DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R2–ES–2012–0061; 4500030113]

RIN 1018–AY51

Endangered and Threatened Wildlife and Plants; Endangered Species Status for Echinomastus erectocentrus var. acunensis (Acuña Cactus) and Pediocactus peeblesianus var. fickeiseniae (Fickeisen Plains Cactus) Throughout Their Ranges

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine that *Echinomastus erectocentrus* var. *acunensis* (acuña cactus) and *Pediocactus peeblesianus* var. *fickeiseniae* (Fickeisen plains cactus) meet the definition of endangered species under the Endangered Species Act of 1973, as amended. This final rule implements the Federal protections provided by the Act for these species. The effect of this regulation will be to add these species to the List of Endangered and Threatened Wildlife and Plants under the Endangered Species Act.

DATES: This rule becomes effective October 31, 2013.

ADDRESSES: This final rule is available on the Internet at *http://www.regulations.gov,* Docket No. FWS–R2–ES–2012–0061. Comments and materials we received, as well as supporting documentation used in the preparation of this final rule, are available for public inspection at *http://www.regulations.gov.* All of the comments, materials, and documentation that we considered in this rulemaking are available by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Arizona Ecological Services Office, 2321 West Royal Palm Rd., Suite 103, Phoenix, AZ 85021; by telephone 602–242–0210; or by facsimile 602–242–2513.

FOR FURTHER INFORMATION CONTACT: Steve Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office, 2321 W. Royal Palm Road, Suite 103, Phoenix, AZ 85021; by telephone (602) 242–0210; or by facsimile (602) 242–2513. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

This document consists of a final rule to list as endangered *Echinomastus erectocentrus* var. *acunensis* (acuña cactus) and *Pediocactus peeblesianus* var. *fickeiseniae* (Fickeisen plains cactus) under the Act. For the remainder of this document, these species will be referred to by their common names.

Why we need to publish a rule. On October 3, 2012 (77 FR 60509), we published proposed rules to list acuña cactus and Fickeisen plains cactus as endangered species and to designate critical habitat for both species. In this document, we finalize our determinations as endangered species for these species under the Act. The Act requires that a final rule be published within one year of a proposed rule in order to add species to the lists of endangered and threatened plants to provide protections under the Act. We have determined that critical habitat for the acuña cactus and the Fickeisen plains cactus is prudent and determinable in the proposed rule and will soon publish in the **Federal Register** our final determination designating critical habitat for both cacti. The final critical habitat designation and supporting documents will publish under Docket No. FWS–R2–ES–2013–0025, and can also be found at the above locations.

The Endangered Species Act provides basis for our action. Under the Endangered Species Act, we can determine that a species is an endangered or threatened species based on any of five factors: (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.

For the acuña cactus, the threats to the species and its habitat result from the effects of drought and climate change (Factor A) in combination with predation by native insect and small mammal predators (Factor C). Threats also result from habitat destruction, modification, and degradation from United States-Mexico border activities (Factor A) and nonnative, invasive plant species issues (Factor A). In addition, the existing regulatory mechanisms in place do not directly address the threats to the species.

For the Fickeisen plains cactus, the threats to the species and its habitat result from habitat destruction, modification, and degradation from livestock grazing (Factor A) in combination with predation by small mammals (Factor C) and natural environmental variability and the effects of climate such as drought. When combined with the above mentioned threats, small population size (Factor E) likely exacerbates the effects of these threats on the Fickeisen plains cactus. In addition, the existing regulatory mechanisms are not ameliorating threats to the species.

Peer review and public comment. We sought comments from independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. We obtained peer reviews from two knowledgeable individuals for the acuña cactus and two knowledgeable individuals for the Fickeisen plains cactus, all with scientific expertise to review our technical assumptions, analysis, and whether or not we had used the best available information for both plants. These peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve this final rule. Information we received from peer review is incorporated in this final revised designation. We also considered all comments and information received during the comment period.

Organization of Document

The layout of this rule is as follows: the final listing determination of the acuña cactus and the final listing determination for the Fickeisen plains cactus.

Previous Federal Actions

Please refer to the proposed listing rule for the acuña cactus and Fickeisen plains cactus (77 FR 60509; October 3, 2012) for a detailed description of previous Federal actions concerning these species.

Summary of Changes From Proposed Rule

Since the publication of the October 3, 2012 (77 FR 60509), proposed rule to list and designate critical habitat for the acuña cactus and Fickeisen plains cactus, we have made the following changes in this final rule:

(1) Based on information received from public comments, we reevaluated the threat of nonnative, invasive plants on the acuña cactus. As a result, we

determined that nonnative, invasive plants currently occur in the vicinity of several populations of acuña cactus, including the largest known population, and will become a threat to the acuña cactus in the near future. Therefore, we conclude nonnative, invasive species pose a threat to the acuña cactus and its habitat.

(2) Based on information received from public comments that both affirmed and refuted the threat of nonnative, invasive plants on the Fickeisen plains cactus, we reevaluated this threat. We conducted a thorough review of available information and reassessed the distribution of nonnative, invasive species to Fickeisen plains cactus populations, including their risk of exposure and potential population-level outcomes. We conclude that nonnative, invasive species are stressors on the landscape within the range of the Fickeisen plains cactus, but at this time, we lack site-specific information on which species are present; their abundance, density, and distribution relative to Fickeisen plains cactus populations; and evidence that the cactus is negatively affected by nonnative invasive plants. Therefore, we conclude that there is insufficient evidence that nonnative, invasive species are a threat to the Fickeisen plains cactus at this time.

(3) We have added a discussion concerning the occupancy of the Fickeisen plains cactus on the Kaibab National Forest at South Canyon in House Rock Valley. The South Canyon population is now the only known Fickeisen plains cactus occurrence on National Forest Service Lands. Please see *Abundance and Trends* for more information.

(4) Based on questions raised from a public comment, we reviewed our discussion of *Factor D: Inadequacy of Existing Regulatory Mechanisms.* We acknowledged in the October 3, 2012, proposed rule that there were adequate existing regulatory mechanisms in place for the Fickeisen plains cactus, as mechanisms appear to provide adequate protection to the cacti and its habitat in the manner they were intended to provide. We have furthered this conclusion by noting that the existing regulatory mechanisms in place do not ameliorate the threats to the Fickeisen plains cactus.

Summary of Comments and Recommendations

We requested written comments from the public on the proposed listing and designation of critical habitat for the acuña cactus and the Fickeisen plains cactus during two comment periods. The first comment period, associated with the publication of the proposed rule (77 FR 60509), opened on October 3, 2012, and closed on December 3, 2012. We requested written comments on the proposed listing and critical habitat rule and the associated draft economic analyses during a comment period that opened on March 28, 2013, and closed on April 29, 2013, (78 FR 18938). We contacted all appropriate Federal, State, tribal, and local agencies; scientific organizations; and other interested parties and invited them to comment. Newspaper notices concerning the proposed rule and inviting the general public to comment were published by two local newspapers. We did not receive any requests for a public hearing, and thus, none were held.

During the comment periods for the proposed rule, we received 16 comment letters, including four from peer reviewers, directly addressing the proposed listing of the acuña cactus and the Fickeisen plains cactus with endangered status. All substantive information provided during the comment periods has either been incorporated directly into this final determination or addressed below.

Peer Review

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from three knowledgeable individuals on the acuña cactus and six on the Fickeisen plains cactus having scientific expertise that included familiarity with the respected taxon and its habitat, biological needs, and threats. We received responses from two of the peer reviewers for the acuña cactus and two for the Fickeisen plains cactus.

We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of the acuña cactus and the Fickeisen plains cactus. The peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final rule. Peer reviewer comments are addressed in the following summary and incorporated into the final rule as appropriate.

Peer Reviewer Comments

(1) *Comment:* Two peer reviewers commented that Flora of North America, Volume 4 (2003) presents a more recent taxonomic treatment of *Pediocactus* species than Benson (1982). It recognizes nine species of plants in the genera *Pediocactus,* not seven as stated in the proposed rule. Additionally, one peer reviewer commented that Flora of North America considers the Fickeisen plains cactus a subspecies of *Pediocactus peeblesianus.* The peer reviewer pointed out that we stated that the variety *fickeiseniae* was never validly published; therefore, we should use the current taxonomy.

Our Response: We have corrected our statement in the rule (see ''Taxonomy'' under ''*Species Description*'') that there are nine recognized species of *Pediocactus* in the United States, eight of which are endemic to the Colorado Plateau. We have referred to the Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) as a variety since it was categorized as a candidate species in 1980 based on Benson (1969) and Heil *et al.* (1981). In regard to the current taxonomic treatment of the Fickeisen plains cactus, we are aware that Flora of North America considers the cactus a subspecies of *Pediocactus peeblesianus.* Other taxonomic organizations (e.g., Integrated Taxonomic Information System), however, treat the cactus as a variety and continue to use the name *Pediocactus peeblesianus* var. *fickeiseniae.* We recognize that revising the taxonomy of the cactus should be addressed. In the future, we will inquire into the reasons these organizations differentiate the cactus as a subspecies versus a variety for species management. Under the Act and in regard to plants, we treat variety and subspecies equally (43 FR 17912) in that we do not differentiate between a variety and subspecies when assigning priority classifications to species for listing, delisting, reclassification, or recovery actions (43 FR 43103). We continue to treat the Fickeisen plains cactus as a variety until there is broad acceptance among the botanical community that the cactus should be recognized as subspecies *fickeiseniae.*

(2) *Comment:* One peer reviewer requested a discussion in the final listing rule about the possibility of hybridization between *Pediocactus* species whose ranges converge or overlap with the Fickeisen plains cactus on the Arizona Strip.

Our Response: Three other species of *Pediocactus* occur near the Fickeisen plains cactus: *Pediocactus sileri* (Siler's pincushion cactus), *Pediocactus paradinei* (Kaibab plains cactus), and *Pediocactus bradyi* (Brady pincushion cactus). Phillips *et al.* (1982, p. 8) considered the possibility of hybridization from two nearby *Pediocactus* species in their status report for the Fickeisen plains cactus but did not find evidence of hybridization occurring. Porter (2002,

unpublished report) conducted DNA sequencing between *Pediocactus* species to investigate phylogenic relationships. Although he did not necessarily investigate hybridization among the species, his study would have illuminated any potential hybridization in that evolutionary lineages would be unclear. In our review of the Fickeisen plains cactus, we did not receive information of a discovery of a population having a high degree of variation among individuals that are similar in character to the Fickeisen plains cactus and another *Pediocactus* species. While the potential for hybridization exists, we are not aware of this possibility being apparent.

(3) *Comment:* Two peer reviewers suggested further discussion of the damaged Fickeisen plains cactus with orange-red material observed on the Navajo Nation, and which may be an infestation of the cactus borer beetle (*Moneilema semipuctatum*). One reviewer stated that larva from this beetle have been documented in *Pediocactus despainii* as well as *Sclerocactus wrightiae* in Capitol Reef National Park where the mortality of *Sclerocactus* plants have increased following drought years. The other reviewer stated that the cactus borer beetle impacts can be difficult to detect and are often misidentified as drought mortalities.

Our Response: We have added a discussion of the cactus borer beetle under *Factor C: Disease and Predation.* Based on the information provided by the peer reviewer, infestation by the cactus borer beetle on other cacti species has resulted in mortality. Other than information presented by the Navajo Nation in 1994 of suspected damage to a Fickeisen plains cactus by a cactus borer beetle, we are not aware of any other individuals being affected. As stated in the proposed rule, the Navajo Nation noted no insect or disease reported for the Salt Trail Canyon population in their 2006–2008 report.

(4) *Comment:* One peer reviewer commented that cheatgrass (*Bromus tectorum*) is ubiquitous throughout the American West, noting that, while densities vary from year to year depending on rainfall, the plant has been documented on substrates on which the Fickeisen plains cacti grow and has been identified as a future problem in close proximity to the habitat of this cactus. The reviewer further added that any annual invasive species would have similar impacts of competition with respect to Fickeisen plains cactus seedling germination and establishment and requested further discussion of the impacts of invasive annual species.

Our Response: The impact of nonnative species on the Fickeisen plains cactus and its habitat is unclear. Several species of exotics occur across its range with cheatgrass being the most widespread followed by red brome and redstem filaree. The past and present Navajo Nation botanists have opposing views on the effect of exotics. The current position of the Navajo Nation is that more research is required to fully understand if a negative relationship exists between exotic species and the cactus, and if abundance of exotics is contributing to declines in cactus numbers or preventing the successful germination and establishment of seedlings. We acknowledge that densities of cheatgrass may vary depending on rainfall: In years of above-average precipitation, cheatgrass densities may be high creating a fine fuel source that could increase the fire risk and fire frequency of an area. Following a fire, cheatgrass can quickly spread across the landscape and become a dominant species effectively promoting recurrent fires in the future. However, habitat across the range of the Fickeisen plains cactus is not contiguous in that plants occur in more grassland habitat in Mohave County then in Coconino County where vegetation is sparser. We agree with the peer reviewer that invasive species would increase the risk of fire to native plants and can directly and indirectly compete for soil moisture, nutrients, space, and light. At this time, we do not have sufficient information to determine the distribution of exotic annual species in relation to Fickeisen plains cactus habitat. We also lack information describing direct and indirect effects exotics that have on the plant and its habitat.

(5) *Comment:* One peer reviewer questioned why we stated we did not have sufficient information to evaluate whether the presence of nonnative, invasive species would facilitate the spread of wildfire into the habitat of the Fickeisen plains cactus.

Our Response: Most of the habitat of the Fickeisen plains cactus in Coconino County consists of open areas with sparse vegetation and gravelly soil. The habitat in Mohave County that supports the Fickeisen plains cactus occurs in dense grass where there may be a potential fire risk from exotic annual grasses. As we previously stated, densities of cheatgrass vary across the range of the Fickeisen plains cactus, in addition to densities of other nonnative, invasive species or noxious weeds. If already existing within Fickeisen plains cactus habitat, densities of the nonnative, invasive species may increase in response to rainfall amounts and frequencies, thereby competing with the cactus for soil moisture, nutrients, space, and light. The nonnative, invasive species may also create fuels during the dry summer months and make the habitat prone to a wildfire. Given the diminutive size of the Fickeisen plains cactus, it would likely be killed by a wildfire. With sufficient information to support that high densities of exotics occur in Fickeisen plains cactus habitat, we would consider fire a significant threat. No evidence, however, leads us to believe that densities of cheatgrass or other exotic annual species near Fickeisen plains cactus habitat present a significant threat. No new information concerning the effects of fire and invasive species on the taxon was provided to us during the comment periods.

(6) *Comment:* One peer reviewer expressed concern about the level of protection afforded the Fickeisen plains cactus from the Northern Arizona 20-year Mineral Withdrawal (Public Land Order Number (PLO) 7787) on public lands in the vicinity of Grand Canyon National Park. The peer reviewer noted that not all populations would be protected based on their location near canyon rims and the entire habitat has not been surveyed. The peer reviewer also questioned the finality of PLO 7787 and whether it may be overturned in future political elections. The peer reviewer also thought that a 20-year ban on uranium mining may not be adequate to protect the cactus and its habitat with respect to recovery.

Our Response: We relied on the best scientific and commercial data available at the time of our proposed rule to determine whether uranium mining is a significant threat to the Fickeisen plains cactus across its range. As of the date of publication, PLO 7787 remains in effect and our analysis of the impact of that Order is unchanged. No new information was provided during the comment periods on the threat of uranium mining to the Fickeisen plains cactus or its habitat. If new information becomes available in the future indicating that uranium mining is a significant threat to the Fickeisen plains cactus and its habitat, we will incorporate those findings and reconsider our conclusion in any future recovery planning efforts or 5-year reviews of the taxon.

(7) *Comment:* One peer reviewer acknowledged that off-road vehicle (ORV) use, road construction, and recreational uses within the habitat of

the Fickeisen plains cactus are increasing. The peer reviewer suggests however, that, without scientific documentation, the Service cannot fully quantify the current impacts to the species.

Our Response: We agree with the peer reviewer that ORV use and its impact to the cactus and its habitat has not been investigated. We have very little evidence (three observations) over a 23-year period of cacti being damaged by ORV use or roadwork on lands managed by the Bureau of Land Management (BLM) and Navajo Nation. Because of the scarcity of information we cannot quantify the effects nor can we say that these actions rise to the level of significance such that they result in local or rangewide population declines.

(8) *Comment:* One peer reviewer stated that development on the Navajo Nation is imminent and possibly may be ongoing. The reviewer suggests the Service reconsider the determination that development is not impending.

Our Response: We are aware that the Navajo Nation may be interested in developing areas along the rims of the Colorado River and/or Little Colorado River to increase tourism opportunities. We did not receive information describing a timeframe, commitment, or specifics related to commercial development projects on tribal lands and any potential impacts they may have on the Fickeisen plains cactus. We relied on the best available scientific and commercial data available at the time to determine whether commercial development was a threat to the Fickeisen plains cactus and its habitat. Information we received indicated potential future development was too speculative, and, therefore, we do not consider it to be a threat to the cactus at this time.

(9) *Comment:* One peer reviewer asked for clarification on *Factor D: Inadequacy of Existing Regulatory Mechanisms* and the rationale for our conclusion for the Fickeisen plains cactus. The reviewer pointed to the first paragraph in this section of the proposed rule (77 FR 60509, p. 60544) stating that there are no existing laws or regulations that address the threats to the cactus but the second paragraph states that legal and regulatory mechanisms which are in place appear to be adequate to protect the plant. The reviewer notes that, if conservation measures are largely voluntary throughout the range of the species, then it appears that the existing regulatory mechanisms are likely inadequate to protect the species.

Our Response: The basis for Factor D is to review the existing regulatory mechanisms that apply to the acuña cactus and Fickeisen plains cactus. These mechanisms are then evaluated to assess whether they address any of the threats identified for each plant. For instance if the regulatory mechanism protects individual plant species, but does nothing to protect the habitat, then that mechanism does not address the threats, if there are threats to the habitat. We have clarified our discussion under Factor D in this final rule.

(10) *Comment:* One peer reviewer is concerned that information is lacking regarding threats from illegal collection of the Fickeisen plains cactus and feels that the Service is making a determination about the impacts of collection on this species prematurely.

Our Response: As discussed in the rule, there have been no reported instances of illegal collection, nor have there been documented cases. We, therefore, relied on the best scientific and commercial data available at the time of listing, which indicated that illegal collection on the Fickeisen plains cactus is not a threat at this time. However, if information suggests that collection becomes a threat in the future, we will take that into account during recovery planning for the Fickeisen plains cactus.

(11) *Comment:* One peer reviewer commented that the distribution and range estimates for the Fickeisen plains cactus by NatureServe and Benson are too different and do not provide meaningful information. The reviewer suggested basing the range on current information of population distribution and habitat.

Our Response: There have been two estimates of range: One by NatureServe in 2011, the other by Benson in 1982. As stated in the rule, we do not have certainty that these estimates delineate the range where the Fickeisen plains cactus is distributed. We conclude, however, that the current and historic distributions are very similar as no documentation suggests that additional populations occur outside of its known range. We, therefore, provided an estimate of range that includes the currently known populations.

Public Comments

(12) *Comment:* The U.S. Forest Service provided information clarifying the status of the Fickeisen plains cactus in areas that were considered to be occupied by the plant. They also provided information describing the attributes of occupied habitat.

Our Response: The information demonstrated that one of the locations thought to be occupied by the Fickeisen plains cactus was erroneous. That site, Snake Gulch, located along the western boundary of the Forest is now considered to be unoccupied. We have included this information regarding the status of the population near the eastern boundary into the rule.

(13) *Comment:* A land management agency and a member of the public commented about a statement made in the proposed rule under Factor A—Livestock Grazing in regard to the increases and decreases of the North Canyon Fickeisen plains cactus plot on the Arizona Strip (77 FR 60509, p. 60536). The Federal agency stated that the proposed rule states that grazing has likely diminished the quality of suitable habitat on the Sunshine Ridge and North Canyon plots. This conclusion is based on population fluctuations and the absence of grazing on the North Canyon plot between 2001 and 2008, during which time the population increased. It is important to note that the population increased similarly between 1986 and 1991 while grazing was present in the area. It is, therefore, speculation to conclude without supporting data that grazing is causing population fluctuations or hindering population recovery.

Our Response: During both wet and dry years, the BLM recorded increases in some populations. No weather data was recorded at the sites during these studies, and nearby weather station data is inadequate to draw conclusions. The monitoring was not designed to separate the effects of weather and cattle impacts to the plants; therefore, conclusions cannot be drawn. We agree with the commenter that we do not fully understand what contributed to the increase in plants in the North Canyon plot.

(14) *Comment:* We received comments indicating there are questions regarding the taxonomic validity of *Echinomastus erectocentrus* var. *acunensis.* In particular, there is concern that the variety *acunensis* may be subsumed into the more widespread species *E. johnsonii.* One comment suggests a need for further study, while the second requests justification for choosing one scientific name over another.

