grows, law enforcement may be inadequate to detect illegal takings and commercial transaction of restricted plant materials.

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

Fire. Fires, whether wild or prescribed, within the grassland habitats of *E. fendleri* var. *kuenzleri* are suspected to have serious, immediate impacts to small populations. Affected populations may be slow to recover from wildfire and unable to withstand a fire frequency of short intervals Sivinski (2007: 93). Although Wester (2019: 348) found no evidence that the species was negatively affected by prescribed fire, high fuel loads did increase mortality. Prescribed fire is becoming a popular management tool on federal lands for the purpose of reducing the amount of woody vegetation on livestock rangelands, which benefits *E. fendleri* var. *kuenzleri* by preventing the development and spread of more damaging high intensity fires. The optimal frequency and season of burning that will not jeopardize the continued existence of *E. fendleri* var. *kuenzleri* has not been established for these habitats.

Livestock grazing has had a significant effect on the frequency of natural fire within cactus habitats. Removal of fine fuels by grazing animals reduces the ability of a fire to ignite and spread 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.

Land managers on the Lincoln National Forest and with the BLM Pecos District avoid direct impact to the cactus from prescribed fire activities by teaching fire personnel to correctly identify the cactus and implementing a 50-meter (164-foot) buffer around known populations.

Drought. During 16 of the last 22 years (2001-2022), there has been moderate to exceptional drought conditions in the area where *E. fendleri* var. *kuenzleri* occurs, with 10 percent of the time in exceptional drought (National Drought Mitigation Center

2015, Four County Data). From 2002 to 2004, conditions were anomalously dry with unusually high temperatures throughout all of southwestern North America (Breshears et al. 2005: 15, 144). Similar extreme weather patterns occurred from 2011-2013, 2018-2019, and 2021-2022.

Echinocereus fendleri var. *kuenzleri* has likely experienced and rebounded from periods of drought in the past, however, should substantial climate change materialize with increased severity and frequency of drought, it would likely reduce the long-term survivorship of this cactus. Continued and more systematic monitoring to assess *E. fendleri* var. *kuenzleri* demographic responses and population trends is important to track drought occurrence and impacts upon this cactus. At this point, effects from the threat of drought can only be surmised based on other related cacti and drought research.

Climate Change. Based on the unequivocal evidence of warming of the earth's climate from observations of increases in average global air and ocean temperatures, widespread melting of glaciers and polar ice caps, and rising sea levels recorded in the Intergovernmental Panel on Climate Change Report (IPCC 2007a: entire, 2013: entire), climate change is now a consideration for federal agency analysis (Government Accounting Office 2007: entire), and the Service will incorporate climate change into our ESA decision making (Service 2010: entire). The earth's surface has warmed by an average of 0.74°C (1.3°F) during the 20th century (IPCC 2007b: 30). The IPCC (2013: 7) projects that there will very likely be an increasing in the frequency of hot extremes, heat waves, and heavy precipitation events as a result of climate change.

This global climate information has been downscaled to our region of interest, and projected into the future under two different scenarios of possible emissions of greenhouse gases (Alder and Hostetler 2014: 2). Climate predictions for the cactus area include a 5 to 6 percent increase in maximum temperature (up to 4°C(7.2°F)), 11 percent decrease in precipitation, and a 25 percent increase in evaporative deficit over the next 25 years (National Climate Change Viewer, Four County Data, https://apps.usgs.gov/nccv/maca2/maca2_counties.html, accessed July 25, 2023).

Climate change also involves an increase in atmospheric carbon dioxide which is commonly associated with increased temperatures and the greenhouse effect. Increased carbon dioxide directly affects plant photosynthesis (Huxman and Scott 2007: 28). At the plant level, adapting to drought involves the ability to balance carbon sequestration (the uptake and storage of carbon), carbon respiration (efflux back into the atmosphere), and maintenance of sustainable evapotranspiration rates (Huxman and Scott 2007: 28). Cacti have a unique photosynthetic pathway referred to as crassulacean acid metabolism (CAM) which is most effective in low soil moisture, intense sunlight, and high daytime temperature conditions. CAM is considered to be a desert adaptation (Nefzaoui et al. 2014: 121), and CAM plants may have an advantage under drier conditions predicted by climate change (Reyes-Garcia and Andrade 2009: 755). Some plants grow more readily and accumulate greater biomass under conditions of increased

carbon dioxide, but we do not yet understand how enhanced carbon dioxide levels will impact *E. fendleri* var. *kuenzleri*.

