Fickeisen plains cactus
(*Pediocactus peeblesianus* var. *fickeiseniae*)

5-Year Review:
Summary and Evaluation

Photograph: Daniela Roth

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
Phoenix, Arizona
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5-YEAR REVIEW
Fickeisen plains cactus (*Pediocactus peeblesianus* var.*fickeiseniae*)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office: Interior Region 7 (NM)
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Lead Field Office: Arizona Ecological Services Field Office, Interior Region 8
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1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service or USFWS) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species 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 as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. 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 including public review and comment.

1.3 Methodology used to complete the review:

We initiated a status review on the Fickeisen plains cactus to address new information on its status, distribution, threats, and management throughout its range since its 2013 listing. This 5-year review serves as the taxon's first formal review. The Arizona Ecological Services Office conducted and completed this review using information in our files, meetings, or emails. We informally solicited information on April 16, 2019, from persons who have expertise or experience working with the Fickeisen plains cactus and requested new information. We received information from the Bureau of Land Management (BLM) and the Navajo Nation. The Kaibab National Forest responded to our request but did not have new information. The public notice for this review was published in the Federal Register on July 26, 2019 (84 FR 36113); one public comment was received.

1.4 Background:

FR Notice citation announcing initiation of this review: 84 FR 3611, July 26, 2019

1.4.1 Listing history:

Original Listing
FR notice: 78 FR 60607
Date listed: October 31, 2013
Entity listed: Variety
Classification: Endangered

1.4.2 Associated rulemakings:

Final critical habitat designation, 81 FR 55265, September 19, 2016.

1.4.3 Review History:

This is the first 5-year Status Review conducted on the taxon.

1.4.4 Species' Recovery Priority Number at start of 5-year review: Unassigned.

1.4.5 Recovery Plan or Outline: Development of a recovery plan is scheduled for 2022.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

_____Yes
__X__No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan?

____Yes
_X__No

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

The Fickeisen plains cactus is a small globose cactus in the family Cactaceae. Individual stems may be unbranched to occasionally branched, and grow 2.5-6.5 centimeters (cm) (1.0-2.6 inches [in]) above the soil surface and up to 5.5 cm (2.2 in) in diameter (Heil and Porter 2003). The corky or spongy texture of the spines makes the

subspecies unique and distinguishes it from other members in the genus *Pediocactus* (Heil et al. 1981). The Fickeisen plains cactus has contractile roots that enable the plant to retract into the soil during the winter and summer seasons and during drought conditions. Plants may shrink down into the soil until the crown sits flush with the soil surface. Some individuals may become completely buried by soil litter or gravel. At maturity, many plants are quarter-size making them difficult to locate. Additional information about its life history and habitat is available in the final listing rule (78 FR 60607) and final rule designating critical habitat (81 FR 55265).

2.3.1.1 New information on the species' biology and life history:

In 2015, we awarded Dr. Clare Aslan who is an expert in pollination ecology at Northern Arizona University, section 6 traditional grant funding to investigate the role of pollinator abundance and diversity in the reproductive output of the Fickeisen plains cactus (Aslan 2017). During the flowering season of March through May in 2016 and 2017, Aslan studied the pollinators of the Fickeisen plains cactus to determine how interspecific interactions vary across the taxon's geographic range and land use history. Her study included four populations on the BLM, Kaibab National Forest, and private lands: 34 individuals at Cataract Ranch; 54 individuals in and outside the North Canyon monitoring plot; 208 individuals at South Canyon; and 21 individuals at Beanhole Well (Figure 1). The four separate study sites, located over 14 kilometers (km) (9 miles [mi]) from one another, differed in elevation and the broader vegetation community. She visited sites on 37 separate dates in 2016 and 36 separate dates in 2017 to search for open flowers.

Observation start times ranged from 10:15 am until 4:29 pm to capture flower opening and closing; and total observation was 52.80 hours. She located at total of 317 individual Fickeisen plains cacti among all sites. She then conducted a careful search for individual plants that appeared to be budding.

Aslan (2017) described that the Fickeisen plains cactus pollination rates were "extremely low." She stated that the average number of open flowers located in any given site during any single observation was one flower in 2016 and 12.8 flowers in 2017. An extreme drought occurred in 2016, and subsequently no plants produced fruit. Aslan observed a large number of flower buds but those failed to mature into flowers. Consequently, there was no fruit produced in 2016. Of ten plants marked for fruit production in 2017, there was an average of 1.79 fruit produced.