Our Response: As stated in the proposed rule, the Cactaceae treatment in the Flora of North America (Zimmerman and Parfitt 2003, pp. 194–195) recognizes the entity as *E. erectocentrus* var. *acunensis.* A 2007 study by Baker indicated that all *Echinomastus* populations could be placed under a single taxon circumscribing an enormous amount of morphological variation, or they could be recognized as infraspecific taxa

under a single species. Baker's 2012 *Echinomastus* treatment in the Intermountain Flora notes that further study is needed in order to properly circumscribe subspecific taxa. To date, no peer-reviewed publications state that *E. erectocentrus* var. *acunensis* should not be considered as a valid taxon; therefore, the Service accepts this nomenclature.

(15) *Comment:* One commenter suggested that the Service relied upon insufficient evidence of a threat to either cacti species and selectively overlooked uncertainties and data gaps, as well as evidence of increases in populations of these species. Specifically, they commented that listing is unwarranted because we do not have sufficient information on the abundance and health of either species, surveys vary by methodology and accuracy, and data is old and incomplete.

Our Response: The Act requires that we use the best scientific and commercial data available regardless of the age of the information. In the proposed rule, we solicited the public for any new information on these species; while we received information clarifying what was published in the rule, no new population information was received. In some cases, the best available data is derived from different species with similar habitat requirements. We have used the best available scientific and commercial data, including results of numerous surveys, peer-reviewed literature, unpublished reports by scientists and biological consultants, and expert opinion from biologists with extensive experience with the species. We acknowledge that additional surveys and continued monitoring of existing plots would be valuable and should be considered as a recovery action for these species.

Based on our review of the best available scientific and commercial data, we have determined that both species warrant listing as endangered because they are in danger of extinction throughout all or a significant portion of their ranges. We determine whether any species is an endangered or a threatened species based on a five-factor threat analysis. For the acuña cactus, the threats to the species and its habitat result from the effects of drought and climate change; predation by native insect and small mammal predators; habitat destruction, modification, and degradation from United States-Mexico border activities (Factor A); and nonnative, invasive plant species issues (Factor A). In addition, the existing regulatory mechanisms in place do not directly address the threats to the species. For the Fickeisen plains cactus, the threats to the species and its habitat result from habitat destruction, modification, and degradation from livestock grazing (Factor A) in combination with predation by small mammals (Factor C) and natural environmental variability and the effects of climate such as drought. When combined with the above-mentioned threats, small population size (Factor E) likely exacerbates the effects of these threats on the Fickeisen plains cactus. In addition, the existing regulatory mechanisms are not ameliorating threats to the species. Please refer to the Summary of Factors Affecting the Acuña Cactus and Summary of Factors Affecting the Fickeisen Plains Cactus for more detailed information.

(16) *Comment:* One commenter believes the Service is attributing population decline in both species due to drought and speculates this drought is caused by climate change that may happen in the future.

Our Response: As is the case with all models, there is uncertainty associated with climate change projections due to assumptions and scale used and other features of the models. Projected future drought would increase an already existing impact of long-term drought on these species. The Service finds that drought over the past 30 years within the region has negatively impacted seedling recruitment and adult survivorship. In addition, projections of future climate in the region include continued drought and warming winters. Therefore, the continued effects on seedling recruitment and adult survivorship are likely to continue into the future. The Service will continue to follow and assess the science behind climate change and update our summaries as new information is published.

(17) *Comment:* One commenter is concerned that should either plant be listed, the final listing rule could be misused to impose undue burdens on American industries or activities that produce greenhouse gas emissions because the proposed rule identified the future effects of climate change as a threat to both species. The commenter requested that, if listing occurs at all, these cacti should be listed as threatened and a special rule should be created under section 4(d) of the Act establishing limits on the application of section 9 take prohibitions similar to the special rule for the polar bear under section 4(d) of the Act (December 16, 2008; 73 FR 76249).

Our Response: While the Service may find that the effects of climate change are threats to species, regulation of greenhouse gas emissions is beyond the scope of the Act. The term ''threatened species'' means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Alternatively, the term ''endangered species'' means any species which is in danger of extinction throughout all or a significant portion of its range. We have determined both acuña cactus and Fickeisen plains cactus are in danger of extinction throughout all or a significant portion of their range and, therefore, meet the definition of endangered species under the Act.

Listing either species as threatened is not the appropriate determination because the threats described are severe enough to create the immediate risk of extinction. As described in the Determination for the Acuña Cactus, the combination of declining rainfall, ongoing drought conditions, and the effects of climate change is expected to continue the documented trend of mortality exceeding recruitment across all populations of the acuña cactus. When mortality exceeds recruitment in a population, the result is often a declining population. Given this, we consider none of the populations to be stable or secure. The factors significantly threatening the species are not expected to be abated in the foreseeable future, and some populations may have decreased to levels where they are no longer viable. For these reasons, we have determined the acuña cactus meets the definition of an endangered species under the Act. Similarly, as described in the Determination for the Fickeisen Plains Cactus, the effects from climate change are expected to continue the documented trend of mortality exceeding recruitment across all populations. This, in combination with the other factors significantly threatening the species, leads us to conclude that the threat of extinction is high and immediate for the Fickeisen plains cactus, thus warranting a determination of endangered species status rather than threatened species status for the Fickeisen plains cactus.

If a species were listed as threatened, the Secretary can issue a special rule under section 4(d) of the Act if deemed necessary and advisable to provide for the conservation of the species. A section 4(d) rule is designed to provide for conservation of species through allowing take of listed species under certain allowable activities. That is, take, as defined under the Act, if it occurs under an allowable activity, would not be a violation of the Act. In the case of these two cacti, the Service

is not able to issue a 4(d) rule since we have determined both meet the definition of an endangered species.

(18) *Comment:* One commenter suggested the proposed rule underestimates the extent of the range of the acuña cactus, noting in particular the population of *Echinomastus* species found in 2009 in the Bighorn and Littlehorn Mountains, which was not included in analysis for the acuña cactus.

Our Response: We are aware of the populations of acuña cactus in the Bighorn and Littlehorn Mountains. Morphometric analysis of Baker (2007, p. 11) suggests that, while individuals among these populations share many characters in common with *E. erectocentrus* var. *acunensis,* they also show characteristics of var. *lutescens.* Therefore, as the identity of these populations has not been verified, we did not include these populations in our evaluation of the status of the species.

(19) *Comment:* One commenter is concerned that the Service relied on only a few of the known populations of acuña cactus to derive data for decline and used inconsistent monitoring efforts and a lack of statistically robust methods to estimate total abundances and changes in abundance over time. The commenter feels that information is lacking, and a decision to list the acuña cactus as endangered is premature. The commenter provided four examples of population decline data used in this rule and which they dispute: (1) Rigorous sampling of the overall population at OPCNM is needed and prior estimates of population numbers are speculative; (2) sampling at the Coffeepot Mountain population has been inconsistent and no meaningful conclusion regarding this population can be drawn; (3) the Mineral Mountains population counts from the 1990s do not indicate type of sampling or area covered and, therefore, should not be compared with 2011 sampling; and (4) upon their own visit to the population at Indian Village Hill, they found 33 individuals, as compared to the Service visit of 2011 which found just 8 individuals, illustrating that individuals were being missed in surveys. The commenter acknowledges there appears to be a decline in some of the monitored populations of acuña cactus, but suggests there is also evidence that small populations are viable and relatively stable.

Our Response: We have used the best scientific and commercial data available; while these references may include varying survey and monitoring methodologies, they nonetheless provide important data upon which we can base our analysis. We acknowledge that additional surveys and continued monitoring of existing plots would be valuable and should be considered as a recovery action for these species. We address the commenter's examples here: (1) In addition to overall population estimates, monitoring plots within Organ Pipe Cactus National Monument (OPCNM) show a pronounced decline in acuña cactus numbers which outweighs recruitment and is a serious concern for park managers (NPS 2012, p. 1; Holm 2006, p. 2–2). (2) We received public comments during the first comment period which indicated that the Coffeepot Mountain acuña cactus population was revisited by OPCNM staff in 2008. The population was censused in 1987 and again in 2008, and total living plants at that location decreased from 310 to 77. (3) The same BLM botanist was involved in the 1990s, 2002, 2008, and 2011 acuña cactus survey of the same ridgelines in the Mineral Mountains. Original surveys indicated more than 100 individuals present; in 2011 these and a fourth new population on a nearby ridgeline totaled 33 living plants (Service 2008a, entire; Service 2011b, p. 1). (4) At Indian Village Hill, researchers found 102 individuals in 1996. The Service acknowledges that it should not have utilized the 2011 Service report indicating current population numbers at this location. The Service report indicated that approximately 8 individuals were noted at this site (Service 2011a, p. 1); however, a full census was not conducted. Nevertheless, the 2013 census of the commenter found 33 individuals, clearly fewer than 102 found in 1996. These and other examples (refer to the ''Abundance and Trends'' of the acuña cactus section of the rule) all illustrate a marked decline in the number of individuals censused over time. There is also evidence that recruitment (the number of juveniles seen) is not keeping up with the number of dead plants counted in any location.

Background

In the proposed listing rule, we provided a description of each species, their life history, and their habitat; an evaluation of listing factors for each species; and our finding for the species. In this final listing rule, we include only those sections that have been revised as a result of the public comments we received and to reflect the best scientific and commercial data available.

Acuña Cactus

It is our intent to discuss below only those topics directly relevant to the listing of the acuña cactus as an endangered species in this section of the final rule. The biology and habitat sections remain unchanged since publication of the proposed rule. Please refer to the proposed listing rule for the acuña cactus and Fickeisen plains cactus (77 FR 60509; October 3, 2012) for a detailed description of the biology and habitat of the acuña cactus. We have updated the ''Species Description'', ''Taxonomy'', ''Distribution and Range'', and ''Abundance and Trends'' sections below as a result of information received from the public during the public comment periods.

Species Description

The acuña cactus is a small, spherical cactus, usually single-stemmed, that can be up to 40 centimeters (cm) (16 inches (in)) tall and 9 cm (3.5 in) wide (Arizona Rare Plant Guide Committee 2001, unpaginated; Zimmerman and Parfitt 2003, pp. 194–195). The acuña cactus has 11 to 15 radial spines up to 2.5 cm (1.0 in) long and 3 to 4 mauve-colored, up-turned central spines up to 3.5 cm (1.4 in) long (Arizona Rare Plant Guide Committee 2001, unpaginated; Zimmerman and Parfitt 2003, pp. 194–195). Rose, pink, or lavender flowers 3.6 to 6 by 4 to 9 cm (1.4 to 2.3 by 1.6 to 3.5 in) are produced in March (Arizona Rare Plant Guide Committee 2001, unpaginated; Zimmerman and Parfitt 2003, pp. 194–195). The fruits, which are held in place by a tight mesh of spines, are pale green, are 1.25 cm (0.5 in) long, and contain small, nearly black seeds (Felger 2000, p. 208). The fruits ripen in April (Arizona Rare Plant Guide Committee 2001, unpaginated) and as they dry, they split longitudinally, exposing the seeds (Morawe 2012, pers. comm.).

Taxonomy

This species was originally described in 1953 by W.T. Marshall as *Echinomastus acunensis* (Marshall 1953, pp. 33–34). It is known by many synonyms, including *Sclerocactus erectocentrus* var. *acunensis* (Coulter) Taylor and *Neolloydia erectocentra* (W.T. Marshall) var. *acunensis* L. Benson (Arizona Game and Fish Department (AGFD) 2004, p. 1). The Cactaceae treatment in the Flora of North America (Zimmerman and Parfitt 2003, pp. 194–195) recognizes the entity as *E. erectocentrus* var. *acunensis.* The other variety, *E. erectocentrus* var. *erectocentrus* (needle-spine cactus), is also recognized as a valid taxon in the Flora of North America. The two varieties are generally considered to be morphologically distinct and

geographically isolated, but there have been questions regarding the morphology of some individuals (AGFD 2004, p. 6). To address those concerns, the Service funded a project to analyze the morphological distinctness of the two varieties, which was completed in January 2007. The results of this study suggest that there are four distinct taxonomic groups, including the separation of variety *acunensis* and variety *erectocentrus* (Baker 2007, pp. 19–21). Baker (2007, p. 20) recommended nomenclatural changes, based on the International Rules of Botanical nomenclature, but formal name changes were not proposed in his study. Since that time, Baker collected additional morphology data from other *Echinomastus* populations and concluded in his 2012 Intermountain Flora *Echinomastus* treatment, that all varieties of *Echinomastus* be combined into a single species *E. johnsonii* (Baker 2012, p. 445). In this treatment, however, Baker notes that further study is needed in order to determine if separating the species into varieties may be warranted (Baker 2012, p. 446). To date, there are no peer-reviewed publications stating that *E. erectocentrus* var. *acunensis* should not be considered as a valid taxon. Therefore, we accept Baker's 2007 work and the Flora of North America, which separate the acuña cactus from the needle-spine cactus as valid and distinct taxa separated morphologically and geographically.

Distribution and Range

The acuña cactus populations are known from Maricopa, Pima, and Pinal Counties in Arizona and from Sonora, Mexico (AGFD 2004, p. 2). In western Pima County, plants are known from the Puerto Blanco Mountains and adjacent Aguajita Wash on National Park Service (NPS) lands within OPCNM; from the Sauceda Mountains on Bureau of Land Management (BLM) and Tohono O'odham Nation lands; from Department of Defense military lands on the Barry M. Goldwater Gunnery Range (BMGR); and from private lands near Ajo. In Maricopa County, the acuña cactus is known from the Sand Tank Mountains on BLM lands within the Sonoran Desert National Monument. In Pinal County, plants are known from Mineral Mountain on BLM, State, and private lands. In Sonora, Mexico, the acuña cactus occurs on Reserva de la Biosfera El Pinacate y Gran Desierto de Altar (Pinacate Biosphere Reserve), communal ejido lands, and private ranches. Available information indicates that the current range of this species does not differ from the historical range, with the exception that the current Ajo populations likely had been part of a larger population that occurred before mining activity began there (Rutman 1996b, pers. comm.; Rutman 2007, p. 7). However, there are no survey records for this species in the area prior to mining activity.

Abundance and Trends

As the number of dead individuals documented within acuña cactus populations has increased greatly since study began in the 1970s, it is important to track the number of healthy, unhealthy, and dead individuals. This not only allows us to document trends in total plant numbers, but also can help in our understanding of the cause and extent of mortality. A discussion of abundance and trends of acuña cactus populations on Federal, State, and private lands, along with lands in Sonora, Mexico, is presented below.

Federal Land—National Park Service

Organ Pipe Cactus National Monument—There is one large area of approximately 1,326 ha (3,277 ac) within OPCNM that contains as many as 2,000 acuña cactus individuals (Rutman 2011, pers. comm.; AGFD 2011, entire). In 1981, this population was estimated to contain 10,000 individuals (Buskirk 1981, p. 3). Within this area, two 20-by-50-m (66-by-164-ft) permanent monitoring plots were established in 1977, with the aim of investigating growth, mortality, and recruitment of this species. Between 1977 and 1981, mortality reached 31 percent in the plots (Phillips and Buskirk 1982, p. 2). Two more plots were added in 1983, and two more in 1988. From 1988 through 1991, the population was thought to be stable or increasing (Johnson *et al.* 1993, p. 172), with 446 individuals found in the 6 plots by 1991 (Holm 2006, p. 6). From 1993 through 2012, annual mortality was variable, but exceeded recruitment in most years (NPS 2012, p. 2). In 2012, the total number of individuals recorded in the 6 plots was 38 adults and 15 juveniles (NPS 2012, entire).

In order to verify the identification and location of plants, specimens are collected, pressed, and placed on sheets that are stored in herbaria. A 1952 herbarium collection from a second location within OPCNM is evidence that a second disjunct population of the acuña cactus occurred historically within OPCNM. The information associated with this collection states the plants were located south of Dripping Spring within 3 m (10 ft) of the U.S.-Mexico border; an exact location was not provided. Although staff at OPCNM were unaware of this herbarium collection, they state that the general area of its collection has been visited during surveys for sensitive cultural and natural resources, as well as for buffelgrass; no acuña cactus plants were noted (Morawe 2012, pers. comm.). We do not know if the population or a seedbank exists at this location; however, we do know that lands immediately adjacent to the border have changed significantly in recent decades with the creation of border fencing, vehicle barriers, and Border Patrol service roads. Although this population likely once supported enough individuals to warrant collection for herbaria, it is likely this population no longer exists at this location. During a public comment period, we requested any information about the status of the acuña cactus at this location; no additional information on the cactus was received.

Federal Land—Bureau of Land Management

Sauceda Mountains—Within the Coffeepot Area of Critical Environmental Concern (ACEC), there are several small acuña cactus populations, each on less than 2 ha (5 ac) of land.

In 1982, the BLM (Phoenix District) established three 20-by-50-m (66-by-16-ft) monitoring plots on Coffeepot Mountain. These plots were visited, and data were collected periodically between 1982 and 1992. In 1982, researchers found 157 living and 3 dead plants within the plots. Over the years of study, many new recruits were found; however, there was also ongoing mortality with newly dead individuals documented each year. BLM staff reported a precipitous decline of this population in 1989 (Johnson 1989, p. 1). A note to the file in 1991 stated that many individual plants were missing, dead, or dying, and that there appeared to be little regeneration in this population (BLM 1991, p. 1). By the monitoring visit in 1992, researchers recorded 150 plants dead, 22 plants missing and presumed dead, and 150 plants within the plots that were either healthy or in some stage of decline (Butterwick 1982–1992, entire). The plots have not been formally measured since 1992, but the BLM has visited this site 21 times since then to assess general health and threats to the population. Field notes indicate that few juveniles were seen in 2008, and no juveniles were seen in 2009; no mention of juveniles was made in 2010 or 2011 (Anderson 2011, p. 2). The site was not visited in 2012.

A complete census of individual acuña cacti from both within and nearby the Coffeepot Mountain plots in 1987 found 310 living and 332 dead plants (Rutman *et al.* 1987, p. 2). In 2008, staff of OPCNM censused the number of individuals from both within and nearby the plots and found 77 living and 80 dead plants (Morawe 2012, pers. comm.). The loss of 252 dead plants during this time is also of interest, as it shows that the cage-like spinal remains of acuña cacti do not persist in the environment for extended periods.

In 2006, a second population, estimated to be between 50 and 100 individuals, was located 1.2 kilometers (km) (0.75 miles (mi)) northwest of the Coffeepot Mountain monitoring plots in Ryans Canyon (Rutman 2006, p. 2). Rutman (2006, entire) did not mention size class or health of this population. This site has not been revisited. In 2006, a third population was discovered 1.4 km (0.87 mi) to the northeast of the Coffeepot Mountain monitoring plots. Approximately 30 acuña cacti were noted there at the time; 25 percent mortality was reported 1 year later (Anderson 2011, p. 1). An October 2011 site visit by Service and BLM botanists revealed 23 adult and 2 juvenile living and 15 dead plants at this location (Service 2011a, p. 3). A fourth population was discovered in March 2011, in a location near the third population; 10 plants were noted. No indications were given as to the age class structure or health of this population (Anderson 2011, entire).

At an acuña cactus site the BLM calls Little Ajo Mountains, southeast of the New Cornelia Mine on less than 0.4 ha (1 ac), the population has fluctuated from 5 plants in 1997, to 7 plants in 2001, to 7 plants in 2006, to 11 plants in 2007, to 7 plants in 2008, and finally to 12 plants (including 5 very small plants) in 2011 (Rutman 2006, p. 2; Anderson 2011, entire; Service 2011a, p. 1). In 2013, the site was visited and 12 plants were located, 5 of which were reported to be uprooted and 2 were juvenile (Westland Resources 2013, p. 3). Westland Resources noted that the five individuals that were uprooted were lying on their side and may have been the target of herbivory or may have been knocked over by a passing animal (2013, p. 3).

Sonoran Desert National Monument—In 2006, approximately 200 individuals were reported from the Sand Tank Mountains in an area less than 25 ha (61.8 ac) in size. In 2007, the site was revisited, and 4 groups of individuals accounting for 125 of the approximately 200 individuals were mapped (Anderson 2012b, pers. comm.; Anderson 2011, p. 2). No indications were given as to the age class, structure, or health of this population (Anderson 2011, entire). This site has not been revisited.

Mineral Mountain—There are 3 individual acuña cacti growing on BLM land adjacent to 30 living plants and 22 dead plants on Arizona State Trust lands (State land). This population is discussed collectively below under ''State Land''.

Federal Land—Department of Defense

Barry M. Goldwater Gunnery Range—In 1997, a single adult individual was reported from just north and outside of the populations in the Coffeepot ACEC (Geraghty *et al.* 1997, p. 5) within Department of Defense (DOD) managed lands on the BMGR. This site was revisited in 2012, but no plants were located (Whittle 2012a, pers. comm.). It is unknown if the one previously located individual has been extirpated or was missed during the survey, nor is it known if a seedbank persists at this location.