Growing seasons are becoming longer and warmer in many regions (Kunkel 2013: 1) including the southwest (Cayan et al. 2001: 399; Easterling 2002: 1329). Earlier soil moisture stress would result in decreased flowering and reproduction, and because this cactus has a limited distribution, we would predict a substantial population reduction with a long-term warming trend. Munson et al. (2013: 2030) predicts declines in vegetative cover including cacti in Chihuahuan Desert habitats due to climate change. Adaptation to changes in climate patterns would also require a plant to change its phenology (timing of life cycle events) to coincide successfully with extreme shifts in temperature, precipitation, and soil moisture (Walther et al. 2002: 389), which are all part of the evapotranspiration equation. The potential for rapid climate change, which is predicted for the future, could pose significant challenges for plants because they may not be able to adjust their phenology or photosynthetic mechanisms quickly enough. For *E. fendleri* var. *kuenzleri*, the threat of drought and climate change exists but is more of a long term less immediate issue at this time. Nevertheless, climate and its impact should continue to be evaluated. Based on the limited distribution of this cactus, we consider drought and climate change an ongoing, yet not imminent, threat to the species.

2.3 Synthesis:

A recent genetic study found that the extreme var. *kuenzleri* morphology (very few, very thick spines; few ribs) has arisen two separate times in the evolutionary history of *E. fendleri* (Beck et al. 2023: 6). This suggest that the Fort Stanton individuals (Northern Sacramento Mountain management area) are more closely related to *E. fendleri* var. *fendleri* populations nearby in Lincoln County and that the lineage containing the Elk (Southern Sacramento Mountain management area) and Texas Hill populations (Guadalupe Mountain management areas) is the lineage that most closely corresponds to the *E. fendleri* var. *kuenzleri* morphology (Beck et al. 2023: 9). The most recent Recovery Plan (2021: viii) for *E. fendleri* var. *kuenzleri* requires that a minimum of three geographically separated core sites be maintained and that at least one core site must be maintained in each management area (northern Sacramento, southern Sacramento, and Guadalupe Mountains). Therefore, further genetic studies are still needed to see where the Bullis and Prude *E. fendleri* var. *kuenzleri* populations (Guadalupe Mountain management area) and the *E. fendleri* var. *fendleri* populations in the Guadalupe Mountains fall on the evolutionary tree before making any changes to the listing or distribution for *E. fendleri* var. *kuenzleri.*

After reviewing the best available scientific information, we conclude that the Kuenzler hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*) remains a threatened species. The evaluation of threats affecting the species under the factors in 4(a)(1) of the Act and analysis of the status of the species in our 2016 5-year review remains an accurate reflection of the species current status.

3.0 RESULTS

3.1 Recommended Classification:

No change is needed.

3.2 New Recovery Priority Number:

No change recommended.

Brief Rationale:

Given the data on *Echinocereus fendleri* var. *kuenzleri* distribution, threats, and taxonomic uncertainty we believe no status change is warranted.

3.3 Listing and Reclassification Priority Number: No change recommended.

Reclassification (from Threatened to Endangered) Priority Number:
Reclassification (from Endangered to Threatened) Priority Number:
Delisting (Removal from list regardless of current classification) Priority Number:

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Continual standardized monitoring and surveying to give a clearer idea of the current abundance and overall range of *E. fendleri* var. *kuenzleri*, as well as any further threats to the cactus from livestock grazing, fire, illegal take, drought, climate change, and development. Further molecular research on genetic variations within the species *Echinocereus fendleri* to help clarify the taxonomic standing of *E. fendleri* var. *kuenzleri*.

The success of transplanting is still in question. Further research is needed before establishing it as a standard conservation measure.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of Kuenzler Hedgehog Cactus

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service, NM Ecological Services Field Office]

Approve SHAWN SARTORIUS Digitally signed by SHAWN SARTORIUS Date: 2023.08.31 15:03:47 -06'00'

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2

Approve _____