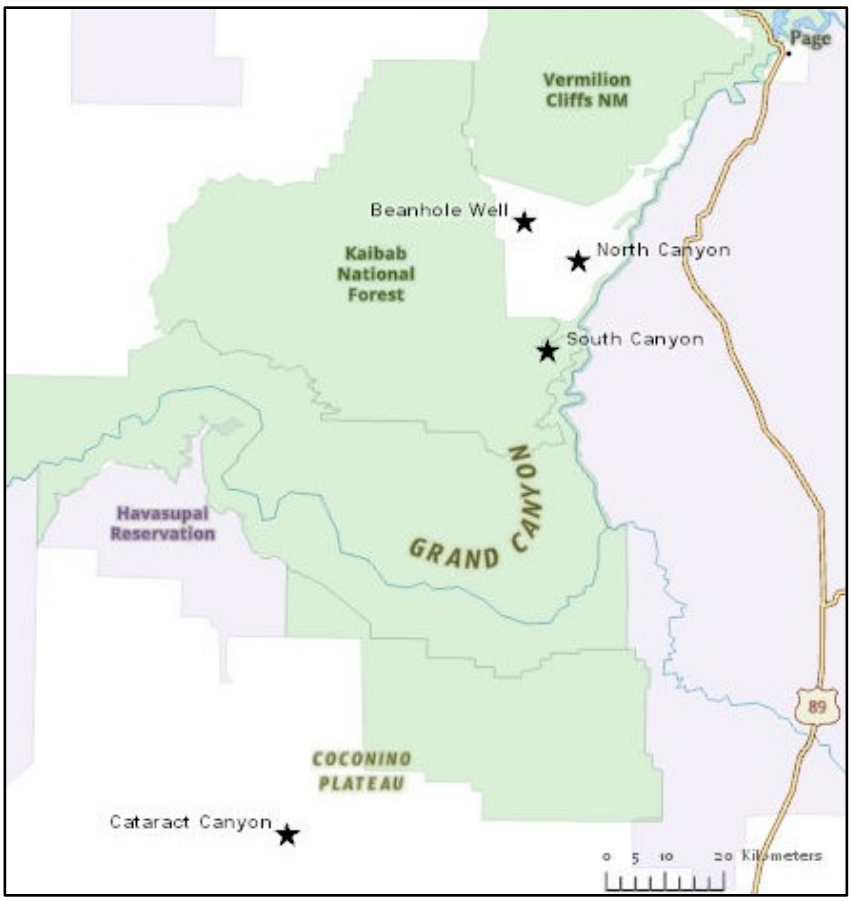

Figure 1. General locations of four Fickeisen plains cactus study sites visited by Clare Aslan (2017), Northern Arizona University.

Of 317 plants, Aslan (2017) observed a pollinator visiting two single flowers. The first observation occurred on April 20, 2016, at Cataract Ranch and the second observation occurred on April 6, 2017, at North Canyon. In both cases, the flower visitor was a solitary bee from the genus *Agapostemon* (i.e., metallic green sweat bees) (Figure 2). Bumblebees, butterfly species, and a diversity of other potential pollinators occurred in the immediate vicinity of Fickeisen plains cacti and visited other flowering species but were not detected visiting flowering Fickeisen plains cacti. She also found that the total amount of time in which Fickeisen plains cacti's flowers are open and available for pollination in any given site is low. Flowers remained open for only a few hours on warm, sunny days, and stay closed on cool, overcast days, further limiting pollination.

Aslan (2017) noted that the Fickeisen plains cactus may have a specialized pollinator or that the low visitation is indicative of a depauperate pollination community with densities and pollinator diversity reduced from historic levels.

Figure 2. Solitary native bee in the genus *Agapostemon* observed visiting Fickeisen plains cactus flowers outside of BLM's North Canyon monitoring plot in House Rock Valley. Photo by Clare Aslan, Northern Arizona University.

Solitary bees from the genus *Agapostemon* are a known pollinator of *Pediocactus* species (Peach et al. 1993). BLM documented a green metallic bee visiting flowering Siler pincushion cacti (*Pediocactus sileri*) during the 2016 monitoring period but did not identify the bee to family.

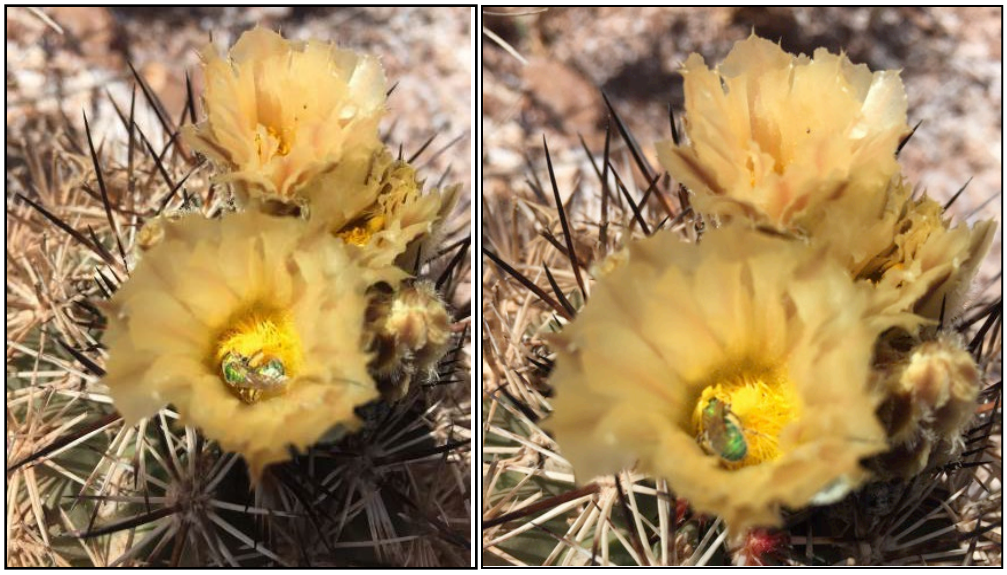

Figure 3. Solitary native bee, believed to be from the genus *Agapostemon* visiting Siler pincushion cacti (*Pedicactus sileri*) flowers in the Atkin Well monitoring plot on the Arizona Strip. Clare Aslan (2017) observed a similar native bee visiting Fickeisen plains cactus flowers. Photos by Jace Lambeth, BLM.