State Land

Mineral Mountain—Plants were collected by S. Hart in 1992, from the population straddling BLM and State land east of Florence (University of Arizona Herbarium 2011, entire). There were no details of the number of individuals seen, just a map with three locations. In the 1990s, the BLM revisited this site and estimated 100 individuals were scattered across 3 ridgelines (Service 2008a, p. 1). In 2008, the Service and BLM searched this area finding fewer than 20 living and many dead plants; no young plants were seen. In 2011, the Service and BLM botanists revisited the location and found 33 living and 22 dead plants scattered across 4 adjacent ridgelines on less than 5 ha (12.4 ac) of land; no juveniles were found (Service 2011b, p. 1).

Ninety-Six Hills—This population is in the vicinity of Florence on less than 1 ha (2.47 ac) of land. Parfit (1977, p. 1) noted that plants here were common, but very localized. Many plants of various ages and sizes were noted, as well as many dead plants. Engard (1977, p. 1) noted many seedlings and mature plants and also that the plants were abundant locally. Rutman and Krausman (1988, p. 1) found 29 live plants and 6 dead plants in a 2-hour survey in the same general area. Breslin (2008, pp. 3–5) reported that in over 60 hours of survey effort in the area he had located 45 plants, 1 seedling, and 17 dead plants. On March 20, 2008, the Service plant ecologist found 11 live plants and 10 dead plants in a 3-hour survey. In the same general area, C. Butterworth (2008, pers. comm.) found 32 live plants, of various sizes, except seedlings. He noted that seedlings were very noticeably absent. A 2011 2-hour survey by three Service and BLM botanists revealed no living and two dead adults in this same general area (Service 2011b, p. 3). Because this population was not mapped with Geographic Information Systems, it is impossible to know if survey efforts in 1977, 1988, 2008, and 2011 were all conducted in the exact same location within this general area. Therefore, it is not possible to conclude that this population has been extirpated.

Private Land

Ajo Area—The combined area of these multiple sites is less than 0.4 ha (1 ac) (Rutman 2007, p. 1).

An isolated population near Darby Wells was first reported by Heil and Melton (1994, p. 14). Fewer than 10 plants were found at this site in 2007 (Rutman 2007, p. 4). There is no record if juveniles were among the plants found. The site has not been revisited.

On Indian Village Hill, there were 102 plants in 1996, when the population was first recorded (Rutman 1996b, pers. comm.). In 2006, 30 living and 33 dead plants were found; in 2007, fewer than 40 plants were found (Rutman 2006, p. 1; Rutman 2007, p. 4). There is no record if juveniles were among the plants found in either year. In 2011, Service and BLM botanists counted eight living and seven dead plants in a small area that was surveyed; no juveniles were found (Service 2011a, p. 1). In 2013, biologists from Westland Resources did a complete survey of the area and found 33 live and 8 dead individuals (Westland Resources 2013, p. 3). During this survey, they also discovered a single individual growing nearby across the road.

There were 16 live and 19 dead acuña cacti on Weather Tower Hill in 2006 (Rutman 2006, p. 1). There is no record if juveniles were among the plants found. The site was revisited in 2013 by Westland Resources biologists; 17 living and 26 dead individuals were located (Westland Resources 2013, p. 2). During this survey, they also discovered a separate subpopulation 200 m (656 ft) from the known population containing 10 living (including 1 juvenile) and 5 dead individuals (Westland Resources 2013, p. 2).

Florence Area—Roadside populations occur on less than 0.4 ha (1 ac) collectively; any additional populations that may be present on private land occur on an unknown quantity of land.

Roadside Population One—The 2011 site visit revealed nine living and two dead individuals; no juveniles were found, though all nine were young healthy individuals (Service 2011b, p. 2).

Roadside Population Two—The 2011 site visit revealed two living and two dead individuals; no juveniles were found (Service 2011b, p. 2).

There may be other locations on private lands unknown to Service or BLM botanists.

Sonora, Mexico

Felger (2000, p. 208) noted the occurrence of the acuña cactus between 3 and 18 km (2 and 11 mi) southwest of Sonoyta along the Peñasco highway; no population estimates were made. Surveys of 7 acuña cactus populations from an area from 2009 through 2010 revealed 659 living and 942 dead plants growing on approximately 1,700 ha (4,200 ac) (Pate 2011, pers. comm.; Pate 2011, map 1 and map 2). Pate (2012a, pers. comm.) noted seeing a few small seedlings among these plants. From 2012 to 2013, researchers located 18 additional populations of acuña cactus in the vicinity of, but not within, those censused in 2009–2010 (Van Devender 2012, pers. comm.; Van Denvender 2013, pers. comm.). In these surveys, an additional 371 living and 801 dead individuals were counted; a few small living plants were noted (Van Devender 2012, pers. comm.; Van Devender 2013, pers. comm.). The total land area of the general region containing all 25 known populations in Sonora is roughly 6,900 ha (17,050 ac).

Summary

Presented below is the total estimate of living, dead, and juvenile acuña cactus plants in populations visited over multiple years, including census results from 2011 through 2013, and from previous years if sites have not been revisited or population estimates not updated. Notable trends are the large amount of mortality within the populations that have been visited more than once, high numbers of dead individuals within many populations visited once, and the low numbers of juvenile plants in all populations.

- NPS—2,000 plants, or 55.4 percent of known individuals; estimated in 2011 by OPCNM staff. This population estimate is down from 10,000 individuals estimated at this location in 1981. Within the OPCNM plots, the number of recorded individuals peaked in 1991, with 165 adult and 281 juveniles counted. In 2012, researchers noted 38 adult individuals and 15 juveniles within these plots (NPS 2012, p. 1).
- Sonora, Mexico—1,030 plants or 28.5 percent of known individuals; estimated from 2009 to 2010 and 2012 to 2013 surveys. During surveys of these plants, an additional 1,743 dead plants were located among the living. There are no previous estimates from these populations. A few juvenile plants were noted during both survey periods.
- BLM—422 plants, or 11.7 percent of known individuals; estimated from 2011 and other recent surveys. At Coffeepot Mountain within the largest BLM population, 310 living and 332 dead individuals were recorded from both within and nearby established plots in 1987. By 2008, this population was reduced to 77 living and 80 dead plants noted within and nearby established plots. No juveniles were noted since 2008, when a few were seen.
- Private Land—81 plants (70 near Ajo and 11 near Florence), or 2.2 percent of known individuals; estimated from 2013 and other recent surveys. A single population that was revisited on several occasions showed a total population of 102 individuals in 1996; in 2006, 30 living and 33 dead plants were found. In 2013, researchers recorded 33 plants from this population.
- State Land—75 plants, or 2.1 percent of known individuals; estimated from 2011 surveys. At one location in the 1990s, the population was estimated to be 100 individuals; in 2008, only 20 living and many dead plants were found with no juveniles seen. In 2011, researchers recorded 30 living plants, including a new subpopulation previously not recorded. No juvenile plants were located in 2011. At a second location, in 1977, plants were considered common but localized, and the site supported many plants of various ages and sizes. Surveys of this area in 2008 resulted in the location of 45 adult plants with no juveniles found. In 2011, no living plants and two carcasses were located in this same area, though surveys were not as thorough as in 2008; we use the 2008 number of 45 individuals for population estimates herein.
- Military BMGR—1 plant, or less than 0.03 percent of known individuals in 1997; this individual was not relocated in 2012.

Summary of Factors Affecting the Acuña Cactus

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal List of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on any of the following five factors: (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; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Based on the habitat characteristics described above, potential factors that may affect the habitat or range of the acuña cactus are: (1) Urban development and site degradation; (2) livestock grazing; (3) border activities; (4) nonnative, invasive plant species issues; (5) mining; and (6) drought and climate change.

Urban Development and Site Degradation

The immediate threats from urban development include the direct loss of individuals and habitat. Indirect impacts of urban development include fragmentation of acuña cactus and associated pollinator populations, which can reduce genetic vigor of the cactus and result in degradation and fragmentation of habitat adjacent to development. When development occurs, there is also an increased use of habitat for recreational activity, which may also deplete habitat and result in mortality of individuals. The acuña cactus populations in OPCNM and the Sonoran Desert National Monument are protected from the immediate threats associated with urban development due to their National Monument status. National Monuments are lands set aside and managed to protect the natural and cultural resources within; development is minimal, though some site degradation may still occur.

To meet the country's energy demands, there has been a recent emphasis by the Federal Government to use BLM lands for development of renewable energy. Currently, there are no planned solar or wind energy projects on or near populations of the acuña cactus in the Sauceda, Sand Tank, or Mineral Mountains (Werner 2011, pers. comm.). However, a solar field has recently been constructed on patented mine lands in the Ajo area (Morawe 2012, pers. comm.). Most populations on BLM lands are remotely

located and relatively inaccessible; therefore, we do not anticipate development in these areas.

As Arizona's population is expected to continue to grow in the future, both Pinal County and the State Land Department are promoting urban development in the vicinity of Florence (Pinal County 2009, pp. 4, 60, 94; Guthrie *et al.* 2011, p. 1). When the housing market rebounds, it is likely that additional State land in this area will be sold for urban development (Pinal County 2009, p. 42; Guthrie *et al.* 2011, p. 2). In the vicinity of Florence, there are no current plans for development of State land known to support acuña cacti. Private lands near Florence containing acuña cacti populations have been for sale as subdivided 16.2-ha (40-ac) parcels for many years. With the recent economic downturn, it is unlikely this land will be sold in the near future. The only known private land populations where access is readily available are at 3 sites near Ajo, totaling less than 0.4 ha (1 ac) and supporting fewer than 40 individuals in total (Rutman 2006, p. 1; Rutman 2007, pp. 1, 4; Service 2011a, p. 1). In most of the privately owned locations, the sites are littered with broken glass, bottles, and trash; however, plants appear little impacted by this habitat degradation (Service 2011a, p. 1; Service 2011b, p. 2).

Indirect urbanization effects to the areas that support the acuña cactus include ORV activity, which has been reported on BLM lands near both Ajo and Florence. These reports, however, showed no impact to the acuña cactus populations in 1994 (Heil and Melton 1994, pp. 15–16), although habitat degradation and direct loss of individuals is possible from this activity. In 1989, the BLM closed the Coffeepot ACEC to recreational ORV use (BLM 2012a, p. 2–195). In 2002, the BLM prohibited ORV use on the Sonoran Desert National Monument, and, in 2005, affirmed a restriction to designated, established, routes in the Sand Tank Mountains area (BLM 2012a, p. 2–181). In 2012, the BLM Lower Sonoran Field Office released Resource Management Plans (RMPs) for the Sonoran Desert National Monument and the Lower Sonoran Decision Area (BLM 2012b, c, entire).

The Lower Sonoran Decision Area encompasses approximately 930,200 acres of BLM-administered land in south-central Arizona, mostly south and west of Phoenix, and extends south to the United States-Mexico border, west to the Yuma County line, and as far east as the town of Globe. On the Sonoran Desert National Monument, motorized vehicle use is limited to designated roads or primitive roads (BLM 2012c, p. 2–78). Throughout the Lower Sonoran Decision Area, including the Coffeepot ACEC, travel is limited to existing roads and trails (based on current BLM route inventories) until route designations are completed. When designations are completed, travel will be restricted to designated roads, primitive roads, and trails (BLM 2012b, p. 2–113). These new RMPs for the Lower Sonoran Decision Area and the Sonoran Desert National Monument will remain in effect for the next 15 to 20 years (Foreman 2011, pers. comm.). The impacts of ORV activity on State or private lands are unknown; for ORV activity within the border region, see the discussion below of border activities.

In Sonora, Mexico, scattered populations of the acuña cactus occur within 10 km (6.2 mi) of the town of Sonoyta. Although the area is reported to be little-used and unoccupied except by drug and human smugglers (Pate 2011, pers. comm.), in recent decades and as a result of human demand, the Sonoyta region has been heavily impacted by *Olneya tesota* (ironwood) and *Prosopis velutina* (mesquite) woodcutting for coal production, brick foundries, and tourist crafts, and the lands' subsequent conversion to exotic grasslands for cattle grazing (Suzán *et al.* 1997, pp. 950, 955). This activity has affected more than 193,000 ha (478,000 ac) of lands in the Sonoyta region (Nabhan and Suzán 1994, p. 64). In a study of ironwood extraction in northern Mexico, the Sonoyta study sites exhibited the highest number of damaged and dead trees and had the lowest associated plant diversity (Suzán *et al.* 1996, p. 642). It is likely that habitat parameters for the acuña cactus populations in Sonora are impacted by this activity, particularly because ironwood is considered a dominant associate of the acuña cactus (Phillips *et al.* 1982, p. 5) and may serve as a nurse plant for a variety of cacti (Suzán *et al.* 1996, p. 635).

In addition, the actions of harvesting, burning, loading, and transporting wood and charcoal can result in running over individual acuña cactus and causing injury or mortality of plants, if such actions occur in areas supporting the acuña cactus. Also, human population growth and development in the border region between the United States and Mexico has risen in recent decades (Brown and Caldwell 2008, pp. 1–6); it is reasonable to conclude that the direct and indirect effects of urbanization are likely to increase threats to the acuña cactus populations in this region. The acuña cactus populations are currently split by a major highway, Interstate 8, and a power transmission line; many plants occur within 200 m (660 ft) of these corridors (Pate 2011, map 1 and map 2).

In summary, the direct and indirect effects of urbanization are threats to a portion of the known populations of the acuña cactus. However, these effects are currently limited to the acuña cactus populations in the vicinity of Ajo and Florence in the United States and in the immediate border region of Sonora, Mexico. These areas collectively make up roughly 31 percent of known living acuña cactus individuals across the range of the acuña cactus, including Mexico. The majority of the range in the United States is protected from urban development because populations are on Federal lands, where little or no development will take place. In addition, most populations of the acuña cactus are relatively remote or otherwise protected from the effects of urbanization. We conclude that urban development and site degradation is not currently a threat to any entire population of the acuña cactus. As a result, based on our review of the available information, we conclude that the direct and indirect effects associated with urbanization are not threats to the acuña cactus and its habitat.

Livestock Grazing

In general, grazing practices can change vegetation composition and abundance and cause soil erosion and compaction, reduced water infiltration rates, and increased runoff (Klemmedson 1956, p. 137; Ellison 1960, p. 24; Arndt 1966, p. 170; Gifford and Hawkins 1978, p. 305; Waser and Price 1981, p. 407; Robinson and Bolen 1989, p. 186; Holechek *et al.* 1998, pp. 191–195, 216; and Loftin *et al.* 2000, pp. 57–58). These anticipated effects leave less water available for plant production (Dadkhah and Gifford 1980, p. 979). In addition, livestock can step on or knock over individual acuña cactus. Although other species of cacti may be good survival forage for livestock (Vega-Villasante *et al.* 2002, p. 499), herbivory of the acuña cactus has not been reported. Livestock grazing levels and habitat condition vary greatly between populations due to varied land ownership and management. A discussion of livestock grazing practices within the acuña cactus range on Federal, State, and private lands, along with lands in Sonora, Mexico, is presented below.

Federal Land—National Park Service

Organ Pipe Cactus National Monument—Beginning in the early

1900s and continuing through the 1970s, lands within OPCNM were grazed heavily, with as many as 3,000 head of cattle and hundreds of burros present at a time when carrying capacity was estimated to be 314 cattle per year (Rutman 1997, p. 364; NPS 2011b, entire). Grazing by domestic animals was halted per NPS policy and has not occurred within OPCNM since 1976 (NPS 1997, p. 33). Lands here continue to recover slowly after loss of soils and vegetation and may take many decades or centuries to recover fully (NPS 2001, pp. 27, 124). Currently, OPCNM supports the largest population of the acuña cactus (55.4 percent of known living acuña cactus individuals), and we are not aware of historical effects to the population as a result of past livestock grazing.

Federal Land—Bureau of Land Management

Sauceda Mountains—All four populations of the acuña cactus on BLM lands in the Sauceda Mountains have been managed since 1988 in the Coffeepot ACEC, which attempts to apply grazing management practices to ensure perpetuation of botanical diversity within the area and prohibits the development of livestock facilities that would serve to increase livestock use within the area (BLM 2011, p. 141). Collectively these four populations make up 5.9 percent of known living acuña cactus individuals. In 1987, when speaking of the then proposed Coffeepot ACEC, Olwell (1987, p. 1) noted relatively pristine conditions with no immediate threat to the acuña cactus plants. At that time, however, the population of acuña cactus within the Coffeepot ACEC in the vicinity of permanent monitoring plots was reported to have substantial animal activity from cattle, javelina, and jackrabbits, with browsing, grazing, and soil disturbance noted (Rutman *et al.* 1987, p. 2). Anderson (2011, entire) noted no habitat impacts from grazing in this population during yearly visits from 1994–2011. This population is the farthest population from a single cattle tank (see below) within the ACEC and, therefore, is less subjected to livestock pressure.

On BLM land south of Ajo, five individuals were noted to be uprooted and lying on their side (Westland Resources 2013, p. 3). It was speculated these individuals were either predated upon or had been knocked over by a passing animal. It is unknown if cattle were responsible for these losses.

Sonoran Desert National Monument—In 1970, a cattle tank named Conley Reservoir was established within the Coffeepot ACEC boundary prior to the ACEC designation and remains today (Foreman 2012, pers. com.). A population of acuña cactus very near this tank was visited by the BLM botanist in 2010, who found abundant prickly pear (*Opuntia* spp.), which are known to increase with disturbance and are often cited as an indicator of poor range condition (Johnson 2000, entire; Anderson 2011, p. 2). A site visit in 2011 by Service and BLM botanists found habitat impacts such as soil disturbance from both cattle and feral burros; however, no acuña cactus plants appeared to be directly impacted by these animals (Service 2011a, p. 3). Feral burros also impact vegetation on neighboring military lands (see *Barry M. Goldwater Gunnery Range* section below).

The BLM's 2012 Lower Sonoran Decision Area RMP allocates all of the land within the Childs Allotment, within which the Coffeepot ACEC lies, as available for livestock grazing (BLM 2012b, p. 2–82). According to this document, past grazing levels (3,802 animal unit months/317 cows yearlong) and type of use (perennial/ephemeral) will remain the same, and livestock facilities that would increase livestock use within an area of known or newly discovered populations of acuña cactus will not be developed (BLM 2012b, p. 2–124). This management plan will remain in effect for 15 to 20 years (Foreman 2011, pers. comm.).

Sonoran Desert National Monument—In 2001, Presidential Proclamation 7397 (Clinton 2001, entire) created the Sonoran Desert National Monument; one population of acuña cactus containing 5.5 percent of known living acuña cacti occur in the Sand Tank Mountains. This area was designated for military purposes in 1941, and has had no livestock grazing for more than 60 years (Clinton 2001, p. 2). During a site visit in 2006, no habitat impacts from livestock were reported from this location (Anderson 2011, p. 2). The livestock management regime of no livestock being permitted within the Sonoran Desert National Monument Sand Tank Mountains acuña cactus population will be maintained for at least the next 15 to 20 years (BLM 2012c, p. 2–63; Foreman 2011, pers. comm.).

Mineral Mountain—This population is discussed collectively below under ''State Land''.

Federal Land—Department of Defense

Barry M. Goldwater Gunnery Range (BMGR)—A single acuña cactus plant was found on BMGR approximately 1 km (0.62 m) to the north of a known population within the BLM Coffeepot ACEC (Geraghty *et al.* 1997, p. 5). This individual was not relocated in a 2012 survey (Whittle 2012a, pers. comm.); however, this plant or its seedbank may remain. Livestock grazing is not authorized on the BMGR, though some trespass cattle do occur (Whittle 2012b, pers. comm.). Feral burros on BMGR are a concern, however, and BMGR managers plan to implement a burro trapping program in the future, in an attempt to reduce damage to vegetation (Whittle 2012b, pers. comm.).

State Land

Mineral Mountains—Populations of acuña cactus on State land in the Mineral Mountains are subject to grazing; two land sections containing this species are collectively part of a larger 6,118 ha (15,118 ac) grazing lease with a total carrying capacity of 118 animal units (Sommers 2012, pers. comm.). Three individual acuña cacti from this group of populations overlap onto adjacent BLM land. This BLM land, which is not fenced from adjacent State land, has a total permitted number of cattle of 1,224, though the lessee did not run the full amount of animals in the past few years due to drought conditions (Tersey 2013, pers. comm.). During a 2011 site visit, the habitat appeared unaltered by livestock, and no cattle were seen (Service 2011b, p. 1).

Ninety-Six Hills—Three additional land sections near Box O Wash containing this species are collectively part of a lease of 12,369 ha (30,565 ac) with a total carrying capacity of 236 animal units (Sommers 2012, pers. comm.). Both leases incorporate State and BLM lands, although in this area the species has been found on State lands and not the associated BLM lands. No livestock were seen during the November 2011 site visit to this population (Service 2011b, p. 3). Only 2 dead individual acuña cacti were found, and neither appeared to have been knocked over by cattle (Service 2011b, p. 3). In the past, Rutman and Krausman (1988, p. 1) recommended that this State land habitat could benefit from improved livestock management, as cattle trails there were numerous during a 1988 site visit. In a 2008 site visit, it was noted that quite a few of the dead acuña cactus plants may have been knocked over by livestock (Service 2008b, p. 1). It is unknown what the grazing lease or animal units were for this period of time. In 2011, several individuals were noted to have grown additional arms following the loss of the growing tip (Service 2011b, pp. 3–4). This was possibly due to injury caused by cattle, a beneficial adaptation to

disturbance noted previously by Phillips *et al.* (1982, p. 6). The populations on State land represent 2.1 percent of known living acuña cactus individuals. Although livestock grazing on State lands may benefit from improved management, the impacts to the acuña cacti are small.

Private Land

Ajo—Populations of the acuña cactus on private lands near the town of Ajo were noted to occur in degraded habitat with low species richness; these sites were suspected to have had a grazing history of severe use (Rutman 1995, p. 1).

Florence—Those acuña cacti on private lands near Florence are in an unknown condition, as they are not typically visited by Service staff. Two roadside populations visited in 2011 had 4 dead plants and 13 healthy plants collectively; all dead plants seemed to have died from drought or insect attack, although 1 population did contain evidence (feces) of cattle use (Service 2011b, p. 2). Private lands account for 2.2 percent of known living acuña cactus individuals.

Sonora, Mexico

In Mexico, researchers report livestock grazing in parts of the Sonora range (Stoleson *et al.* 2005, p. 60), but mostly the habitat remains little-used and unoccupied land (Pate 2011, pers. comm.). Sonora maintains 28.5 percent of the known acuña cactus individuals across the range; their recent decline, as evidenced by 1,743 dead plants counted since 2010, has not been attributed to livestock.

In summary, 61 percent of acuña cactus individuals occur within lands protected from cattle grazing either by NPS or BLM National Monument status. In areas occupied by the acuña cactus where livestock grazing does occur, impacts from livestock do not appear to be a consistent or significant threat to populations. Based on our review of the available information, we conclude that, although there is evidence that grazing impacts to the acuña cactus do occur, we do not believe that these effects occur to such an extent that livestock grazing is a threat to the acuña cactus and its habitat.

Border Activities

Over the past decade or more, tens of thousands of people illegally attempt crossings of the U.S.-Mexico border into Arizona annually (cross-border violators) (Service 2011c, p. 14). As a result of increased U.S. Customs and Border Protection (CBP) activity in the Douglas, Arizona, area, and in San Diego and southeastern California, cross-border violator traffic has shifted into remote desert areas such as OPCNM (Service 2011c, p. 14). For example, in 2001, an estimated 150,000 people entered OPCNM illegally from Mexico (Service 2011c, p. 14). With the increase in technology, border fencing, and manpower between 2001 and 2012, these numbers are down considerably, with 6,218 arrests of cross-border violators from OPCNM in the year 2011 (Oliver 2012, pers. comm.). Although the number of arrests does not represent all those who attempted to enter OPCNM illegally, this number is suspected to be considerably less than reported in 2001. Despite the fact that these numbers are down due to enforcement and deterrence efforts by the CBP, the thousands of people crossing through the border area illegally still represent a substantial impact to the landscape.

More than 84 percent of the known living acuña cactus individuals occur within 16.5 km (10.25 mi) of the border in either OPCNM or Sonora, Mexico. Cross-border violators, CBP, and NPS law enforcement activity in this area may degrade acuña cactus habitat by creating new roads and trails, disturbing vegetation and soils, and moving exotic plant seeds or plant parts, leading to their spread into unoccupied areas (Duncan *et al.* 2010, p. 124). At OPCNM, the acuña cactus occurs in an area that is closed to visitors due to dangers of drug and human smuggling. Significant impacts may occur when travel moves off existing roads causing vegetation destruction, soil compaction (Duncan *et al.* 2010 p. 125), and, potentially, direct mortality of the acuña cactus by running over individuals, although no direct impacts to acuña cactus have been observed. Staff at OPCNM note that, in 2010, two vehicle tracks and associated articles of clothing from cross-border violators were found within one of the six 20-by-50-m (66-by-164-ft) acuña cactus long-term monitoring plots (Holm 2012a, pers. comm.). Although no individual plants were reported to have been run over in this instance, the occurrence of the activity within this proximity to acuña cactus individuals supports our conclusion that impacts from cross-border violators and border enforcement may negatively impact the species and could be a threat.

The NPS constructed a vehicle barrier along the U.S.-Mexico border at OPCNM in 2006 (Morawe 2012, pers. comm.). After the construction of the vehicle barrier, the general consensus of the OPCNM staff was that cross-boundary vehicle traffic had been reduced by 90 to 95 percent (Morawe 2012, pers. comm.). In 2008, the Department of Homeland Security completed an 8.4-km (5.2-mi) stretch of pedestrian fence, approximately centered on the border town of Lukeville. Some cross-border traffic continues to occur, but the majority of the remaining cross-country traffic in OPCNM is due to law enforcement activities (Morawe 2012, pers. comm.).

The Biological Opinion for the Ajo Forward Operating Base Expansion reported personal observations by NPS and Service employees that the number of off-road tracks and new roads continues to increase (Service 2011c, p. 19). These new off-road tracks and roads are believed to be the result of CBP response by vehicle, horseback, and foot to cross-border violators, whom are travelling primarily on foot (Service 2011c, p. 19). By 2011, OPCNM personnel had mapped thousands of miles of unauthorized off-road impacts from cross-border violators, CBP, and law enforcement activities (Service 2011c, p. 18). Staff at OPCNM has been compiling data on off-road traffic and mapping unauthorized roads on OPCNM for a report. This report was not available to us by the time of writing the final rule. Although most of the unauthorized roads were created prior to construction of vehicle barriers and pedestrian fences along the U.S.-Mexico border, it is not known if the additional roads were created after the construction of the border fences. In 2011, NPS staff noted no new heavily utilized routes due to off-road travel by vehicles, but staff did state that single vehicles drive across habitat and individual acuña cactus plants may be driven over. There is no evidence that acuña cacti have been harmed, but damage to larger plants has been documented due to similar activity (Rutman 2011, pers. comm.). In cooperation with Service staff, CBP has begun efforts to educate Border Patrol agents on the locations and appearance of acuña cactus so that the areas that support the plant can be avoided to the maximum extent possible. A road atlas has been printed and distributed to CBP agents working in the area, though acuña cactus habitat is not indicated on this map (Morawe 2012, pers. comm.).

A system of sensors and communication towers is currently in place and is being expanded within the border region; this technology improves deterrence, detection, and apprehension of cross-border violators entering or attempting to enter the United States illegally (Service 2009, p. 5). It is expected that, with increased communication and sensor tower technology, the need for CBP agents to

patrol the area will be reduced, thus reducing circumstances requiring vehicles to drive off authorized roads (Service 2009, p. 16). CBP agents on foot or on horseback may conduct off-road pursuit of suspected cross-border violators at any time, including in areas designated or recommended as wilderness (Service 2009, p. 17). Where such motorized pursuits are necessary, CBP has committed to using the least intrusive or least damaging vehicle readily available, without compromising officer or agency safety.

No existing or proposed communication towers are near any acuña cactus populations within OPCNM; however, human traffic patterns have changed since the installation of towers in and near OPCNM. These towers have been effective at reducing foot traffic through acuña cactus habitat (Morawe 2012, pers. comm.). When communication and sensor towers and associated tactical infrastructure require maintenance and repair, the acuña cactus could be directly affected by repair and maintenance of this infrastructure if maintenance vehicles traveled off approved access routes. The CBP has committed to use only approved access routes for these maintenance activities, and OPCNM staff report that CBP has kept their agreement in this regard. Because towers are effective at helping CBP see illegal activity, however, enforcement-related off-road vehicle activity has increased (Morawe 2012, pers. comm.). When walking into an area to do fieldwork, including acuña cactus annual monitoring, OPCNM staff understand that their footprints into sensitive habitat may be tracked by CBP agents (Morawe 2012, pers. comm.). In addition, if these maintenance and repair activities occur in undisturbed areas in the habitat of listed plant species, a survey must be conducted and a sufficient buffer created to protect any plants found (HDR 2012, pp. 4–3).

Illegal drug and human smuggling also adversely affects the area of the Coffeepot ACEC, but the area is less impacted than other border areas (BLM 2011, p. 344). This is likely the case with the other populations on private and BLM lands near Ajo. Within BMGR, cross-border violators and associated activities represent a significant threat to natural and cultural resources within the BMGR, including having widespread and adverse effects on soil and hydrology (U.S. Departments of the Air Force and Navy 2007, pp. 3–11). We are aware of no instances of illegal activity or law enforcement activity impacting the populations near Florence. The Service (2008b, p. 1) noted that little to no human activity, including ORV use, was observed during a 2008 site visit to these populations.

The acuña cactus populations across the border from OPCNM, in Mexico, occur on land that is little used, unoccupied, and subject to heavy traffic by drug and human smugglers (Pate 2011, pers. comm.). This area was reported to be unsafe, and warnings were given to Service personnel not to travel to this location alone (Larios 2012, pers. comm.). In 1993, the Mexican Government established Pinacate Biosphere Reserve, a 7.7-million ha (1.9-million-ac) reserve for the region's flora, fauna, geology, and archeology preservation. A portion of the acuña cactus individuals in Sonora occur within the Pinacate Biosphere Reserve. It is unknown what, if any, protection this designation provides the acuña cactus.

In summary, the two areas containing the largest number of living acuña cactus (84 percent of the known living acuña cactus individuals) occur along the U.S.-Mexico border (in OPCNM and Sonora, Mexico). Within populations, acuña cacti are typically spaced within 3 m (9.8 ft) of each other, and vehicle traffic through any population could potentially impact many individuals. This area is heavily impacted by cross-border violators, CBP, and law enforcement activity, as evidenced by the tremendous increase in illegal roads and trails documented by agencies along the border. To date, no individual acuña cactus plants are reported to have been lost to these activities; however, reporting from this area is inconsistent. With anticipated continued border activity in the area, it remains possible that acuña cactus individuals and their habitat will be impacted. These impacts include: Creation of new roads and trails; disturbance of associated vegetation including nurse plants and microclimates; compaction or erosion of soils; movement of nonnative, invasive plant seeds and plant parts; and the potential to cause direct mortality to individuals by running over plants with vehicles. Therefore, based on our review of the available information, we conclude that cross-border violators, CBP, and law enforcement off-road activities are a threat to the acuña cactus and its habitat.

Nonnative, Invasive Plant Species

Throughout the Sonoran Desert ecosystem, invasions of the introduced *Pennisetum ciliare* (buffelgrass), *Bromus rubens* (red brome), *Eragrostis lehmanniana* (Lehmann lovegrass), *Schismus barbatus* (Mediterranean grass), and *Pennisetum setaceum* (fountaingrass) have altered nutrient regimes; species composition and structure through competition for open space; microclimates; and fire frequency, duration, intensity, and magnitude (Brooks and Pyke 2001, p. 5). Although most of these species were intentionally introduced as forage for livestock, as erosion control, or as ornamentals, each is now considered invasive and a threat to this ecosystem (Búrquez-Montijo *et al.* 2002, entire). Species such as buffelgrass are expected to increase their range even with continued and predicted drought events (Ward *et al.* 2006, p. 724). It is generally thought that invasion by exotic annual grasses will continue unchecked in the Sonoran Desert ecosystem in the future, reducing native biodiversity through direct competition and alteration of nutrient and disturbance regimes (Franklin and Molina-Freaner 2010, p. 1671).

Herbarium sheets contain labels that give information regarding where a specimen was collected, by whom, when the collection was made, and additional information such as what plant species were found in association with the collected specimen. There are no exotic species noted as associates on 39 of the 40 acuña cactus specimen herbarium sheets located at the Arizona State University, University of Arizona, or San Juan College Herbarium collections (ARIZ 2011, entire). These collections cover the range of the acuña cactus and date from 1952 through 2009. One specimen collected in 1982 has exotic annual red brome grass listed as an associate. Although fountaingrass found on nearby property was reported to be a possible threat to the acuña cactus near Ajo (Falk 2005, pers. comm.), no exotic grasses were noted within the Ajo, Little Ajo Mountains, or Coffeepot ACEC habitats during field surveys in October 2011 (Service 2011, p. 4). One researcher familiar with all known populations of the acuña cactus noted no associated threats from exotic plant species in any population (Baker 2011, pers. comm.). However, according to a peer-review comment received regarding this rule, buffelgrass is reported to be abundant and rapidly expanding in the Ajo region, the Sauceda Mountains, and the Sikort Chuapo Mountains, which lie between these two areas (Morawe 2012, pers. comm.). This reviewer also noted that buffelgrass is increasing distribution within ORCNM such that it now surrounds the entirety of acuña cactus habitat (Morawe 2012, pers. comm.).

Two of our peer reviewers feel that, although no acuña cactus populations are currently known to harbor buffelgrass, given the current rate of expansion and lack of management programs in many areas, buffelgrass could appear in acuña cactus populations within 5 to 20 years.

In summary, we have reviewed the available information on the effects of and occurrence of nonnative, invasive plants in or near populations of the acuña cactus in southern Arizona and Sonora, Mexico. Known populations of the acuña cactus are well distributed across southern Arizona and northern Sonora and occur in areas subject to effects from nonnative, invasive plant species. Although no populations of the acuña cactus currently show evidence of effects from nonnative, invasive species, reports indicate that buffelgrass is currently in close proximity and could expand into acuña populations within the near future. Therefore, our review of the best scientific and commercial data available indicates that, while nonnative species do not co-occur with the acuña cactus presently, there is potential for the invasion of at least one troublesome invasive plant, buffelgrass, within the near future. Therefore, we conclude nonnative, invasive species pose a threat to the acuña cactus and its habitat.

Mining

The immediate threats from mining activity include the direct loss of individuals and habitat. Indirect impacts of mining activity include fragmentation of acuña cactus and associated pollinator populations, which can reduce genetic vigor of the cactus and result in degradation and fragmentation of habitat and dusting of individual cacti adjacent to mines and associated roads.

The acuña cactus populations in OPCNM and the Sonoran Desert National Monument are protected from the immediate threats associated with mining due to their National Monument status (NPS 1997, pp. s–iii; BLM 2012c, p. 2–69). The 2012 BLM Sonoran Desert National Monument RMP continues the mining closure within the boundaries of the National Monument (BLM 2012c, p. 2–69). Authorized surface-disturbing activities within occupied acuña cactus habitat areas within the Coffeepot ACEC will be minimized, mitigated, or avoided to ensure stable populations (BLM 2012b, p. 2–32). The ACEC is closed to saleable minerals (e.g., sand and gravel; BLM 2012b, p. 2–88, Map 14), open with special mitigation to leasable minerals (e.g., oil and gas; BLM 2012b, p. 2–88, Map 13), and open, subject to mitigation to maintain resource values, for locatable minerals (hard rock mining; BLM 2012b, p. 2–87). No known mining activities are planned on BLM properties, though a BLM parcel adjacent to populations on State lands near Florence may host a gravel mining operation in the future (Service 2011b, p. 1). Verified mining threats near Florence, as well as within Mexico, are unknown.

Mining activity on private land near Ajo has a long history; the New Cornelia copper mine was one of the first open pit mines in Arizona dating to 1854 (Arizona Mining Association 2011, entire). This mine was closed in 1985, and a 2008 investigation by company owners determined the mine would not be reopened due to current economic conditions (Ajo Copper News Oct 29, 2008). As of 2013, the mine remains closed.

The small populations of the acuña cactus that remain in Ajo may have been part of a much larger population that occurred before mining activity began, but there are no survey records for this species in the area prior to mining activity. As a result, it is unclear to what extent the acuña cactus and associated habitat were removed due to historical mining in this area, but there was certainly some loss of individual acuña cactus and habitat. Rutman (1995, p. 1) noted that on the east side of the Ajo rock dump, roads, wells, prospecting holes, rock piles marking mining claims, and past use of explosives occurred immediately adjacent to the acuña cactus plants. Rutman (2006, p. 1) noted that habitat was lost when Indian Hill Village Road was built and occupied habitat may also have been lost where the following buildings and infrastructure now occur: Assembly of God Indian Mission, New Cornelia mine, parking lot for the mine lookout, baseball diamond, and the large informal parking lot to the north of the hill. It is possible that these populations were at one time connected with the few plants to the southeast of the open pit mine on BLM land. There is little doubt that the historical size and range of the Ajo area populations of acuña cactus have been reduced.

We are aware of no acuña cactus populations that are currently impacted by active mining. It is reasonable to project that some mining will occur in the future that could affect acuña cactus populations near Florence, Ajo, and in the Coffeepot ACEC. However, these effects will occur in limited areas that do not support a majority of known individual acuña cactus. The acuña cactus populations will remain well distributed across their range even if future mining activities affect a few populations. Therefore, based on our review of the available information, we conclude that current mining activity and mining in the near future are not threats to the acuña cactus and its habitat.

Drought and Climate Change

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). Thus, the term ''climate change'' refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Climate change will be a particular challenge for biodiversity because the interaction of additional stressors associated with climate change and current stressors may push species beyond their ability to survive (Lovejoy 2005, pp. 325–326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Hannah *et al.* 2005, p. 4). Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field *et al.* 1999, pp. 1–3; Hayhoe *et al.* 2004, p. 12422; Cayan *et al.* 2005, p. 6; Seager *et al.* 2007, p. 1181). Climate change may lead to increased frequency and duration of severe storms and droughts (Golladay *et al.* 2004, p. 504; McLaughlin *et al.* 2002, pp. 6072–6074; Cook *et al.* 2004, p. 1015).

The current prognosis for climate change impacts in the American Southwest includes fewer frost days; warmer temperatures; greater water demand by plants, animals, and people; and an increased frequency of extreme weather events (heat waves, droughts, and floods) (Weiss and Overpeck 2005, p. 2074; Archer and Predick 2008, p. 24). How climate change will affect summer precipitation is less certain because precipitation predictions are based on continental-scale general circulation models that do not yet account for land use and land cover effects or regional phenomena, such as those that control monsoonal rainfall in the Southwest (Weiss and Overpeck 2005, p. 2075; Archer and Predick 2008, pp. 23–24). Some models predict dramatic changes in southwestern vegetation communities as a result of climate change (Weiss and Overpeck 2005, p. 2074; Archer and Predick 2008, p. 24), especially as wildfires carried by nonnative plants (e.g., buffelgrass) potentially become more frequent, promoting the presence of invasive, exotic species over native ones (Weiss and Overpeck 2005, p. 2075). The Sonoran Desert has experienced drought conditions since 1998 (Bowers 2005, p. 421; Western Region Climate Center (WRCC) 2012, entire). Recent trends for the region predict that climate of the region will become much drier in the next 2 to 3 decades (Schwinning *et al.* 2008, pp. 14–15). The impact of current and future drought, which may be long-term and severe (Seager *et al.* 2007, pp. 1183–1184; Archer and Predick 2008, entire), will continue to affect the acuña cactus and its habitat throughout its range.

Climate change is likely to affect the long-term survival and distribution of native plant species, such as the acuña cactus, through changes in temperature and precipitation. Over the past 40 to 50 years, the United States has experienced more extreme weather events, heat waves, and regional droughts than in previous decades (Karl *et al.* 2009, p. 27). The southwestern United States has experienced the greatest temperature increase in the continental United States; average temperatures increased approximately 0.8 degrees Celsius (°C) (1.5 degrees Fahrenheit (°F)) compared to a 1960 to 1979 baseline (Karl *et al.* 2009, p. 129). By the end of this century, temperatures averaged across the Southwest region are expected to warm a total of 2 to 5 °C (4 to 10 °F) above the historic baseline period of 1960–1979 (Karl *et al.* 2009, p. 129). The frequency and intensity of high temperature extremes will increase, and heat waves currently considered rare will become more common (Karl *et al.* 2009, pp. 33–34). This region has experienced drought conditions since 1998 (Bowers 2005, p. 421; WRCC 2012, entire). Annual mean precipitation levels are expected to decrease in western North America and especially the southwestern States by midcentury (IPCC 2007, p. 8; Seager *et al.* 2007, p. 1181; Girvetz *et al.* 2009, entire). The current trend in the Southwest of less frequent, but more intense, precipitation events leading to overall drier conditions is predicted to continue (Karl *et al.* 2009, p. 24). The levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States (Seager *et al.* 2007, p. 1181). In summary, the drought the southwestern United States has been experiencing since the late 1990s is the worst in more than 100 years and is being exacerbated by record warming (Karl *et al.* 2009, p. 130).