Aslan (2017) results highlighted further research needs, such as whether the Fickeisen plains cactus has a specialized pollinator, if the 2017 low pollination rates was a rare occurrence, and if there is a need for pollinator restoration practices to increase pollinator diversity.

2.3.1.2 Abundance, population trends, demographic features, or demographic trends:

We describe BLM's demographic monitoring results, the taxon's updated status on the Navajo Nation, and Babbitt Ranches' management efforts below. We did not receive information about any additional populations. In total, we are aware of 37 populations range-wide, but two populations may be extirpated (see the Navajo Nation discussion below). We use the NatureServe's definition of occurrences to define a population. We consider an occurrence of plants in suitable habitat that is within 1 km (0.6 mi) of another to be a single population; whereas, occurrences separated from another by a distance of 1 km (0.6 mi) or greater are different populations (NatureServe 2002).

BLM Arizona Strip District Office
The BLM Arizona Strip District Office established long-term monitoring plots for the Fickeisen plains cactus in 1986 (Table 1, Appendix). The plot locations were located in areas that contained dense Fickeisen plains cactus individuals and were easily accessible (78 FR 60631). Seven plots are 10 by 10 meters (m) (33 by 33 feet [ft]) in size. These plots are referred to as North Canyon (one plot), Sunshine Ridge (two plots), and Clayhole Ridge (four plots). There is also one large plot, the Dutchman Draw plot that is 20 by 10 m (66 by 33 ft) in size.

Figure 4. A flowering Fickeisen plains cactus growing among needle and thread grass (*Hesperostipa comate*) outside of the Dutchman Draw monitoring plot in 2017, Arizona Strip. Photo by Jace Lambeth, BLM.

Within each plot, the BLM gives each cactus a numbered tag and annually records information on abundance, reproduction (the percent of tagged plants flowering or fruiting), recruitment (i.e., individuals with a diameter less than 20 mm (0.78 in)), and the number of missing or retracted plants (78 FR 60631).

The BLM noted that rodent damage was high in the original Dutchman Draw plot a few years ago where they dug so much that it "looked like a plow had been in the plot" (Lambeth 2017). The BLM did not report the size of the expanded plot. Long-term trends within BLM standardized monitoring plots show the annual number of cacti recorded in the four plots over a 30-year period falling from a high of 314 in 1992 to a low of 52 cacti in 2017 (Table 1, Appendix).

Figure 5. Close-up view of two flowering Fickeisen plains cactus growing outside of the Dutchman Draw monitoring plot in 2017, Arizona Strip. Photo by Jace Lambeth, BLM.

Navajo Nation

The Fickeisen plains cactus occurs on the west side of the Navajo Nation, between the western border of the Nation and the area surrounding U.S. Highway 89 to the east. The distribution of populations occurs from the census-designated places of Bitter Springs in the north to Cameron in the south (Talkington 2019). At the time of listing, the Navajo Natural Heritage Program estimated that there were a total of 506 individual Fickeisen plains cacti distributed among 15 known populations on the Navajo Nation (78 FR 60607; NNDFW 2013). The number of cacti within each population ranged from two to over 300 individuals. Up until 2015, botanists had not thoroughly surveyed many of the populations in over a decade. For other populations, plants were located by chance without the botanist conducting a full survey of the area or delineating the population boundary (Hazelton 2015).

With funding from Section 6 of the Act, Cooperative Endangered Species Conservation Fund, and assistance from the Service, the Navajo Natural Heritage Program conducted a comprehensive status assessment of the Fickeisen plains cactus in 2015 (Hazelton 2015). The objectives were to (1) determine its status among known populations, (2) address data gaps in its known distribution by searching for new populations, and (3) produce an updated status report for the Navajo Nation. Two biologists conducted field inventories of pre-determined survey areas from April 2 to April 12, 2015, corresponding with its flowering season. They visited all known Fickeisen plains cactus point locations and completed a series of closely spaced walking transects in areas of high quality and marginal habitats. For every cactus found, they recorded its location coordinates and the number of cacti in the immediate vicinity. Biologists assigned all cacti to three categories. Juvenile cacti were those without flowers and less than or equal to 1cm (0.39 in) in diameter. This category included seedlings and young cacti that are too small to produce flowers. Reproductive adults had flowers or flower buds and included a few 1 cm diameter cacti in flower. Lastly, sterile adults had diameters greater than 1 cm (0.39 in) but no flowers, flower buds, or fruit at the time of the site visit (Hazelton 2015). Hazelton (2015) omitted three populations from this survey because they were surveyed in 2013, including Hellhole Bend, which is discussed below.

In total, Hazelton (2015) counted 1,101 individual Fickeisen plains cacti from 20 populations. Populations consisted of a single cactus to 354 cacti with 87% classified as reproductive adults, 8% sterile adults, and 5% juvenile cacti. Three of the populations are new where they discovered plants within the one square kilometer sections located within gaps of the Fickeisen plains cactus distribution. No plants were located in two surveyed areas, Small Ridge and Shinamo Wash. Previously, a single Fickeisen plains cactus occurred at Small Ridge in 2004, and 12 adult cacti and four seedlings occurred at Shinamo Wash in 1993. The lack of detecting Fickeisen plains cactus at these two sites may indicate extirpated populations (Hazelton 2015).

The 2019 Navajo Nation census data estimates the Fickeisen plains cactus population at 1,572 individuals within 22 populations (Talkington 2019). This included a new population discovered in 2017 and a population found in 2013 but inadvertently missed from the 2015 report. Although there has been an increase in abundance from 2013 to 2019, the Navajo Natural Heritage Programs cautions comparing earlier estimates from those in 2015 given the different methodologies. Future surveys for the taxon will use the 2015 standardized protocol developed by the Navajo Nation for more accurate estimates.

Demographic Monitoring

Demographic monitoring of the Fickeisen plains cactus began in 2006 at the Salt Trail Canyon population and in 2012 (78 FR 60607) at the Hellhole Bend population (Talkington 2019). Each site consists of four circular plots each with

a 4-m (13 ft) radius measured from center. Within each plot, each individual is marked with a tag and its location recorded from the plot's center.

Salt Trail Canyon Monitoring Site

The Navajo Natural Heritage Program botanist began monitoring the Fickeisen plains cactus population near the Salt Trail Canyon in 2006 (78 FR 60607). The number of plants between 2006 and 2018 in the 4 monitoring plots declined by 58%, with 122 plants counted in 2006 and 51 plants in 2018 (Talkington 2019). Surveyors found the highest number of dead cacti in 2009 (34 dead cacti), 2011 (26 dead cacti), and 2017 (21 dead cacti). There were no seedlings (size class defined as between 0-0.99 cm/0.39 in in diameter) observed in the years 2008, 2009, 2014, and 2015. In the remaining seven years of monitoring, the number of seedlings within the plots never exceeded six individuals suggesting low recruitment. The highest number of cacti with flowers and flower buds occurred in 2008, but no seedlings occurred in 2009, as would be expected. The lowest years for reproduction were 2007 and 2011.

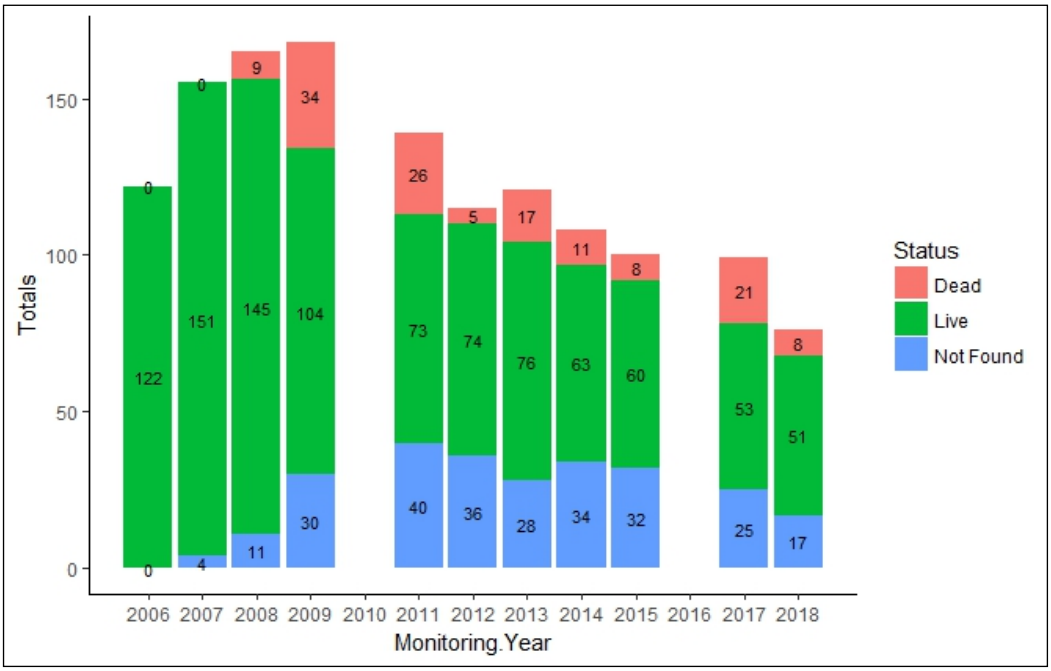

Figure 6. Total numbers and status of Fickeisen plains cactus found by year in four monitoring plots at the Salt Trail monitoring site. Cacti "not found" are presumed to be either retracted underground or dead. Chart is reprinted from Talkington (2019).

Hellhole Bend Monitoring Site

The Navajo Natural Heritage Program botanists discovered the Hellhole Bend population in 2009 along 2 km (1.24 mi) of the canyon rim (Hazelton 2015). They counted 314 Fickeisen plains cacti, making it the largest population known on the Navajo Nation. In 2013, botanists conducted a second count by surveying meandering transects along the canyon rim to establish the population's boundaries (Hazelton 2015). During this effort, they counted 358

Fickeisen plains cacti. The Navajo Natural Heritage Program identified feral horses as a potential threat to the cactus.