Heat stress in adult cacti is minimal compared to other plant species as they are able to survive heat stress due to both morphology and metabolism (Smith *et al.* 1984, pp. 647, 650; Wahid *et al.* 2007, p. 199). In a study of Sonoran Desert cacti, Smith *et al.* (1984, pp. 647, 650) found that short cacti (such as the acuña cactus) and massive cacti had higher heat tolerance than most other cacti species studied, and more than vascular plants overall. They also found heat tolerance varied with stem orientation, stem diameter, and location on the landscape including a portion of the species' range (Smith *et al.* 1984, p. 649). Extreme temperatures can, however, negatively impact seedling survival in many Sonoran Desert plants, and drought coupled with high temperatures lessens temperature tolerance in seedlings (Nobel 1984, pp. 310, 316). We found no additional information on projections for cacti in general, or the acuña cactus in particular, indicating the impacts of increased heat stress combined with increasing drought stress as climate models project. We do know, however, that drought or high temperatures alone can damage non-cacti species, and the combination causes more detrimental interactive effects on these plants than either stressor independently (Huang and Jiang 2002, p. 288).

We are aware of several reports of drought stress apparent on individual acuña cactus. In cacti and other succulents, stem swelling and shrinking is typical with rain-drought cycles (Mauseth 2000, p. 1107). At OPCNM, monitored acuña cactus individuals were reported to have shrunk in size from 1 year to the next, and researchers noted shrinking individuals may be dying (Ruffner 1989, p. 1). In addition, 1986 datasheets from monitoring plots at OPCNM categorized cacti based on health of the individual; one category from the time was ''desiccated'' (dried out) (Buskirk 1986, pers. comm.). Although such descriptive categories have not been in use in monitoring for some time, OPCNM staff note their importance and would like to reinstate them in future monitoring (Holm 2012b, pers. comm.). In addition, plants already stressed from prolonged drought are more susceptible to insect attack and disease (Mattson and Haack 1987, p. 110), and such attack is prevalent in all acuña cactus populations across their range (see discussion in *Factor C. Disease or Predation*). Mortality in measured plots at OPCNM was most severe in 1993, when 40 adults were lost, and again in 1997, when 53 adults were lost (NPS 2011a, p. 2); both of these were years with dry summers (WRCC 2012, entire). Between 2001 and 2011, 78 adults were lost in these plots, and 25 of these losses occurred in the very dry year of 2007 (NPS 2011a, p. 2; WRCC 2012, entire). During this same 10-year period, 31 new adults were recorded as additions to the population through recruitment (NPS 2011a, p. 2).

In addition to the health of adult individuals, drought is directly related to acuña cactus population health with regard to reproduction and establishment. In his 3-year study of the reproductive ecology of the acuña cactus, Johnson (1992, pp. 403, 405) concluded that the positive association of rainfall and annual variation in the number of flowers produced indicates that water availability limits flower production in this species. Although Johnson cites yearly precipitation in relation to flower production, it seems more likely that winter precipitation is the driving factor, as flowers are produced early in the spring following winter precipitation events. Within monitoring plots established by Buskirk in 1977 (Buskirk 1981, p. 1), total flowers counted peaked at 902 in 1992 (Holm 2006, p. 10); corresponding precipitation during the winter of 1992–1993 was 29.7 cm (11.66 in) (WRCC 2012, entire). By comparison, in the last 10 years of measurement, the average number of flowers counted in these plots was 198 (Holm 2006, p. 10); the corresponding average winter precipitation during these years was 9.7 cm (3.8 in) (WRCC 2012, entire).

Resource limitation may affect the acuña cactus seed set through ovule abortion (Johnson 1989, p. 11). Because

flowering commences in early March and fruiting commences in late April (Johnson 1989, pp. 5, 8), it is likely also that winter precipitation is correlated with fruit set. Fruit production was monitored at the OPCNM plots beginning in 2004, and has shown considerable variation since that time with a low of 29 fruits produced in 2007, when total winter precipitation was 6.8 cm (2.69 in), and a high of 361 fruits produced in 2005, when winter precipitation was 16.4 cm (6.47 in) (NPS 2011a, p. 1; WRCC 2012, entire).

Johnson (1989, pp. 5, 12) determined that acuña cactus seedling survival was dependent on summer precipitation and that soil moisture availability limits the distribution of the species. Rice (2001, pers. comm.) noted that in greenhouse trials of the acuña cactus, seedlings and new recruits were primarily lost due to desiccation; emphasizing that establishment is the most critical and limiting phase of the acuña cactus life cycle. Throughout the species' range, rainfall has been declining, and drought conditions have been dominant since 1998 (Bowers 2005, p. 421; WRCC 2012, entire); this has likely influenced seedling survivorship (Holm 2006, p. 2–1—2–13; NPS 2011a, p. 1). For example, in the measured plots at OPCNM, the recruitment rate peaked in 1992, coinciding with consecutive seasons with near to above average rainfall (NPS 2011a, p. 1; WRCC 2012, entire). In the Coffeepot Mountain BLM monitoring plots, seedling or juvenile plants were observed in all years when plots were measured; however, the number of dead plants far exceeded recruitment in any year (Butterwick 1982–1992, entire). In many site visits throughout the region over the past 10 years, there have been reports of low or no recruitment (Service 2008a, p. 1; Service 2008c, p. 1; Anderson, 2011, p. 2; Service 2011a, entire; Service 2011b, p. 3; Westland Resources 2013, p. 4).

In summary, since the late 1990s, the southwestern United States has been experiencing drought conditions and increasing high temperatures. Climatic predictions suggest continued less frequent, but perhaps more intense, summer precipitation, reduced winter precipitation; and increasing temperatures in this region (Seager *et al.* 2007, p. 1181; Archer and Predick 2008, pp. 23–24; Karl *et al.* 2009, p. 24). Data from the acuña cactus monitoring plots at OPCNM and at Coffeepot Mountain, along with occasional surveys of these and most other populations, indicate major population declines have occurred across the acuña cactus range over the past 30 years. It appears that a combination of drought stress, warmer winters, and insect attack have reduced adult plant numbers, while heat stress, lack of precipitation, and seed predation have combined to reduce or halt reproduction (see *Factor C. Disease or Predation,* below). Because the current drought is occurring on a regional scale, and because climatic models predict future regional droughts, it is likely that all populations of the acuña cactus will continue to decline due to drought and the effects of climate change. In addition, it appears that drought and climate change in combination with insect damage and predation, as a combined effect, is the more likely scenario for rangewide level impacts to acuña cacti (see *Factor C. Disease or Predation,* below). Most, if not all, of the acuña cactus populations are impacted by drought and the effects of climate change, including effects to both individual cacti and to productivity and establishment. Therefore, based on our review of the best scientific and commercial data available, we conclude that drought and the effects of climate change are threats to the acuña cactus across its range. When combined with insect predation (see *Factor C. Disease or Predation,* below), the effects on acuña cactus populations are significant.

Summary of Factor A

In conclusion, based on our review of the best scientific and commercial data available, we have determined that individual plant loss, as well as fragmentation of acuña cactus and associated pollinator populations due to the effects of urbanization; livestock grazing; and mining do not impact the species at a population level and, therefore, are not threats to the acuña cactus. Currently, 84 percent of the known living acuña cactus individuals occur along the border near OPCNM. Cross-border violators and associated CBP and law enforcement off-road activities may be affecting individual acuña cactus plants and their habitat. If there is an increase in off-road activities in or near acuña cactus populations or habitat, the likelihood of loss of individuals or loss or modification of habitat also increases. In addition, while no populations of the acuña cactus currently show evidence of effects from nonnative, invasive species, reports indicate that buffelgrass is currently in close proximity and could expand into acuña populations within the near future. Finally, a large amount of mortality has been documented within all populations that have been visited more than once, relating to a combination of the intricately correlated increases in drought and heat stress, warmer winter temperatures, and insect attack (see *Factor C. Disease or Predation,* below). Thus, based on our review of the best scientific and commercial data available, we conclude that loss and degradation of habitat due to nonnative, invasive species; off-road border activities; and the effects of drought and climate change, are threats to the acuña cactus and its habitat.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Unauthorized collection has, in the past, been identified as a threat to the acuña cactus (Phillips *et al.* 1982, p. 9; Phillips and Buskirk 1982, p. 2; Rutman 1996a, pers. comm.; Rutman 2007, p. 6). At OPCNM, a large number of individuals are located adjacent to Puerto Blanco Drive, which was formerly a scenic loop drive. Although historically collection is suspected to have occurred in this population (Buskirk and Phillips 1983, pers. comm.; Rutman 1996a, pers. comm.), the significance of this past collection varies. Buskirk (1981, p. 5) noted that he did not believe collection was a significant source of mortality between 1977 and 1981, yet Phillips and Buskirk (1982, p. 2) noted three mapped roadside cacti lost to collectors, stating that collecting could be a significant cause of loss in OPCNM. Additionally, Rutman (1996a, p. 2) noted that along the scenic drive road at OPCNM, considerable collection of the largest size class of plants occurred. This road was closed to visitors in 2003; the staff of OPCNM hope to reopen this road in the future, though it will remain closed indefinitely while border issues continue, making it unlikely that collection will occur there in the near future (Rutman 2011, pers. comm.; Morawe 2012, pers. comm.; Pate 2012a, pers. comm.).

On BLM-administered lands, the acuña cactus plants occur in very remote locations, and no reports of collection are known. Rutman (1995, p. 2) noted collection did not appear to be a threat to the population surrounding the Coffeepot Mountain plots during annual visits between 1988 and 1990. Similarly, no evidence of collection was seen during 2011 Service and BLM site visits to nearby populations within the Coffeepot ACEC (Service 2011a, p. 4).

On State and private lands in the Florence area, Rutman (1995, p. 3) noted that population locations were published and, easy to access, and that, for many years, collectors have been taking plants. She also noted individual plants seen the previous year were missing, and no carcasses were found

upon revisiting (Rutman 1995, p. 3). No evidence of collection from visited sites was found during 2011 Service visits (Service 2011b, p. 1). Private lands in the Ajo area are also accessible, though we have no reports of collection there.

Buskirk and Phillips (1983, pers. comm.) refer to some acuña cactus collection, but refer to it as relatively uncommon and unsystematic at present. No documented cases of unauthorized collection (in violation of the Arizona Native Plant Law) of this cactus have been found in any of the known populations. Heil and Melton (1994, p. 15) note that the acuña cactus is easy to grow and raise from seed and that this species is rare in the gardens of cactus collectors. An investigator within the Office of Special Investigations of the Arizona Department of Agriculture stated that he does not believe collection of the acuña cactus is a threat to the species (Reimer 2011, pers. comm.). Therefore, based on our review of the best scientific and commercial data available, we conclude that, while there is evidence that unauthorized collection of the acuña cactus did occur in the past, there is little evidence that collection occurs to such an extent currently as to constitute a threat to the acuña cactus, nor do we expect collection to become a threat in the future.

Factor C. Disease or Predation

In general, cacti are susceptible to attacks from numerous types of insects, and the acuña cactus is no exception. The interior flesh of cacti provides both a nesting area and food source for beetles, weevils, and other insects. Once an infestation has occurred, cacti can die from the eating and tunneling activities or from the introduction of fungus or disease. In addition, drought may cause physiological stress responses in plants, such as limiting their photosynthesis and cell growth. Plants already stressed from prolonged drought are more susceptible to insect attack and disease (Mattson and Haack 1987, p. 110).

Four native species of insects have been documented to impact the acuña cactus. Of these, cactus weevils (*Gerstaeckeria* spp.) and cactus longhorn beetle (*Moneilema gigas*) are documented to be most responsible for the acuña cactus declines (Rutman 2007, p. 6; Johnson 1989, p. 10). Cactus weevils are stem-boring insects; the adults feed externally while the larvae feed internally (Burger and Louda 1995, p. 1560). Cactus longhorn beetle adults feed on pads or terminal buds of cacti; their larvae burrow into stems or roots causing the severing of root and stem, collapse, and death of plants (Kelly and Olsen 2011, p. 7; Johnson 1989, p. 10). Raske 1966 (p. 106) cites Dodd (1927) stating that the cactus longhorn beetle has one reproductive cycle per year; however, a noted cactus expert, Alan Zimmerman, believes that increased warming in recent decades facilitates longer breeding cycles and more reproduction in both the cactus longhorn beetle and cactus weevil (Rutman 2007, p. 6).

Other insects with lesser impact on the acuña cactus are snout moth (*Yosemitia graciella*) larvae and unknown ant species. Snout moth larvae are noted to feed internally on cacti (Simonsen and Brown 2009, entire) and on fruits, thus reducing seed set (Johnson 1992, p. 405). Johnson (1992, p. 405) noted snout moth predation accounted for a reduction in seed set of 35 percent in 50 monitored plants at OPCNM. Ants have been noted in greenhouse conditions and in the wild to consume and transport the acuña cactus seeds (Butterwick 1982–1992, entire; Rutman 1996b, pers. comm.; Rutman 2001, pers. comm., p. 1; Anderson 2011, p. 1). In a similar species, *Coryphantha robustispina* ssp. *robustispina* (Pima pineapple cactus), ants have been documented eating fruits and transporting seeds (Baker 2011, pp. ii, 23). While ants do consume seed, they also scatter seed away from the mother plant thereby reducing predation by small mammals (O'Dowd and Hay 1980, p. 536; Vander Wall *et al.* 2005, p. 802). Ants may also aid in reducing the seedbank of competing plant species (O'Dowd and Hay 1980, p. 539). All of the above-mentioned insects have been documented at OPCNM near or on acuña cactus individuals (Johnson 1989, p. 10; Johnson 1992, p. 405; Rutman 1996b, pers. comm.; Rutman 2001, pers. comm., p. 1), with ants documented at Coffeepot Mountain (Butterwick 1982–1992, entire). It is likely that insect depredation occurs in other populations as well, though studies have not been conducted, and insects have not been collected in these populations. No diseases have been documented in the acuña cactus, though plants are exceptionally susceptible to bacterial rot after minor stem damage (Rutman 2007, p. 3). In 2011 site visits across the species' range, a majority of living adult acuña cacti were in various stages of decline, with stems blackening from the base upward and resulting in eventual cactus death. The cause of this blackening is unknown; it could be natural aging of the plants or the result of stress, insect damage, or disease.

A variety of small mammals, such as native ground squirrels, pack rats, rabbits, and mice, can severely damage or kill both mature and young cacti during times of drought when free water is unavailable (Kelly and Olsen 2011, pp. 8–9). There have been reports of loss of the acuña cactus due to small mammal depredation evidenced by scattered spines and rooted bases at OPCNM (Buskirk 1981, p. 5; Buskirk and Phillips 1983, pers. comm.; Heil and Melton 1994, p. 15; Holm 2006, pp. 2–3). In general, plants that die of desiccation, insect damage, or disease leave erect carcasses, while those that die from small mammals leave only scattered remains of the cacti in the vicinity (Morawe 2012, pers. comm.). It is likely that small mammal depredation occurs in other populations outside of OPCNM as well, though studies have not been conducted and small mammal occurrence in these populations has not been documented.

In 2011, nearly all populations of the acuña cactus on BLM, State, and some private lands were visited by Service staff (Service 2011a, entire; Service 2011b, entire). In every population, some partially living and dead plants were found uprooted and toppled over. This was also noted in 2013 in a population near Ajo on BLM land (Westland Resources 2013, p. 3). In 1996, there was a high mortality event associated with many live, reproductive plants found uprooted and lying on the ground in the Coffeepot Mountain population and the populations around Ajo (Rutman 2007, p. 3). This episode has not been explained; however, various hypotheses include vandalism, thrashers (birds) digging them up, and javelinas uprooting the plants. Given the severing of stem from root that commences when plants are infested with cactus longhorn beetle, it is entirely possible that episodes of plants falling over occur following peak years for these insects, possibly in association with birds or other animals hearing and attempting to remove the insects within. There were above-average temperatures in Ajo the 2 years preceding the 1996 uprooting event; this uprooting may have been correlated to increased insect activity and uprooting. Above-average annual temperatures have been recorded at the Ajo Weather Station 15 times during 25 years of recordkeeping between 1975 and 2010 (WRCC 2012, entire). This trend is consistent both at OPCNM and in Florence, where 21 of 25 recent years and 19 of 25 recent years, respectively, had above-average temperatures (WRCC 2012, entire). The increased warming in recent decades is likely benefiting insects and stressing acuña cactus plants, resulting in

significantly increased mortality rangewide.

Between 1982 and 1992, both recruitment and mortality were recorded within and outside of the established BLM plots at the Coffeepot Mountain acuña cactus population. Field notes from throughout the 10-year period of study indicate insect damage to individual plants has been ongoing within this population. Field notes included the following comments: tubercles (knoblike projections on the main stem) with holes, damage on apex (top), exposed root, numerous ants, plant dying, insect damage to fruit, hollow inside, uprooted, chlorotic (yellowing), beetle wounds on side, unhealthy, damaged meristem (growing tip), appears dying at the base, base rotting, sickly, and not rooted (Butterwick 1982–1992, entire). In 1987, the BLM reported high mortality in this population with more dead plants observed (332) than living (310) (Rutman *et al.* 1987, p. 1). In 1989, the BLM reported a precipitous decline of this population (Johnson 1989, p. 18). In 2008, staff of OPCNM censused this population and found 77 living and 80 dead plants (Morawe 2012, pers. comm.) with low or no recruitment reported from the entire population during 21 site visits between 1992 and 2011 (Anderson 2011, entire). Within the monitoring plots at OPCNM, datasheets from 1986 categorized cacti as being: uprooted from the base, shell of spines, dead with upright carcass, stepped on, and missing, among others (Buskirk 1986, pers. comm.). Within these plots, adult recruitment has been observed in every year of monitoring since 1989; mortality has been observed in all but 2 years during this same period (NPS 2011a, p. 1). On average, the annual adult mortality within these plots is 12 percent, exceeding the annual recruitment of 7.7 percent (NPS 2011a, p. 1). The decrease in reproduction, increase in mortality, or a combination of both have resulted in the decline in plants within (NPS 2011a, p. 1) and outside of the plots at OPCNM. Across this population, the previous estimate of acuña cactus numbers were greater than 10,000 individuals (Buskirk 1981, p. 3); current estimates are between 1,000 and 2,000 plants total (Rutman 2011, pers. comm.).

At Coffeepot Mountain, population decline has been dramatic with at least two episodes of 50 percent reductions reported from individuals in and around monitoring plots (Butterwick 1982–1992, entire; Rutman *et al.* 1987, p. 2; Anderson 2011, p. 2; Anderson 2012b, pers. comm.; Morawe 2012, pers. comm.). At OPCNM, the number of individuals on all 6 monitoring plots has declined in all but 2 years since 1989 (NPS 2011a, p. 1; NPS 2012, p. 2), and in total population estimates between 1981 and 2011 (Buskirk 1981, p. 3; Rutman 2011, pers. comm.). In 2011, site visits to most of the remaining populations on BLM, State, and private lands indicated large proportions of the populations were dead with many plants uprooted, hollow plants, and many individuals in all size classes reported to be unhealthy or blackening from the base (Service 2011a, entire; Service 2011b, entire). Also, researchers in Mexico reported that 62.9 percent of the 2,773 total plants found were dead (Pate 2012b, pers. comm.; Van Devender 2013, pers. comm.).

In conclusion, uprooting and depredation have been ongoing for at least several decades at OPCNM, at Coffeepot Mountain, and in other populations. The pronounced decline in the acuña cactus numbers over the last 3 decades documented throughout the species' range on BLM, State, and private lands, as well as lands in Sonora, Mexico, is of serious concern. It appears that the combination of drought stress and insect attack have reduced adult plant numbers and that warmer winters may be increasing insect numbers attacking acuña cacti. Most, if not all, of the populations are significantly impacted by predation; predation, in the form of insect attacks, occurs throughout the range of the acuña cactus. We also believe that the extent to which this threat affects the acuña cactus populations is interactive with the occurrence of drought and other climatic variables such as warmer winters. The ability of the acuña cactus populations to recover from insect attacks depends on the successful germination and survival of seedlings. However, these populations are also experiencing decreased reproduction, which may render the populations unable to recover as they continue to lose mature individuals, with low levels of seedling recruitment and survival. Therefore, based on our review of the best scientific and commercial data available, we conclude that predation is a threat that is resulting in significant population impacts to the acuña cactus, and this threat is expected to continue into the future.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine whether existing regulatory mechanisms are inadequate to address the threats to the species discussed under the other factors. Section 4(b)(1)(A) of the Act requires the Service to take into account ''those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species. . . .'' We interpret this language to require the Service to consider relevant Federal, State, and tribal laws, plans, regulations, cooperative agreements, and other such mechanisms that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. We give strongest weight to statutes and their implementing regulations and management direction that stems from those laws and regulations. An example would be State governmental actions enforced under a State statute or constitution, or Federal action under statute.