Monitoring of Fickeisen plains cactus demographic trends and fruit production began in 2012 within the Hellhole Bend population (Talkington 2019). The Navajo Natural Heritage Program botanist recorded data from 2012 to 2013 and from 2016 through 2018. During these years, the total number of live plants varied but showed an overall increase from 106 in 2012 to 132 to 2018. The number of plant deaths and plants not relocated increased from one dead and one not found in 2013 to nine dead and 46 not found in 2018. The botanist presumed the missing plants were retracted underground at the time of the survey or dead. The number of seedlings (0-0.99 cm/0-0.39 in size class) varied with 16 individuals in 2017 to 5 individuals in 2018; the majority of cacti (54 to 70%) were within the 2-2.99 cm (0.79-1.18 in) size class. These results suggest that seedlings make up a very small proportion of plants in the plots, and recruitment is generally low and highly variable (Talkington 2019).

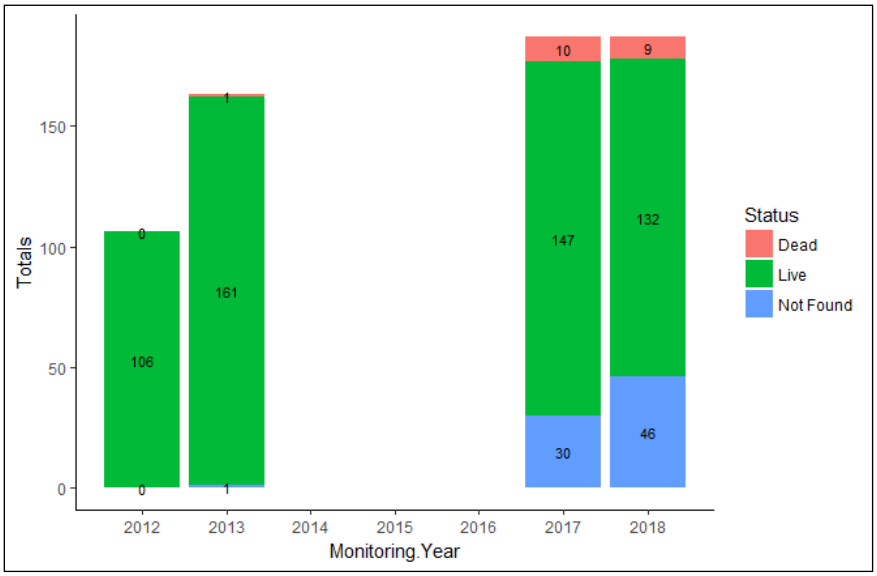

Figure 7. Total numbers and status of Fickeisen plains cactus found by year in the four monitoring plots at Hellhole Bend. Cactus "not found" are presumed to be retracted underground or dead. Chart reprinted from Talkington (2019).

Private Lands

SWCA Environmental Consultants, in partnership with Babbitt Ranches, LLC, Landsward Foundation, and the Service co-hosted a workshop to develop draft survey and monitoring protocols for the Fickeisen plains cactus (SWCA 2014). A component of the *Draft Babbitt Ranches Fickeisen Plains Cactus Management Plan* (Babbitt Ranches, LLC 2013) is to standardize long-term demographic monitoring and pre-construction presence/absence survey methods. A goal of the draft protocols was to reduce disturbing the cactus' habitat and avoid stepping on plants while carrying out these activities. Those in attendance included the Service, Kaibab National Forest, Navajo Nation, Grand

Canyon Trust, The Nature Conservancy, and Arizona State Lands as well as, acknowledged Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) experts from the BLM and The Arboretum at Flagstaff. The group raised unresolved questions, factors to consider when designing the different protocols, and shared different perspectives and opinions. Overall, the workshop was successful in creating a preliminary methodology for carrying out different types of surveys in potentially suitable habitat and identifying the types of information to detect long-term trends in recruitment and mortality (SWCA 2014). While finalizing the survey and monitoring protocols requires additional work, we decided to have internal discussions to address all of the questions and will take the lead in the future to develop these methods more fully.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Currently, Porter's (2010) phylogenetic analysis recognizing the *Pediocactus peeblesianus* var. *fickeiseniae* and *Pediocactus peeblesianus* var. *peeblesianus* as distinct varieties (or subspecies), and the circumscription (i.e., definition of a taxon) valid (Heil and Porter 2001, 2003) is widely accepted.

Baker (2014) reassessed morphological variations of stem characters within and among populations of *Pediocactus peeblesianus* (var. *fickeiseniae* and var. *peeblesianus*), reaching a conclusion that these two cacti are one species. He determined that as both plant varieties grow in size, the length of the largest spine increased, as does the average length of all of the spines per areole. Baker also found some overlap in the two varieties' morphological characteristics with no correlation to geography, and suggested it was not practical to segregate populations of *P. peeblesianus* into two varieties.