Having evaluated the significance of the threat as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing State and Federal regulatory mechanisms to determine whether they effectively reduce or remove threats to the acuña cactus.

Regarding the threat of unauthorized collection, the acuña cactus is protected by the Arizona Native Plant Law (Arizona Revised Statutes, Chapter 7, 2007, entire), which prohibits collection without obtaining a permit on all public lands and directs that plants may not be moved off private property without contacting the Arizona Department of Agriculture. Due to the difficulty in implementing this law, it has not been effective in reducing impacts from collection, nor does it protect habitat. However, no documented cases of unauthorized collection of this cactus have been found in any of the known populations in recent decades. There is little threat of collection on private lands due to restricted public access (see *Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*); the majority of the acuña cactus populations are on State and Federal lands. In addition, NPS regulations prohibit the collection or removal of the acuña cactus on NPS lands, where the largest known acuña cactus population occurs. The main road accessing the acuña cactus population in Acuña Valley in OPCNM is currently closed to the public, thus reducing impacts from collection to this population. Although the remoteness of many populations limits both visitation and enforcement of the existing

regulatory mechanisms, unauthorized collection is reported to result in a relatively minor impact to this species. We conclude that the regulations that exist to protect against the impacts from over collection of the species, primarily the NPS regulation prohibiting removal and the closure of the primary access route in OPCNM, are serving to reduce the impacts from collection.

No regulations in place address threats to acuña cactus and its habitat from site degradation or address the primary threats to acuña cactus of insect predation, drought, and the effects of climate change. Urban development, livestock grazing, unauthorized collection, and mining are not identified to occur at a level that is a threat to acuña cactus populations. However, without management of impacts from these activities, impacts could rise significantly. Special management prescriptions in place address some of these concerns on Federal lands. For example, the Sonoran Desert National Monument and OPCNM exclude livestock grazing and mining, promote the reduction of nonnative, invasive plant species, and are unlikely to support urban development. In Mexico, a portion of the known population is within the boundary of Pinacate Biosphere Reserve, which may afford some protections. While management prescriptions with regard to these stressors may be applied opportunistically across different land management agencies within the region, they do afford some protection and minimize impacts to the species and its habitat.

With respect to threats to the species caused by nonnative, invasive plant species, some land managers and private citizens implement invasive plant surveys, control, and monitoring, while others do not. Even with management, these species can be difficult to control without ample resources and time. Given that there are gaps in continuous geographic coverage regarding the management of nonnative, invasive species, populations of acuña cactus remain vulnerable to invasion.

With respect to threats to the species caused by activities along the U.S.-Mexico border, a number of documents such as Biological Opinions (e.g. Service 2009, 2011) dictate that certain actions be taken by CBP to reduce effects to resources in the U.S.-Mexico border region. These documents are primarily associated with habitat of the federally listed endangered Sonoran pronghorn antelope (*Antilocapra americana* ssp. *sonoriensis*) and off-road activity, specifically identifying sensitive areas to avoid. Such measures provide some relief from the threats caused to the species resulting from cross-border violators and CBP enforcement activities in the southern portion of the acuña cactus range. Likewise, CBP-sponsored projects, including the mapping of off-road tracks and revegetating unauthorized roads, may also benefit the acuña cactus (Holm 2012a, pers. comm.).

In cooperation with Service staff, CBP has begun efforts to educate Border Patrol agents on the locations and appearance of acuña cactus so that areas that support the species can be avoided to the maximum extent possible. A road atlas has been printed and distributed to CBP agents working in the area, although acuña cactus habitat is not indicated on this map (Morawe 2012, pers. comm.). In addition, the efforts of CBP to stop cross-border violators in recent years by means of traffic barriers and other infrastructure has greatly reduced cross-border violator activities and afforded some protection to the habitat. However, due to the difficulty and ever-changing status of border issues, compliance with these agreements has been difficult. Reports indicate a two-track road and associated cross-border violator clothing were found in 2010 within one of the six long-term monitoring plots at OPCNM. The cross-border violator activities are, by their very nature, in violation of the law and regulations. Therefore, regulations designed to protect the species and its habitat will be generally of little impact to alleviate the threats caused by activities of cross-border violators. As noted above, the interdiction efforts of the Border Patrol, including patrols, electronic surveillance, and fence construction have contributed to a significant reduction in cross-border violator off-road traffic that has benefited the acuña cactus and other species. However, we do not find regulatory mechanisms to be adequate to directly address these threats discussed in Factor A.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

We have evaluated the best scientific and commercial data available, and we did not find any indication of potential threats related to this factor. We considered such threats as small population size and overall rarity of the acuña cactus, but we did not find any indication that these are threats to the species. Therefore, we conclude that other natural or manmade factors are not threats to the acuña cactus.

Determination for the Acuña Cactus

We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats to the acuña cactus. We find that the species is in danger of extinction due to the current and ongoing modification and destruction of its habitat and range (Factor A) from long-term drought; effects of climate change; ongoing and future border activities; and future nonnative, invasive species issues. The acuña cactus habitat is impacted across its range by long-term drought, warmer winters occurring in the past several decades and projected to continue with climate change, and insect predation. In addition, the majority of the acuña cactus individuals (84 percent) occur within 16.5 km (10.25 mi) of the border in either OPCNM or Sonora, Mexico. As described above, the complexities of addressing off-road excursions by cross-border violators result in unpredictable actions on the part of CBP and law enforcement and threatens acuña cactus and its habitat. Furthermore, nonnative, invasive species have been located in the vicinity of several populations of acuña cactus and are projected to invade these populations within the next 5 to 20 years (Morawe 2012, pers. comm.).

The primary threats to the species are due to the effects of drought and climate change, and insect predation. These threats are exacerbated at local scales by off-road excursions by cross-border violators and CBP and law enforcement response, and will be impacted by nonnative, invasive plants in the future. We find that unauthorized collection (Factor B) does not currently occur to such an extent to constitute a threat to the species. We find that predation (Factor C), in combination with drought and heat stress, exacerbates the threats to this species. Although mechanisms are in place that afford some protection to the species and its habitat with regard to potential stressors to the species, no regulations are in place to address insect predation, drought, and the effects of climate change. With regard to off-road border activity, although the interdiction efforts of CBP, including patrols, electronic surveillance, and fence construction, have contributed to a significant reduction in cross-border violator off-road traffic that has benefited the acuña cactus and other species, regulations have little impact to alleviate these threats. Therefore, we do not find regulatory mechanisms to be adequate to directly address these threats discussed in Factor A. Finally, we find other natural or manmade

factors are not threats to the acuña cactus (Factor E).

The elevated risk of extinction of the acuña cactus is a result of the cumulative stressors on the species and its habitat. Mortality of more than 84 percent of individuals has been documented over a 24-year period within long-term monitoring plots at OPCNM. Mortality of more than 75 percent of individuals has been documented over a 21-year period at Coffeepot Mountain. These two examples of loss that has occurred on protected lands with ongoing management efforts for the acuña cactus show both a rapid and a severe decline of the species. In the acuña cactus, water and heat stress reduce flower and seed production, and seedling survival is dependent on summer precipitation and soil moisture. Warmer and drier winters combined with increased insect attack negatively impacts the survivorship of reproductive adults. Of the remaining living individuals across the species' range, a large portion were in various stages of deteriorating health, primarily blackening from the base upward, when visited by a botanist in 2011. Across populations, minimal or no recruitment has been seen in recent years. Throughout the species' range, rainfall has been declining, and drought conditions have been dominant for several decades; climate change is anticipated to increase drought periods and warming winters. This combination is expected to continue the documented trend of mortality exceeding recruitment across all populations. When mortality exceeds recruitment in a population, the result is often a declining population. Given this, we consider none of the populations to be stable or secure. The factors significantly threatening the species are not expected to be abated in the foreseeable future, and some populations may have decreased to levels where they are no longer viable. All of the threats, combined with high levels of mortality and low recruitment in the populations, contribute to a substantial risk of extinction and lead to our finding that the acuña cactus is in danger of extinction throughout its range; therefore, the acuña cactus meets the definition of an endangered species under the Act.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We find that the acuña cactus is presently in danger of extinction throughout its entire range based on rangewide documented rapid loss of individuals, decline in the health of many remaining individuals, little to no recruitment, and continuation of the threats, as described above. Therefore, on the basis of the best scientific and commercial data available, we are listing the acuña cactus as an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act.

Listing the acuña cactus as a threatened species is not the appropriate determination because the ongoing threats described above are severe enough to create the immediate risk of extinction. The continued loss of reproductive adults and juveniles poses a significant and immediate risk of extinction to the species throughout the species' range, and are not restricted to any particular significant portion of that range. All of these factors combined lead us to conclude that the threat of extinction is high and immediate; thus, we conclude that the acuña cactus meets the definition of an endangered species.

Under the Act and our implementing regulations, a species may warrant listing if it is an endangered or threatened species throughout all or a significant portion of its range. The threats to the survival of the species occur throughout the acuña cactus' range and are not restricted to any particular significant portion of that range. Accordingly, our assessment and final determination applies to the species throughout its entire range.

Fickeisen Plains Cactus

It is our intent to discuss below only those topics directly relevant to the listing of the Fickeisen plains cactus as endangered in this section of the final rule. As a result of public comments we received, we have updated the sections below as a result of information received during the public comment periods.

Species Description

The Fickeisen plains cactus is a small, unbranched to occasionally branched, globose (globular) cactus. At maturity, many plants are the size of a quarter making them difficult to locate even when their location is known. The stems of mature Fickeisen plains cactus are 2.5 to 6.5 cm (1.0 to 2.6 in) tall and up to 5.5 cm (2.2 in) in diameter (Heil and Porter 2003, p. 213; Arizona Rare Plant Guide Committee 2001, unpaginated); covered with tubercles (knoblike projections on the main stem) that form a spiral pattern around the plant (AGFD 2011a, p.1). Each tubercle has 6 to 7 radial spines per areole (tip where spines develop), 4 to 7 millimeters (mm) (0.15 to 0.27 in) in length, and 1 central spine (15 to 18 mm (0.59 to 0.70 in) long) that is straight to strongly curved. Spines are soft and corky (spongy) and white to pale gray in color. Flowers are 2.5 cm (0.98 in) in diameter, cream-yellow or yellowish-green in color, and produced on the apex (top) of the stem. Fruits are turbinate (top-shaped), and turn reddish-brown at maturity (AGFD 2011a, p. 1). The seeds are dark brown to black, 3 mm (0.11 in) long, and 2 mm (0.08 in) wide (AGFD 2011a, p. 1). The lifespan of the Fickeisen plains cactus is estimated to be between 10 to 15 years (Phillips *et al.* 1982, p. 9).

Taxonomy

The Fickeisen plains cactus was first discovered near Cameron, Arizona, in the late 1950s. It was originally described in the scientific literature by Benson (1969, pp. 23–24), then later by Heil *et al.* (1981, pp. 28–31), who recognized the name and taxon in a review of the genus *Pediocactus.* The Flora of North America treats the taxon as a subspecies of *Pediocactus peeblesianus,* finding that the name ''*Pediocactus peeblesianus* var. *fickeiseniae''* was not validly published by Benson (Heil and Porter 2003, p. 213). The difference between a subspecies and a variety based on the International Code of Botanical Nomenclature is that a subspecies has a higher rank in nomenclature. Some botanist or other taxonomic organizations may use the terms subspecies and variety interchangeably. The Service considers *Pediocactus peeblesianus* var. *fickeiseniae* to be a valid taxon since it was classified as a candidate species in 1980. Under the Act and in regard to plants, we treat subspecies and varieties equally (43 FR 17912) in that we do not differentiate between a subspecies or variety when assigning priority classifications to species for listing, delisting, reclassification, or recovery actions (43 FR 43103). Our previous documentation referring to the Fickeisen plains cactus used the name ''*P. peeblesianus* var. *fickeiseniae'',* and we will continue to use this name. Other synonyms of *Pediocactus peeblesianus* var. *fickeiseniae* that have been used are *Navajoa fickeisenii* and *Toumeya fickeisenii* (Benson 1982, p. 955).

The genus *Pediocactus* contains nine species of cacti; eight of these are rare endemics of the Colorado Plateau region in Arizona, Colorado, New Mexico, and Utah (Heil and Porter 2003, p. 213). According to Benson (1982, p.750), the structural differences exhibited by

Pediocacti among various sites, coupled with a poor seed dispersal mechanism and specializations to specific geology or soil type, indicate that the existing plants are probably relicts of a once widespread genus with a distribution fractured by climatic conditions. Although there are great dissimilarities among plants in the genus *Pediocactus,* they are united by their unusual method of fruit dehiscence and deciduous floral remnant (Heil *et al.* 1981, p. 18). Within the species *Pediocactus peeblesianus* are two recognized varieties, variety *peeblesianus* (Peebles Navajo cactus) and variety *fickeiseniae.* The Fickeisen plains cactus is differentiated from the Peebles Navajo cactus by the presence of a central spine. The corky or spongy texture of the spines makes the species unique and separates it from other members in the genus (Heil *et al.* 1981, p. 21). Chloroplast DNA sequencing further provides strong support of the separation of these two varieties (Porter 2002, pp. 15–16).

Biology

The general biology of the Fickeisen plains cactus is similar to other species in the genus *Pediocactus.* The Fickeisen plains cactus is a cold-adapted plant with contractile roots that enables the plant to retract into the soil during the winter (cold) and summer (dry) seasons, as well as during periods of 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 thus limiting the time plants can be found (Phillips *et al.* 1982, p. 4). The general phenology is as follows: when ambient air temperatures rise in the spring and adequate rainfall occurs, plants emerge from beneath the soil surface to flower in mid-April. Flowers open in the mid-morning for 1 to 2 days. An entire population generally completes anthesis (the period when the flower is open and functional) in 7 to 14 days (Travis 1987, p. 6). Spring flowering is believed to be influenced by cold temperatures and precipitation from the preceding winter months (Brack 2012, pers. comm.), which enables moisture to accumulate in the soil during times when solar evaporation rates are low and may facilitate seedling germination. By June, plants will produce fruit then shrink back into the soil, losing one-half their height above ground. Plants generally remain retracted underground during the winter months; however, some individuals may re-emerge in the autumn following monsoonal rains. The length of time a plant remains retracted can vary between individual plants. Hughes (2000a, p. 2) has documented some plants remaining retracted underground for at least 3 years, but reported that a plant emerged after remaining retracted after 5 years (Hughes 2000, p.2). The Fickeisen plains cactus is also subject to root rot during very wet years and frost heaving during the winter season. Locating individuals of the Fickeisen plains cactus can be difficult, even when their exact location is known. Searches for individuals are best done during their flowering period.

Reproduction has not been specifically studied on the Fickeisen plains cactus. For other species in the genus *Pediocactus,* reproduction occurs through cross-pollination by native bees (Pimienta-Barrios and del Castillo 2002, p. 79). Insects observed visiting flowers of the Fickeisen plains cactus include species of hover flies (family Syrphidae) and bee flies (family Bombyliidae), mining bees (family Andrenidae), and sweat bees (family Halictidae) (Milne 1987, p. 21; Navajo Nation Heritage Program (NNHP) 1994, p. 3; Peach *et al.* 1993, pp. 312–314; Tepedino 2000, p. 7). Although flies may pollinate flowers of the Fickeisen plains cactus, the primary pollinators of the plant are believed to be halictid bees from the genera *Lasioglossum, Halictus,* and *Agapostemon,* based on several studied species of *Pediocactus* (Tepedino 2012, pers. comm.).

The mechanisms of seed dispersal in the Fickeisen plains cactus have not been investigated and are poorly understood. Most site visits to areas occupied by the Fickeisen plains cactus have observed seedlings established very close to the adult plant (Goodwin 2011a, p. 9; NNHP 1994, p. 4). The general shared belief is that most species of *Pediocactus,* including the Fickeisen plains cactus, lack a good mechanism for seed dispersal, which is a contributing factor to its endemism and isolated, localized populations (Benson 1982, p. 750; Milne 1987, p. 4).

Population monitoring of the Fickeisen plains cactus suggests that this variety has a low reproductive capacity. Hughes (1996a, p. 50) reported that significant episodes of recruitment within the BLM monitoring plots occurred 2 to 3 times over a 9-year period from 1986 to 1995. He found that 30 to 40 seeds are generally produced from a single fruit (Hughes 2011, pers. comm.), and believed that low seed production hinders substantial increases in plant abundance from occurring, even during favorable weather conditions that would support germination (Hughes 1996a, p. 50). During the monitoring period, Hughes (1996a, p. 50) found that flowering and fruiting in the Fickeisen plains cactus occurs once individual plants reach 16 mm (0.63 in) in diameter and as the diameter increases more fruit are produced. He documented individuals between 20 mm (0.79 in) and 20.9 mm (0.82 in) in diameter that produced 1.37 fruit on average (range of fruit produced 1 to 3) compared to individuals at 50 mm (1.97 in) and larger that produced 3.60 fruits on average (range of fruit produced 2 to 5).

The correlation between larger sized individuals and increased fruit production has also been found in other *Pediocactus* species (Phillips *et al.* 1989, p. 4; Hreha and Meyer 2001, p. 86), suggesting that larger, older individuals have a higher reproductive output and contribute more to the population growth rate by potentially having a greater influence on seed output than smaller, younger plants. In examining long-term monitoring information by the BLM, the majority of individuals observed tend to range between 20 mm (0.79 in) and 30 mm (1.18 in) in diameter, indicating at least 2 fruits should be produced per individual per year. Fruit production, however, occurred irregularly over a 22-year period with 35 percent, on average, of the total number of reproducing individuals. For comparison purposes, a population biology study on the *Pediocactus paradinei* (Kaibab plains cactus), which is similar in size to the Fickeisen plains cactus, summarized its population structure and found the following: plants between 11 to 20 mm diameters were pre-reproductive individuals that occasionally flowered but never fruited. Plants that were 21 to 30 mm were young reproductive individuals with lower reproductive effort than larger plants, and those 31 to 40 mm diameter and larger were older reproductive individuals with higher fruiting success (Warren *et al.* 1992; p. 134).

Episodic recruitment may play a role in increasing the threats to the species because adult mortality may continue at a high rate between periods of recruitment, lowering the reproductive potential of the population when conditions are favorable for seed germination.

Habitat

The Fickeisen plains cactus is a narrow endemic restricted to exposed layers of Kaibab limestone on the Colorado Plateau. Plants are found in shallow, well-draining, gravelly loam soils formed from alluvium, colluvium, or Aeolian deposits derived from limestone of the Harrisburg Member of

the Kaibab Formation and Toroweap Formation; Coconino Sandstone; and the Moenkopi Formation (Travis 1987, pp. 2–3; Arizona Geological Survey (AZGS) 2011; Natural Resources Conservation Service (NRCS) 2012). Most populations occur on the margins of canyon rims, flat terraces, limestone benches, or on the toe of well-drained hills. Plants are found primarily on slopes of 0 to 5 percent but some also occur on slopes up to 20 percent at elevations between 1,280 to 1,814 m (4,200 to 5,950 ft) (Arizona Rare Plant Guide Committee 2001, unpaginated; AGFD 2011b, entire; Hazelton 2012a, pers. comm.; United States Forest Service (USFS) 2013b, p. 2).

Habitat of the Fickeisen plains cactus is within the Plains and Great Basin grasslands and Great Basin desertscrub vegetation communities (Benson 1982, p. 764; NatureServe 2011). Dominant native plant species that are commonly associated with these biotic communities include: *Artemisia tridentata* (big sagebrush), *Atriplex canescens* (four-wing saltbush), *Atriplex confertifolia* (shadscale), *Bouteloua eriopoda* (black grama), *Bouteloua gracilis* (blue grama), *Bromus* spp. (brome), *Chrysothamnus* spp. (rabbitbush), *Ephedra torreyana* (Mormon tea), *Krascheninikovia lanata* (winterfat), *Gutierrezia sarothrae* (broom snakeweed), *Pleuraphis jamesii* (James's galleta), *Achnatherum hymenoides* (Indian ricegrass), *Sphaeralcea* spp. (globe-mallow), and *Stipa* spp. (needlegrass). Other native cactus species that are commonly found include *Agave utahensis* (Utah agave) and *Echinocactus polycephalus* (cottontop cactus; Brown 1994, pp. 115–121; Turner 1994, pp. 145–155; Hughes 1996b, p. 2; Goodwin 2011a, p. 4; NatureServe 2011). The *Escobaria vivipara* var. *rosea* (spinystar) is typically found in close association with the Fickeisen plains cactus (Hughes 1996a, p. 47). In addition, biological soil crusts are found on the Colorado Plateau and occur within or near the Fickeisen plains cactus populations (NRCS 1997, p. 3; USFS 1999, entire; BLM 2007a, p. 3–15).