2.3.1.4 Taxonomic classification or changes in nomenclature:

We are revising the scientific name of the Fickeisen plains cactus in the List of Threatened and Endangered Plants and Animals from *Pediocactus peeblesianus* var. *fickeiseniae* to *Pediocactus peeblesianus* ssp. *fickeiseniae*. This taxonomic treatment is consistent with the Flora of North America (Heil and Porter 2001, 2003) and the broader botanical community whom state that the original variety, "*Pediocactus peeblesianus* var. *fickeiseniae* L.D. Benson" was not validly published (Heil and Porter 2003; Tropicos 2019). The Integrated Taxonomic Information System (ITIS 2019) recognizes the taxon as *Pediocactus peeblesianus* ssp. *fickeseniorum*. Publication of the technical corrections in the Federal Register will be forthcoming.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

Since its listing, we have no new information regarding changes in the spatial distribution or historic range for the Fickeisen plains cactus. The new Navajo

Nation population is located near an extant population, and therefore, does not change the spatial distribution or historical range of the cactus.

2.3.1.6 Habitat or ecosystem conditions:

Since its listing, we have no new information about the conditions of Fickeisen plains cactus habitat or the ecosystem upon which it occurs.

2.3.1.7 Conservation Measures:

Land management agencies, tribes, and landowners have implemented actions that can directly or indirectly conserve, reduce, or minimize effects to Fickeisen plains cactus and its critical habitat. For example, survey results can determine where plants occur for protection or areas to avoid when assessing future projects. The North Kaibab Ranger District (USFS 2020) proposed conservation measures to minimize effects to the cactus and its critical habitat while implementing fire management actions (i.e. avoidance, hand treatments, invasive plant treatment, follow-up monitoring).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Grazing by cattle, domestic sheep, and feral horses continues within Fickeisen plains cactus habitat. The final listing rule (78 FR 60636) describes grazing effects to the Fickeisen plains cactus and its habitat. The BLM stated the term grazing permit for the Mainstreet and White Pockets allotments, where the Dutchman Draw and Clayhole Ridge monitoring plots occur, was renewed without coordination with our agency under section 7(a)(2) of the Act (L. Christian, BLM, pers. comm. October 1, 2019). The BLM Arizona Strip District Office proposed, authorized, and completed several range improvements around 2014, such as a pipeline and trough in the White Pockets Allotments. The BLM described that those improvements were not located in any habitat for the plant or in any areas where the Fickeisen plains cactus occurs (L. Christian, BLM, pers. comm. October 1, 2019). In addition, the renewed term grazing permits were "automatic" renewals authorized by a 2015 amendment to Section 402(c)(2) of the Federal Land Policy and Management Act (BLM 2015). The amendment states that "when a field office is unable to complete the requirements of the National Environmental Policy Act of 1969 and other applicable laws prior to the expiration of a grazing permit; it must continue the terms and conditions of the expired permit by issuing a new permit with the same terms and conditions" (BLM 2015). While range improvements are located outside of occupied cactus habitat, it is unclear if the improvements led to changes in cattle distribution resulting in moving cattle into occupied cactus

habitat. Monitoring information collected from both plots in 2016 and 2017 did not mention cattle use in occupied habitat.

On the Kaibab National Forest, the South Canyon Fickeisen plains cactus population occurs within the Buffalo Ranch Management Area, which supports forage for the House Rock bison herd (78 FR 60607). In 2013, there was no evidence that bison used occupied cactus habitat at South Canyon (Service 2013). There was little to no water in the area and the habitat did not contain forage that would attract the bison. To our knowledge, these conditions have not changed. The bison herd now spends much of its time on the North Rim of the Grand Canyon National Park and adjacent forested areas of the Kaibab Plateau (NPS 2017). If bison did enter into occupied Fickeisen plains cactus habitat, the Forest Service has committed to ensuring that quality of occupied cactus habitat remains suitable per conditions in their Land and Resource Management Plan (USFS 2014).

We have no other information regarding threats to Fickeisen plains cactus habitat or its range.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

We consider overutilization or unauthorized collection of a Fickeisen plains cactus as a potential threat based on evidence some *Pediocactus* species have been illegally collected; but concluded that overutilization or unauthorized collection did not rise to the level of having a significant impact to the rangewide population (78 FR 60607). Since we listed the Fickeisen plains cactus we have not received information suggesting that unauthorized collection of the cactus has occurred. However, determining that illegal collection has occurred can be difficult for various reasons such as remote population locations and scarce law enforcement resources. Poaching cactus from their native habitat is becoming a growing problem both in Arizona (Bennett 2020; McGivney 2019; Rohrlich and Schlanger 2019) and worldwide (IUCN 2015; Service 2019). For these reasons, we consider overutilization or unauthorized collection of the Fickeisen plains cactus as a potential threat since the majority of its populations have low numbers.

2.3.2.3 Disease or predation:

We include herbivory effects to Fickeisen plains cactus as a classification of threats under the disease or predation-listing factor (Factor C, section 4(a)(C) of the Act).

In the final listing rule (78 FR 60607), we identified small mammal herbivory and cactus borer beetle (*Moneilma semipuctatum*) effects as threats to the Fickeisen plains cactus. Aside from the BLM report of 10 dead plants in the Clayhole Ridge monitoring plot from rodent herbivory, we do not have any

other information specific to these threats.