Biological soil crusts are formed by a community of living organisms that can include cyanobacteria, green algae, microfungi, mosses, liverworts, and lichens (Belnap 2006, pp. 361–362). A preliminary soil assessment within occupied Fickeisen plains cactus habitat on the Kaibab Nation Forest suggested there are good biotic soil crusts in the general vicinity of the population and the microsites where cacti occur may have elevated macro and micro nutrient levels (MacDonald 2013, p. 1) potentially due to the presence of the biological soil crusts. The biological soil crusts provide many positive benefits to the other native vegetation within the Plains and Great Basin grassland community by providing fixed carbon and nitrogen on sparsely vegetated soils, soil stabilization and erosion control, water infiltration, improved plant growth, and seedling germination (NRCS 1997, pp. 8–10; Floyd *et al.* 2003, p. 1704; Belnap 2006, entire).

The climate associated with the range of the Fickeisen plains cactus is highly variable and influenced by events in the tropical Pacific and northern Pacific Ocean (United States Geological Survey 2002, p. 2). Precipitation is bimodal, occurring in the winter (January to March) and summer (July to September) months. The average annual precipitation ranges from 15.2 to 35.5 cm (6 to 14 in) per year; snowfall accumulation averages 22.9 cm (9 in), primarily from January to February (WRCC 2012, entire). Winter precipitation is considered critical for the regional native plant community to ensure that soil moisture is recharged and a reliable spring growing season, which is particularly important for seedlings that do not have developed root systems (Travis 1987, p. 3; Comstock and Ehleringer 1992, pp. 196–199). Given the diversity of topography and elevation across the range of the cactus, the amount of precipitation received locally varies and is patchy in its distribution.

Distribution and Range

The Fickeisen plains cactus is endemic to the Colorado Plateau in Coconino and Mohave Counties of northern Arizona. Very little is known about its historical range. Heil *et al.* (1981, p. 31) described the plant as widespread along the ledges of the Little Colorado and Colorado Rivers to the hills of the lower House Rock Valley. Benson (1982, p. 765) described the range as northern Arizona from the hills in northeast Mohave County to the vicinity of the Colorado and Little Colorado rivers near the Grand Canyon National Park and southeast Coconino County. The current range of the Fickeisen plains cactus extends from Mainstreet Valley of the Arizona Strip (i.e., the area north of the Colorado River to the Arizona-Utah border) to House Rock Valley; along the canyon rims of the Colorado River and Little Colorado River; the area of Gray Mountain; and along the canyon rims of Cataract Canyon on the Coconino Plateau. The plant is known in approximately the same areas as those described by Heil *et al.* (1981, p.31) and Benson (1982, p. 765), including those found along Cataract Canyon. Benson had identified plants in this area as varieties of *Pediocactus peeblesianus.* Plants nearest the Grand Canyon National Park on the Coconino Plateau were known as variety *fickeiseniae,* while a population further south were considered to be variety *peeblesianus.* These were later verified as the variety *fickeiseniae* (Goodwin 2006, p. 4; Goodwin 2011a, pp. 5–6).

The Fickeisen plains cactus occurs in disjunct populations that are widely scattered over a broad range (Table 1). Populated areas are often separated by many miles and varying topography. Although there is abundant suitable habitat within its range, many areas are unoccupied by the plant for reasons unknown. Philips *et al.* (1982, p. 7) estimated that the plant's known range covered 200 linear km (125 mi) of land, and NatureServe (2011) estimated it to be 12,750 square kilometers (sq km) (4,922 square miles (sq mi)). Based on the current spatial distribution of the Fickeisen plains cactus, we estimate the current range is approximately 8,668 sq km (3,347 sq mi). In addition, its range converges with the range of the endangered *Pediocactus bradyi* (Brady pincushion cactus) in House Rock Valley, and overlaps with the range of the threatened *Pediocactus sileri* (Siler pincushion cactus), and the Kaibab plains cactus, which is protected by a conservation agreement (BLM 2011a, Figure 3.8–1).

Abundance and Trends

From 1962 to 2012, the Fickeisen plains cactus has been documented in approximately 33 populations (Table 1) (AGFD 2011b, entire; Goodwin 2011a, p. 19; NNHP 2011a, entire). Based on the collective information so far, the number of known Fickeisen plains cacti rangewide is about 1,132 individuals, but this does not represent a population estimate because only 6 of the 33 populations have recent information on their status. The majority of populations are small in numbers, some consisting of fewer than 10 individuals. Many of these populations have not been visited in over 18 years or visits have been infrequent and irregular, so that the status of the cactus is unknown. Of the 33 populations, 6 have been recently documented or regularly monitored and provide reliable information describing the status of the Fickeisen plains cactus. These 6 populations have a total of 466 individuals and represent some of the most abundant areas populated by the Fickeisen plains cactus. They are located on lands managed by the BLM (Arizona Strip District), Kaibab National

Forest, State of Arizona, and Navajo Nation, in addition to privately owned lands. Based on the number of documented individuals (number of plants per landowner by total documented plants), the breakout of populations by land owner is as follows: BLM (22 percent), Kaibab National Forest (5 percent), State of Arizona (14 percent), the Navajo Nation (45 percent), and privately owned lands (13 percent).

TABLE 1—NUMBER OF FICKEISEN PLAINS CACTUS REPORTED BY LOCATION, LANDOWNER, AND THE FIRST AND LAST DATE OBSERVED

[1962 to 2012]

Populations	Landowner	First visited	First count	Last visited	Last count
Beanhole Well	BLM	1979	3	1979	3
Marble Canyon	BLM	1979	8	1979	8
Gray Mountain (Mays Wash)	BLM	1981	30	1981	30
South Canyon	BLM	1979	41	1987	52
Toquer Tank	BLM	1986	8	1994	7
Navajo	BLM	1986	4	2001	10
Salaratus Draw I and II	BLM	1986	17	2001	0
Temple Trail	BLM	1986	7	2001	7
Ward	BLM	1986	12	2001	10
Sunshine Ridge II	BLM	1986	9	2004	35
Clayhole Ridge	BLM	1987	23	2012	38
Dutchman Draw	BLM	1986	167	2012	5
North Canyon	BLM	1987	16	2012	42
Sunshine Ridge	BLM	1987	12	2012	4
Kaibab National Forest	USFS	2004	Unknown	2013	62
Shinumo Wash	NN	1993	9	1993	9
Tiger Wash 2	NN	1993	11	1993	11
Little Colorado River Overlook.	NN	1956	Unknown	1997	15
Little Colorado River Gauging Station.	NN	1999	1 (survey out of season)	1999	1
29 mile Canyon	NN	2000	2	2000	2
Big Canyon	NN	2002	15	2002	15
West of Hellhole Bend	NN	2002	5	2002	5
Small Ridge	NN	2004	1 (survey out of season)	2004	1
Little Colorado River Gravel pit.	NN	1956	Unknown	2005	21
Shinumo Altar	NN	1991	Unknown	2012	6
Tiger Wash 1	NN	1993	30	2005	2
Gray Mountain (South of Cameron).	NN	1962	4	2009	3
Hellhole Bend	NN	2009	314	2009	314
Salt Trail Canyon	NN	2006	119	2011	70
Blue Spring	NN	2005	30	2005	30
Gray Mountain (Sewage Disposal Pond).	Private	1984	4	1986	7
Cataract Canyon	Private	2007	54	2011	146
Cataract Canyon	State	2007	98	2011	161
TOTAL					1, 132

Notes: Navajo Nation (NN), U.S. Forest Service (USFS). The increase in plant numbers at Cataract Canyon from 2006 to 2011 is due to new areas being surveyed each year resulting in new occupied sites being located (Goodwin 2012, p. 1). The total number shown does not represent a total population estimate but is to document the total number of individuals that have been observed over the reported time period.

Our knowledge of abundance and trend information was assessed from annual monitoring reports by the BLM (1986 to 2012) and Navajo Nation (2006 to 2011). Each agency has monitoring plans that are set up to track specific information in each of occupied sites on lands they manage. However, there are differences in data collection, and this inconsistency makes it difficult to compare trends across the landscape and between landowners. Therefore, results are presented for each landowner separately. No monitoring program has been established for the Fickeisen plains cactus on the Kaibab National Forest or on private lands. However, any pertinent information regarding abundance, reproduction, and recruitment from these populations were incorporated herein.

Bureau of Land Management Lands—The BLM manages habitat for 14 documented Fickeisen plains cactus populations (Table 1) that occupy an estimated 36.9-ha (91.3-ac) area (BLM 2007b, p. 67) on the Arizona Strip. The total known population on the Arizona Strip has declined roughly 72 percent in 21 years from 323 individuals in 1991 to 89 individuals in 2012 (Table 2).

TABLE 2—NUMBERS OF FICKEISEN PLAINS CACTI RECORDED IN BLM MONITORING PLOTS AND CLUSTER PLOTS
[1986 to 2012]

Year	Dutchman	Clayhole	Sunshine Ridge	North Canyon	Navajo	Sunshine Ridge II	Salaratus I and II	Temple Trail	Toquer Tank	Ward	Total
1986 Plants outside plots*.	167	8	9				17				201
1986	21		6	14	4	2		5	8	10	70
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	Not Observed	22							79
2001	40	63	3	34	10	23	0	7	0	10	190
2002	30	60	12	24							126
2003	50	56	Not Observed	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

Notes: *BLM reported counts of Fickeisen plains cacti outside of established monitoring plots for 1986 only. No monitoring occurred in 1996 by the BLM due to dry conditions resulting in plants retracted underground. No monitoring reports were submitted to the Service for the years 2008 and 2010. Numbers in 2008 were obtained from Hughes 2009.

The Fickeisen plains cactus was first documented on the Arizona Strip in 1977 at Sunshine Ridge with the remaining populations discovered up through 1986 (Phillips 1979, entire; AGFD 2011b, entire). Occupied sites are widely separated from one another (roughly 31 km (19 mi) apart) in geographically disjunct locations. In Mohave County, populations have been documented in Mainstreet Valley near Dutchman Draw, in Hurricane Valley near Toquer Tank, in Lower Hurricane Valley near Temple Trail, in Salaratus Draw in the Hurricane Cliffs, on Clayhole Ridge, and on Sunshine Ridge. Populations have also been documented in Coconino County near the canyon rims of Marble Canyon, South Canyon, and North Canyon Wash in House Rock Valley. Searches for the Fickeisen plains cactus after 1987 have not located any additional populations despite the abundance of suitable habitat present (Hughes 1996a, p. 47; Hughes 2011, pers. comm.).

In 1986, the BLM established long-term monitoring at the Dutchman Draw, North Canyon Wash, Clayhole Ridge, and Sunshine Ridge populations (Hughes 1996a, p. 47). The monitoring plots were located in areas that contained the densest number of Fickeisen plains cacti and were easily accessible (Hughes 2009, p. 28; Hughes 2011, pers. comm.). The four plots were visited annually from 1986 to 2009, and from 2011 and 2012, to record information on abundance, reproduction (the percent of tagged plants flowering or fruiting), and mortality. Beginning in 1995, the BLM began recording recruitment (individuals 0 to 20 mm (0.78 in)) and, in 1998, recorded the number of missing or retracted plants. The BLM also classified plants into five size classes based on their measured width and recorded the information between 1987 and 1995. From 1997 to present, two size classes were used to reflect the juvenile (0 to 15 mm (0.6 in)) and adult (16 to 31 mm and greater (0.63 to 1.22 in)) size classes. The changes to the size classes prevent comparing the data among years; however, it does provide some information regarding the proportion of individuals in the small and larger size classes that can be used to describe the number of seedlings or juveniles versus aging, mature adults. In addition to the four plots, BLM established seven cluster plots: Navajo, Ward, Salaratus Draw 1, Salaratus Draw 2, Sunshine Ridge 2, Temple Trail, and Toquer Tank. Cluster plots consist of rebar centered among a small number of scattered individuals. These are visited once every 5 to 10 years for the purpose of recording presence/absence.

Dutchman Draw—The Dutchman Draw plot is the largest plot, situated within tall, dense grass in Mainstreet Valley. Up until 1999, the number of Fickeisen plains cacti in the plot accounted for the majority of total plants (64 to 74 percent) reported from all Arizona Strip populations. Beginning in 1986, cacti numbers inside the plot increased from 21 individuals to a high of 219 plants in 1992. Also in 1986, there were 167 individuals counted outside the plot. These plants were not mentioned or included in subsequent monitoring reports, and their status is unknown. As of 2012, there were 5 plants observed in the plot (Hughes 2012, p. 1).

From 1989 to 1992, the plot experienced its highest number of seedlings based on the number of plants recorded in the smallest size class. Only one other seedling was detected in 1994. Between 1997 and 2005, the small and large size classes were relatively equal; however, after 2007, the larger size class showed an upward trend while a significant drop occurred in the smaller size class. This gap between the two size classes has continued through 2012, in which all of the individuals are mature adult plants.

A total of 111 plants were reported as recruitment (e.g., plants with a diameter less than 20 mm (0.79 in)) since the BLM began tracking recruitment in 1994, with an average of 7 individuals per year; 94 percent of those were reported from 1994 to 2004. Fruit production has been low within this population. On average, 44 percent of

tagged plants fruited in 6 of the 23 years this information was recorded. From 2001 to 2012, researchers reported 182 plants missing or retracted (average 35 plants per year). Mortality totaled 257 plants over a 15-year period from 1987 to 2012 with 144 of those occurring in the year 2000. The BLM stated that the 144 mortalities included tagged plants that were previously counted as retracted plants, but, because they had not been seen since the late nineties, they were assumed to be dead (Hughes 2000a, p. 2).

In summary, the number of Fickeisen plains cacti within this plot has declined roughly 98 percent from the highest recorded count to the present (2012). Mortality and the number of plants missing or retracted have been higher than the number of new recruits. Although many plants are within reproductive age, little to no reproduction occurred in the years from 1998 to 2012. With only 5 plants located in 2012, we believe this plot will become extirpated in the near future.

Clayhole Ridge—The Clayhole Ridge plot occurs on top of a limestone ridge (BLM 2007b, p. 67) in Clayhole Valley. Plant numbers in the plot have experienced several periods of increase followed by decreases between 1987 and 2012. The lowest number occurred in 1998 with 16 individuals, and the numbers peaked in 2001 with 63 individuals. Since 2001, plant numbers have declined by roughly 40 percent with 38 plants occurring there as of 2012 (Hughes 2012, p. 1).

From 1987 to 1995, 76 percent of the individuals found within this plot were greater than 20.1 mm (0.79 in) in diameter, while 9 percent were between 5 to 10 mm (0.2 to 0.39 in) in diameter. No seedlings were recorded during this time. The gap between the small and larger size classes has continued through 2012, with 84 percent of the individuals in the larger size class. Hughes (1996b, p. 17) attributed this division to the lack of intensive surveys for seedlings.

This plot had the highest percent of cactus producing fruit, and in the most years, compared to the other plots. Fruit production occurred in 21 of the 23 years reported with an average of 36 percent of tagged cacti fruiting (with a range of 6 to 85 percent of tagged cacti fruiting) each year. A total of 36 plants (average of 2 per year) were recorded as recruits in 12 of the 17 years information was collected. A total of 41 mortalities occurred between 1988 and 2012, and 251 plants were reported missing or retracted from 1998 to 2009 (average of 21 plants per year).

In summary, abundance has varied in this plot but plant numbers have averaged about 38 annually. After reaching its highest number in 2001, the plot has been in a downward trajectory since then, declining by 40 percent. Despite the majority of individuals fruiting and considering that larger individuals produced multiple fruit, recruitment has been poor. Mortalities, in combination with the number of plants missing or retracted, are substantially high compared to total abundance. The years between 2000 and 2001 are the exception, when plant numbers increased from 20 to 63. Reasons attributed for the sharp increase are unknown and do not appear to be correlated to weather. The average precipitation amounts for winter and spring of 2000 was very dry (Hughes 2000a, p. 1) and the spring of 2001 was just below-average, which would suggest low plant numbers rather than an increase.

Sunshine Ridge—The Sunshine Ridge plot is located along a ridgeline and downslope on a bench next to Toroweap Road (Hughes 1996b, p. 17). This plot has also experienced considerable variations in abundance. Monitoring began with 6 plants in 1986, and then numbers fluctuated eventually reaching a high of 44 in 1992 to none being observed in 2000, because they were either retracted or dead (Hughes 2000a, p. 1; Hughes 2005a, pers. comm.), possibly in response to below-average precipitation that year. Only four individuals were recorded in 2012 (Hughes 2012, p. 2). The plot had two distinct periods of relatively high numbers: From 1990 to 1995, with an average of 35 plants, and from 2005 to 2011, with an average of 29 plants. The worst years occurred in between these peaks for reasons unknown. The plot was vandalized in 1996, which may have contributed to the significant decline, although plants were not observed to have been damaged by the vandalism (Hughes 2005a, pers. comm.).

From 1987 to 1995 in this plot, 77 percent of individuals were greater than 10.1 mm (0.40 in) in diameter, while only 2 seedlings were observed during that period. From 1997 through 2012, the majority of the plants were in the larger size class, which currently includes 75 percent of individuals.

Fruit production occurred in 10 of the 22 years, with an average of 34 percent of tagged cacti fruiting (with a range of 16 to 79 percent of tagged cacti fruiting). A total of 26 individuals were reported as new recruits (average 1.7 per year) in 7 of the 17 years information was collected. Mortality from 1986 to 2012 totaled 43 plants, with 74 percent of those occurring from 1989 to 1995. Despite low numbers of deaths, 73 plants were reported as missing or retracted (average of 7 per year) from 1988 to 2012, with 89 percent of these reports occurring in the last 6 years.

In summary, this plot has experienced wide fluctuations in numbers over the 24 years it was monitored. Reasons for the variability have not been investigated but can likely be attributed to large numbers of individuals reported missing or retracted and poor reproduction. Moreover, despite a third of the individuals fruiting on average, annually, only two seedlings have been documented over a 16-year period. Compared to the other plots where decreases are gradual, changes in abundance in this plot have been more abrupt. Thus, the status of the species in the plot appears to be unstable and trending toward decline.

North Canyon—The North Canyon Plot occurs in House Rock Valley on two small hills near North Canyon wash. Plant numbers have also varied, but the reasons causing abundance to fluctuate have not been investigated. From 1986 to 1991, plant numbers increased from 14 to 36 individuals then fell to 7 in 1992. The sharp decline was attributed to a high number of plants lost from rodent predation in 1992 (Tonne 2012, p. 17). Post-1992, plant numbers gradually increased to a high of 40 in 2004 and 2005. As of 2012, there are 42 individuals in the plot (Hughes 2012, p. 2).

From 1987 to 1995, researchers found 85 percent of plants were greater than 10.1 mm (0.40 in) in diameter. No seedlings were found during these years. From 1997 through 2002, the size class distribution was relatively equal with 59 percent in the 0 to 15 mm (0.16 in) size class and 41 percent in the 16 to 30 mm (0.63 to 1.22 in) size class. After 2002, the size classes shifted to an average of 19 percent of plants in the smaller class and 81 percent in the larger class. As of 2012, researchers found 74 percent of plants in the larger size class.

Fruit production in this plot occurred in 11 of the 22 years reported, with an average of 35 percent tagged cacti fruiting annually (with a range of 8 to 64 percent of tagged cactus fruiting). Researchers found 35 new recruits (average of 2 plants per year) in 10 of 17 years reported and a total of 37 mortalities, with 26 deaths occurring in 1992. A total of 76 plants were reported missing or retracted (about 5 plants per year); 62 percent of those occurred from 2002 to 2005, when the plot also increased in numbers.

In summary, it is unclear what is occurring in this plot as increased abundance has occurred at the same time of high mortality. In the last 7 years, it has maintained an average of 37 individuals (range 32 to 42 cacti). During this time, fruiting occurred in 3 of the 7 years followed by a total of 9 new recruits; no mortalities occurred, but 28 plants were reported as missing or retracted. Very few small plants were documented between 1986 and 1995. After 1997, the plot's size structure distribution is skewed toward larger individuals indicating it is dominated by aging adults, while smaller plants are either moving into the larger size class as they grow or are deceased, missing, or retracted. Despite the appearance that numbers are relatively stable, reproduction is poor. There is also little evidence of recruitment to the extent younger plants would offset the number of missing or retracted plants. All of this information suggests that the plot is trending toward decline in the near future.

Cluster Plots—Information collected on the seven cluster plots was reported in BLM's 2001 annual monitoring report and is limited to count data (Roaque 2012, pers. comm.). The Navajo and Ward clusters plots are located in proximity to the Dutchman Draw population. In 1986, researchers found 4 plants at Navajo and 12 at Ward. Visits to these sites in 1993 reported zero plants in both plots. These sites were last visited in 2001, and 10 plants were found in each plot. No information describing the 1993 visit was provided in the monitoring report. Reported numbers for Salaratus Draw 1 and Salaratus Draw 2 were 5 and 12, respectively, in 1986 (BLM 1986, p. 2) and 2 and 11 plants, respectively, in 1993. In 1994, the Service visited Salaratus Draw sites and counted 14 plants in Salaratus Draw I and 30 plants in Salaratus Draw II (Service 1995, p. 1). Both of these sites were last visited in 2001, and zero plants were reported (Roaque 2012, pers. comm.). We do not have locations of these sites, in relation to the others, on file. Because the BLM referred to these sites as simply Salaratus Draw in their 1986 annual monitoring report, we do the same in this document unless we need to differentiate the two sites for specific reasons. The Sunshine Ridge II cluster plot had 9 plants in 1986 and 23 plants in 2001. The Temple Trail cluster plot had five plants in 1986, one plant in 1993, and seven plants in 2001.