During her pollination research at Cataract Ranch, Aslan (2017) observed a high density of *Apantesis incorrupta* caterpillars (e.g., larvae in the subfamily Arctiinae [Tiger and Lichen Moths]) at one of the Fickeisen plains cactus populations. The caterpillars defoliated all saltbush plants (*Atriplex* spp.) in the area then began consuming flower petals on the Fickeisen plains cactus. Once the *Apantesis incorrupta* caterpillars stripped all the petals off all open Fickeisen plains cactus flowers, they burrowed into the flowers' ovaries and eliminated the reproductive potential of the cactus for that day. It is unknown if this occurrence was a single event and to what extent it may affect cacti or populations.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

We did not receive any new information regarding the inadequacy of existing regulatory mechanisms effecting Fickeisen plains cactus.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

We consider small population size a threat to Fickeisen plains cactus because having a small number of individuals makes that population more vulnerable to stochastic events such as severe drought (78 FR 60607). The Fickeisen plains cactus was one of 34 rare plant taxa designated to be of management concern for the BLM that were included in a trait-based assessment of their sensitivity and adaptive capacity to climate change (Still et al. 2015). Still et al. (2015) used NatureServe's Climate Change Vulnerability Index (CCVI) (Young et al. 2016), which examines fifteen factors of temperature and moisture changes, landscape context, natural history traits, and documented or modeled response to climate change. They also assessed species vulnerability to climate change with species distribution modeling to predict current and future suitable areas or geographic areas where the species may occur based on spatial, environmental, and climatic variables.

Figure 8. *Apantesis incorrupta* caterpillar feeding on a Fickeisen plains cactus flower, April 2017. Photo by Clare Aslan, Northern Arizona University.

Still et al. (2015) found that the Fickeisen plains cactus received a CCVI score of Extremely Vulnerable, meaning the "abundance and/or range extent within the geographical area assessed extremely likely to substantially decrease or disappear by 2050" (Young et al. 2016). The Species Distribution Modeling predicted the cactus will experience a 94% decrease in suitable area in which its range will contract substantially thus leaving potentially 6% of suitable habitat in the future. Still et al. (2015) noted that factors exacerbating a decrease in habitat suitability are natural barriers to seed dispersal such as canyons and mountains on the Colorado Plateau. Additionally, the amount or locations of designated critical habitat may not offer the cactus sufficient protection in the future.

Still et al. (2015) recommended monitoring current populations, surveying for new populations, developing a seed banking program, and methods for translocations into predicted future suitable areas.

2.4 Synthesis

We received little information that changes our basic understanding about the Fickeisen plains cactus since we listed it in 2013. At listing, we knew of 33 populations (78 FR 60629) and currently we are aware of 37 populations range-wide, with two possibly extirpated. Also, while some populations are regularly monitored (such as those on the BLM Arizona Strip District), many are not monitored, or are evaluated infrequently or irregularly (78 FR 60629). We are encouraged by the recent increased survey and monitoring attention from the Navajo Natural Heritage Program and Babbitt Ranches/Landsward Foundation. Population sizes within the BLM Arizona Strip District monitoring plots appear to have declined by almost 50% since 2013. The enlargement of

the Dutchman Draw plot in 2017 to include 22 additional plants complicates our understanding of long-term trends. The BLM did not elaborate on the new plot size or reasons for the decline in total numbers. Their tally for recruitment, death, and/or missing plants does not explain what could be attributing to the decline. The Navajo Nation's comprehensive 2015 survey effort resulted in more discovered plants. Still, most of the Navajo Nation's populations are small and there is concern for low reproduction rates and seedling numbers, as well as the persistence of two populations.

The latest Fickeisen plains cactus population trend or recruitment rate information includes site-specific issues making it challenging to reach definitive conclusions. The BLM's monitoring information for recruitment based on size is broad making it difficult to distinguish young plants from the number of seedlings. The Dutchman Draw plot expansion and inclusion of "new" plants complicates the long-term monitoring strategy, and specifically what constitutes recruitment. The Navajo Nation reports emphasize that the methods used during the 2015 survey were different from those used in previous surveys and determining population trends with their information would lead to inaccurate conclusions (Hazelton 2015, Talkington 2019). Furthermore, the Navajo Nation has only surveyed many of their populations once. The Kaibab National Forest may conduct demographic monitoring in the future that will add new information to the taxon's rangewide status assessment.

We received other observations and information identifying concerns about Fickeisn plains cactus. The BLM described rodent herbivory affecting ten Fickeisen plain cacti within the Clayhole Ridge plot for two separate years. Aslan's (2017) observations raised concerns about the cactus reproductive output due to few individuals producing flowers, few flowers opening during March through May, and pollinator abundance. *Apantesis incorrupta* caterpillars may contribute to lower reproduction rates by eating flowers and burrowing into the ovaries. Continued drought and sensitivity to climate change may contribute to range contraction and limit dispersal. Without adequate reproduction, these existing and potential threats could have a larger effect, especially on smaller imperiled populations, leading to declines. It is important surveyors seek out new populations and annually monitor known populations with consistent standardized methodology to identify population status and trends to inform future decisions. Active management may be necessary to reduce ground-disturbing activities within occupied habitat and create more populations. In conclusion, we recommend that the classification of the Fickeisen plains cactus remain the same based on the information received for this review.

3.0 RESULTS

3.1 Recommended Classification:

____Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change is needed

3.2 New Recovery Priority Number: 12; the Fickeisen plains cactus is a subspecies, with a moderate risk of extinction, low probability of recovery potential, and no conflict.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Develop a recovery plan for the Fickeisen plains cactus to incorporate new information on biology, ecology, and management recommendations. Establish objective and measurable recovery criteria for down and delisting to address all relevant listing factors.
- Continue to improve coordination and collaboration among all parties conducted land management actions or permitted activities in Fickeisen plains cactus habitat.
- Continue to seek out new Fickeisen plains cactus populations and improve the monitoring of known populations using standardized methodology.
- Conduct genetic studies between populations to determine variability and demographic studies to examine if low pollinator visits effects population size and if gene flow is limited.
- Develop an off-site conservation program for seed banking and propagation techniques. Conduct studies to evaluate the effectiveness of seed germination and seedling establishment and whether new populations can be established by seed or require transplants of already established plants.
- Investigate the need for pollinator restoration practices to increase abundance and diversity of pollinators and supporting habitat.
- Examine the ability for the Fickeisen plains cactus to naturally disperse into unoccupied suitable habitat. Also, examine whether the quality of these unoccupied habitats can remain suitable under future climactic conditions. Develop management plans to conserve and protect those future habitats for the taxon's continuing persistence. Develop a systematic and standardized monitoring protocol to gather and collect long-term demographic information that improves the quality of data and helps formulate rangewide conservation practices to improve the taxon's status.
- Establish coordination meetings with BLM Arizona Strip Field Office to discuss monitoring methods, results, and future management of the cactus.

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Table 1. Documented Fickeisen plains cacti on four monitoring and cluster plots, 1986-2017, BLM Arizona Strip District Office. Note: the 2017 census at the Dutchman Draw plot included eight Fickeisen plains cacti inside the monitoring plot and 22 individuals counted outside of the marked plot boundaries.

Year	Dutchman	Clayhole	Sunshine	North Canyon	Navajo	Sunshine Ridge II	Salaratus I & II	Temple Trail	Toquer Tank	Ward	Total
1987	107	23	12	16					7		**165**
1988	102	35		27					9		**173**
1989	185	31	8	28					9		**261**
1990	186	32	33	33					6		**290**
1991	194	37	43	36					13		**323**
1992	219	44	44	7					7		**321**
1993	168	34	32	13	0		13	1		0	**261**
1994	168	38	35	16			44		7		**308**
1995	188	30	25	11							**254**
1997	122	21	7	21							**171**
1998	49	16	6	26							**97**
1999	45	17	5	28							**95**
2000	37	20	None found	22							**79**
2001	40	63	3	34	10	23	0	7	0	10	**190**
2002	30	60	12	24							**126**
2003	50	56	Not surveyed	24							**130**
2004	45	59	7	40							**151**
2005	34	59	33	40							**166**
2006	36	48	26	32							**142**
2007	32	38	30	39							**139**
2008	23	40	23	33							**119**
2009	33	37	33	31							**134**
2011	12	42	34	39							**127**
2012	5	38	4	42							**89**
2013	3	45	21	38	6	8	1	1	1	2	**126**
2014	5	30	22	39							**96**
2016	2	17	8	25							**52**
2017	30	20	10	23							**83**

Table 2. Annual Fickeisen plains cactus monitoring data from 2013 to 2017 as reported by the BLM Arizona Strip District Office. Sources of mortality by off-road vehicles, trampling, or illegal collection was not detected from 2013 to 2016 and therefore not recorded.

Plot (Year)	Size Structure 1 to 15 (mm)	Size Structure 16 (mm) and over	Percent Tagged Cactus Fruiting	Recruitment		Mortality	
				0 to 20 (mm)	Over 21 (mm)	Natural	Retraction or Missing
Dutchman (2013)	3	0	0	0	0		2
Clayhole (2013)	6	39	42	0	9	4	9
Sunshine (2013)	14	7	0	13	1		22
North Canyon (2013)	13	25	Read in fall. No fruiting.	Not tallied	Not tallied		3
Dutchman (2014)	3	2	60	0	0		
Clayhole (2014)	4	34	53	0	1	3 from rodents	9
Sunshine (2014)	17	5	14	0	0		
North Canyon (2014)	12	27	Read in fall. No fruiting.	1	0		
Dutchman (2016)	1	1	50	0	0		
Clayhole (2016)	3	14	53	0	0	5 from rodents	5
Sunshine (2016)	6	2	0	0	0		
North Canyon (2016)	6	19	Read in fall. No fruiting.	1	0		7
Dutchman (2017)	13	17	90	7	15	1 from rodents	
Clayhole (2017)	6	14	74	0	4	5 from rodents	5
Sunshine (2017)	6	4	20	0	0	1 from rodents	
North Canyon (2107)	4	19	Read in fall. No fruiting.	0	2	1 from drought	8

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Fickeisen plains cactus

Current Classification:

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_**X**_ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: Not Applicable

Review Conducted By: Arizona Ecological Services Office, Phoenix, Arizona

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service, Arizona Ecological Services Field Office

Approve JEFFREY HUMPHREY Digitally signed by JEFFREY HUMPHREY Date: 2020.09.14 17:44:17 -07'00'