The Toquer Tank cluster plot was visited regularly from 1986 to 1991. The reported number of plants found during that time ranged from 8 in 1986, up to 13 in 1991, to 7 in 1994 (Table 2) (Roaque 2012, pers. comm.; AGFD 2011b, entire). Information from BLM's annual monitoring reports for the years 1995 through 2000 noted ''no observations'' for the Toquer Tank cluster plot but did not provide an explanation for what this meant. We do not know if this signifies that the cluster plot was not visited or whether a visit did occur but no Fickeisen plains cacti were observed at the time. Subsequently, the BLM no longer included Toquer Tank in their monitoring reports.

Despite the confusion with Toquer Tank and the length of time since the Salaratus Draw cluster plots were last visited, we believe these areas may still be occupied by the species. When Hughes last visited Salaratus Draw I and II in 2001, he noted that both sites were very dry (Roaque 2012, pers. comm.) and plants may have been retracted at the time. Hughes further noted that the cluster plots are located in areas with dense grass in which the plants are difficult to find if they are not in bloom. We do not have any additional information to describe the conditions at the Toquer Tank cluster plot; however, a visit to the area is warranted. During the public comment period for the proposed rule, we requested any information about the status of the Fickeisen plains cactus at these three areas, specifically information to describe abundance, health, and age-class diversity of the plants. We also requested information describing the status of its habitat and any land use activities occurring within occupied areas. No additional information on the cactus at these sites was received.

House Rock Valley—The Fickeisen plains cactus has been documented in three additional areas in House Rock Valley, excluding those at North Canyon wash. These areas have not been visited in more than 18 years, and information about them is very limited. The Fickeisen plains cactus is documented at Beanhole Well, and along the rims of the Colorado River near Marble Canyon and South Canyon at the North Rim of the Grand Canyon National Park on BLM land. The Beanhole Well population is located just south of Highway 89A near the Vermillion Cliffs. This area has a small number of individuals, containing only three plants that were discovered in 1979 (Anderson and Gierisch 1979, p. 1; AGFD 2011b, entire). Field notes described the plants as healthy, scarce, and with several size classes present. The site had been revisited by Hughes, and while occupied habitat was observed, no plant numbers were reported to us (Calico 2012, pers. comm.).

The Marble Canyon population was visited in 1979, and 8 plants were observed within a 100-by-100-m area (0.06-by-0.06-mi) (Phillips 1979, p. 3). No other information is known. The third is located near the canyon rim of South Canyon. A total of 41 plants among three occupied sites were observed in 1979 within a 1,000-by-200-m (0.62-by-0.12-mi) area. In 1987, researchers observed 52 plants there during a soil study (AGFD 2011b, entire). Travis (1987, p. 4) observed animal burrows in areas occupied by Fickeisen plains cactus at the South Canyon with individual cacti found in the disturbed ground. A monitoring plot was established from 1982 until 1989 with approximately 59 plants total (Phillips *et al.* 1982, p. 7; Phillips *et al.* 1990, p. 5). At the last reading in May of 1989, Phillips *et al.* (1990, p. 5) documented 50 plants, 17 of which flowered and set fruit. However, many of the plants were found to be below the soil surface. A warm and dry winter in 1988 to 1989 was attributed to the plot's poor recruitment and numerous retracted plants (Phillips *et al.* 1990, pp. 8–10). The plot was last visited in 1993 by Hughes (Roaque 2012, pers. comm.), who had observed several Fickeisen plains cacti but did not provide specific information on plant numbers.

Due to the limited information available on these sites, and the fact that none have been visited in more than 18 years, we requested any information about the status of the Fickeisen plains cactus at this site during the public comment period for the proposed rule. We received no additional information on the cactus at these sites.

Navajo Nation Lands—There are 15 known populations of the Fickeisen plains cactus on the Navajo Nation (NNHP 2011a, p. 1). Eleven populations contain fewer than 20 plants, while 3 and possibly 5 populations contain only 2 to 3 individuals (Table 1). In 2009, researchers discovered a single population containing 314 plants. Only 6 of the 15 populations have been visited more than one time by the Navajo Nation Heritage Program staff (NNHP 2011a, p. 1; Navajo Nation Department of Fish and Wildlife (NNDFW) 2012, pp. 8–9). Substantial decreases in plant numbers were recorded during the most recent visits to two of these occupied sites. At one population, the cause of the decline is unknown. The suspected cause of the decline in the second population is discussed below for Salt Trail Canyon. The other four populations appeared stable. Several of the occupied sites

consist of a few individuals. This is partly due to surveys occurring outside of the spring survey season, and the sites never having been revisited thereafter for a more intensive effort (NNDFW 2012, pp. 8–9). Some populations were surveyed in the spring, and plants were found in extremely low densities; the Salt Trail Canyon and Hellhole Bend populations are the exception with high density and large abundance of plants found. The Navajo Nation suspects that there are vast amounts of potential suitable habitat for the Fickeisen plains cactus on their land and additional occupied sites likely exist but have not been discovered (NNDFW 2012, pp. 8–9).

Prior to 1991, the Fickeisen plains cactus was known at two to three sites along the south rim of the Little Colorado River from Cameron to Hellhole Bend. In the spring of 1991, a botanist with the Navajo Nation located a new population near Shinumo Altar and documented 21 Fickeisen plains cacti (NNHP 1994, p. 4). Surveys were conducted in 1993 and 1994. Those efforts located 280 Fickeisen plains cacti at 6 sites, including occupied sites discovered in 1991 (NNHP 1994, p. 3). Re-surveys of known populations between 2004 and 2005 resulted in only half of the 15 populations being located and substantially fewer plant numbers than those reported in 1994 (Roth 2005, pers. comm.). In 2006, a monitoring plot was established at Salt Trail Canyon, one of the Navajo Nation's largest populations (Roth 2007, p. 3). A monitoring plot was also established at Hellhole Bend in 2012, but monitoring information for this plot is not yet available.

With the exception of 2010, the Salt Trail Canyon plot has been monitored annually since 2006 to estimate trends and record reproductive efforts for the Fickeisen plains cactus. In 2006, researchers recorded 119 Fickeisen plains cacti. Plant numbers increased to 143 individuals in 2007, but this rise was primarily due to increased survey efforts that year (Roth 2008, p. 6). Since 2007, plant numbers have declined by 49 percent, with 70 plants relocated as of 2011 (NNHP 2011b, p. 2). In 2009, there were 101 cacti located in the monitoring plot, including 8 new plants. Thirty-one plants were either found dead or could not be located (NNHP 2011b, p. 2). In 2011, 28 plants were found dead or were not located, with one new seedling observed (NNHP 2011b, p. 3). Of the remaining plants in the plot, their observed condition, mean diameter, and reproductive output declined. From 2006 to 2008, the majority of plants were rated in excellent condition. The number of plants rated fair or poor increased from 4 in 2008, to 23 in 2009. These patterns may have been influenced by above-average rainfall in 2005 and 2007, but below-average precipitation in 2008 through 2010, on the Navajo Nation (NNHP 2011b, p. 3).

The mean diameter of plants between 2008 and 2009 was 28 mm (1.10 in). By 2011, the mean diameter declined by 5 mm (0.20 in) as a result of the cactus shrinking rather than a loss of plants in that size class. The plot has been dominated by the larger size classes with one percent of the plants recorded as seedlings. Reproductive structures observed in 2009 and 2011 were flower buds, flowers both at and past their peak, and aborted flower buds, an observation which was similar to phenological results in 2008. In general, reproductive effort in 2009 was moderate, while, in 2011, it was extremely low compared to 2008. In 2008, researchers observed 205 reproductive structures on 98 plants, and attributed this to above-average rainfall in 2007, whereas 2008 and 2010 had below-average rainfall (NNHP 2011b, p. 3).

In summary, short-term results demonstrate a continued decline over the last 5 years. Mortality, combined with the number of plants missing between years, is higher than the number of smaller, young plants observed. In addition, the documented reproductive output appeared to be low in 2011 but variable in years prior, and was likely influenced by below-normal precipitation.

Kaibab National Forest Lands—There were two areas on the North Kaibab Ranger District thought to be occupied by the Fickeisen plains cactus (USFS 2005, p. 148; AGFD 2011b, entire). One population is on the eastern Forest boundary at South Canyon near House Rock Valley and the Grand Canyon National Park. The South Canyon population was discovered in 2004 when a few individuals were observed (FWS files; Phillips 2013, pers. comm.). Information describing abundance, size classes, status, and distribution of the plants was unknown until it was revisited again in March 2013 (Hannemann 2013, pers. comm.). We now know the population consists of 62 plants distributed in several areas along the canyon rim. Plants of various size classes were found, including a few seedlings (diameter less than 1 mm (0.04 in)) and very large adults (diameter greater than 30 mm (1.18 in)). A monitoring site was established to collect detailed information on the status of the Fickeisen plains cactus in the near future.

The second population was believed to be located near the western Forest boundary at Snake Gulch (Phillips 2012, entire; USFS 2013a, pp. 44–46). Several areas in the vicinity of Snake Gulch were considered to be occupied by the Fickeisen plains cactus prior to 2013. An observation of a plant or plants was reported there following a botanical survey in the 1980s (AGFD 2011b, entire). However, searches for the plant in 2002 and 2003 during a section 7 consultation (USFS 2004, p. 601) and again in 2013, failed to locate any individuals. Investigation into the 1980s field information revealed an error in the reporting of the original observation clarifying that Fickeisen plains cactus was never found at Snake Gulch. Although there is potential habitat that is suitable to support the cactus, the site is considered to be unoccupied.

No Fickeisen plains cacti are known to occur on the Tusayan Ranger District. Habitat suitable to support the cactus was believed to exist in the Lower and Upper Basin areas but surveys were needed to verify any potential sites that could be occupied (USFS 2009, p. 72). A floristic survey was completed in 2013 on the Coconino Rim and Upper Basin (USFS 2013b, p. 1). The results of the survey determined that potentially suitable habitat in the Upper Basin was outside of the cactus' known elevational range. In addition, areas underlain by Kaibab limestone appear to be outside of the Tusayan Ranger District's boundary.

State and Private Lands—A large population of the Fickeisen plains cactus was documented in 2006, near the rims of Cataract Canyon on Cataract and Espee Ranches, which are owned and managed by the Babbitt Ranches, LLC (Goodwin 2006, p. 7; Goodwin 2008, pp. 8–10; Goodwin 2011a, pp. 1–9). These ranches are located on the Coconino Plateau south of the Grand Canyon National Park. The land within Cataract Ranch includes 18,210 ha (45,000 ac) of private land and 53,823 ha (133,000 ac) of land leased from the State of Arizona (The Nature Conservancy (TNC) 2000, p. 4). On December 7, 2000, TNC acquired a conservation easement on 13,953 ha (34,480 ac) of the privately owned parcels (TNC 2000, p. 22). In 2001, Coconino County acquired a separate conservation easement on an additional 2,590 ha (6,400 ac) of private land on Cataract Ranch. The deeded land forms a large contiguous block in the southern portion of Cataract Ranch, then is interspersed among numerous parcels of State land in the northern portion of the ranch (TNC 2000, p. 3). The Espee

Ranch is adjacent to the western boundary of the Cataract Ranch and includes State and private lands.

From 2006 to 2011, Goodwin conducted a general floristic inventory on the Cataract Ranch and located 307 Fickeisen plains cacti at 37 sites (2006, p. 7; Goodwin 2008, pp. 8–10; Goodwin 2011a, pp. 1–9). Of the 37 sites, 16 are on the conservation easement land. The number of plants recorded at each site was detected using a 5–10 minute visual search of the area (Goodwin 2011b, pers. comm.). In total, about 146 Fickeisen plains cacti were located on private land, and 161 plants are on State land of the Cataract Ranch (Goodwin 2011a, pp. 18–20). Two mature plants were located on the Espee Ranch. Goodwin defined sites as physical breaks in the habitat separating one occupied area from another (Goodwin 2011b, pers. comm.). Occupied sites had an average of 8.3 plants (range of 1 to 32 individuals) within a 0.10-ha (0.25-ac) or smaller sized area. About 30 percent (92 of 307 plants) of the plants observed were classified as immature plants that appear to be of less than reproductive age. The distribution of the plants appears to be loosely associated with the Cataract drainage. Most occupied areas occurred no farther than 3.22 to 4.83 km (2 to 3 mi) from the rim of the canyon and covered a 48-km (30-mi) linear area (Goodwin 2011a, p. 7). No formal surveys or permanent monitoring plots have been established on the Cataract Ranch. No surveys are planned for the Espee Ranch, but it is likely that additional plants may occur there.

On the eastern side of the Coconino Plateau, two small populations of the Fickeisen plains cactus have been documented near the community of Gray Mountain, which is north of the town of Flagstaff, on a mix of Federal, tribal, and private land. One population is located on private lands next to the boundary of the Navajo Nation and west of U.S. Route 89. In 1984, four Fickeisen plains cacti were found near a sewage disposal pond. Researchers visited the area in 2013 to try and relocate the site where plants were originally found. No in-depth searches were conducted, but one plant in flower was relocated (Service 2013, p.1). The second population is located on the east side of U.S. Route 89 near Mays Wash on BLM and privately owned lands (AGFD 2011b, entire; Goodwin 2012, pers. comm.). In 1981, researchers found 29 live and 4 dead Fickeisen plains cacti and established a monitoring plot in 1983 on BLM land (AGFD 2011b, entire) but we have no information describing those efforts or results. The area was last visited in 1984, and four plants were observed, three of which were in bloom.

The Fickeisen plains cactus has also been documented to the west of the Babbitt Ranches on private land held in fee simple by the Navajo Nation (Chapman 2012, pers. comm.; Navajo Department of Justice 2012, p. 2). Plants, known only as a variety of *Pediocactus peeblesianus,* were first documented there in 1979. The occupied area was revisited in 2006, and the plants were confirmed to be variety *fickeiseniae* (Goodwin 2006, p. 5). Another visit to the area occurred in the spring of 2012, but no documentation describing the site visit or the status of the Fickeisen plains cactus is available (Goodwin 2012, pers. comm.; Hazelton 2012b, pers. comm.) The area is believed to have abundant habitat that is suitable for the Fickeisen plains cactus and likely supports additional, currently unknown plants (Chapman 2012, pers. comm. Goodwin 2012, pers. comm.). If additional Fickeisen plains cacti do exist here, it would expand the known range of the species.

In summary, abundance and trend information on the Fickeisen plains cactus is limited to 6 populations totaling 466 individuals. We acknowledge that additional Fickeisen plains cacti may be present in the other 27 known populations and there may be additional populations within suitable habitat that has not yet been surveyed, but the status of those plants is unknown because these areas have not been visited regularly or visits have occurred once in more than 18 years. Of the six populations, five are being monitored. These five monitoring plots are within the largest populations on the Arizona Strip and one of the largest populations on the Navajo Nation. The BLM has been monitoring the Fickeisen plains cactus for nearly 26 years. Information obtained from their monitoring reports represents the majority of knowledge about the status of the taxon. Long-term monitoring results from the BLM show a 72 percent decline in plant numbers among the four monitored plots combined since 1992. The decline appears to be a result of higher rates of missing or retracted plants and mortality over several consecutive years in conjunction with low seedling recruitment. Adult plants, which produce more fruit and have a greater reproductive output than immature plants have been removed from the BLM populations and are not being replaced by new recruits even during favorable conditions. Short-term monitoring results from the Salt Trail Canyon monitoring plot on the Navajo Nation indicate plant numbers have declined by 49 percent in the last 5 years. This population is also dominated by older adult individuals that appear to have low reproductive output based on aborted reproductive structures observed in 4 of the 5 years monitoring occurred, with high mortality compared to recruitment.

Of these five monitored populations, the observed decline or absence in seedling recruitment and survival is difficult to attribute to a single cause; it is more likely associated with a combination of environmental factors that are acting together. The reproductive capacity for the Fickeisen plains cactus is considered to be naturally low (e.g., seed dormancy, low seed production, poor dispersal mechanisms, and slow growth), in which, introducing external factors that may place additional stress on the life-history characteristics of these populations may further inhibit population growth. Moreover, information from other species of *Pediocactus* suggests that the low recruitment being observed may be influenced by the young age of individuals, as well as other climatic factors. Because these five monitoring plots are located in large populations of the Fickeisen plains cacti but have demonstrated significant decreases in plant numbers, it is likely that the smaller, isolated populations whose status is unknown are also experiencing similar declines. The Fickeisen plains cactus in the Cataract Canyon population and South Canyon on the Kaibab National Forest are the exception. These occupied areas are the only locations showing relatively good age-class diversity (30 percent of the individuals on the Cataract Ranch is considered to be immature). The Kaibab National Forest will begin long-term monitoring in the future and collect detailed information to help our knowledge of the taxon. Until then, it is too early to draw conclusions about the status of plants at these locations. The Fickeisen plains cactus on the Cataract Ranch, however, benefits by the protection afforded to it from the conservation easement.

Based on our review of the best available information on the species, the known numbers of the Fickeisen plains cactus have declined. The species will likely continue to decline for the reasons described below, as mature plants die and few seedlings are present to replace them. The viability of the five monitored populations has been reduced due to low recruitment and the loss of mature, reproductive plants. If the threats described below continue to affect these populations, the long-term

viability of the rangewide population may be compromised. We acknowledge that the observed declines are restricted to monitoring plots that may not accurately reflect rangewide trends. In addition, our inability to conclude with certainty that plants that have been recorded as missing or retracted are dead may mean that we have underestimated the decline. However, we conclude, based on the information analyzed, that the largest Fickeisen plains cactus populations have declined, and that recruitment is reduced or nonexistent.

Summary of Factors Affecting the Fickeisen Plains Cactus

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Based on the habitat characteristics described above, potential factors that may affect the habitat or range of the Fickeisen plains cactus are discussed in this section, including: (1) Livestock grazing; (2) nonnative, invasive species; (3) uranium mining; (4) road construction and maintenance; (5) ORV use and recreation; (6) commercial development; and (7) drought and climate change.

Livestock Grazing

The habitat of the Fickeisen plains cactus has been grazed since the late 1800s, and continues to be used for grazing by cattle, domestic sheep, and feral horses. In general, livestock grazing may result in direct loss or damage to the Fickeisen plains cactus and the habitat that supports its persistence as a result of trampling, compacting soil, increasing erosion, losing the soil seed bank, introducing invasive species, and disturbing native pollinators (Klemmedson 1956, p. 137; Ellison 1960, p. 24; Fleischner 1994, entire; Trimble and Mendel 1995, pp. 234–240; Kearns *et al.* 1998, p. 90; DiTomaso 2000, p. 257). For the Fickeisen plains cactus, the risk of trampling is greatest when plants emerge above ground at the same time that cattle occupy the area. Given their small size and lack of hard spines, plants are vulnerable to being stepped on and may be killed or damaged as a result (Phillips and Phillips 1995, p. 6). During the wet winter months when rainfall is sufficient, water may collect in pockets of bedrock on the canyon rims, attracting livestock to these areas. Although most plants retract in winter, those plants whose crown sits above the surface are still vulnerable to trampling and risk damage to their meristem. Plants can also be dislodged by cattle as they wander through an occupied area. Increased grazing pressure can negatively impact Fickeisen plains cactus habitat. The soil where plants occur is shallow, sandy, and easily compactible, and may be covered by biological soil crusts, which are easily damaged by trampling (NRCS 1997, p. 10; Evans and Johansen 1999, p. 185). Livestock concentrating within occupied areas can lead to soil compaction and erosion that may decrease the ability of the soil to store seed and support seedling establishment and may prevent plants from seasonally retracting underground (BLM 2007b, p. 74).

Bureau of Land Management Lands—Livestock grazing has occurred on the Arizona Strip and within the habitat of the Fickeisen plains cactus since the mid-1800s (BLM 2007a, p. 3–123). Unregulated use of the rangeland between the late 1880s and early 1900s resulted in overgrazing and rangeland deterioration. The passage of the Taylor Grazing Act (43 U.S.C. 315) in 1934 led to grazing reform, the establishment of allotments, and designation of the kind and number of livestock and seasons-of-use regulations. Between the late 1950s and 1980s, the BLM made further adjustments in livestock numbers and the season-of-use, and implemented regulated grazing systems and management plans. Compared to the 1900s, the current permitted level of grazing has been substantially reduced. The land and the vegetation community are slowly recovering with habitat improvements noted by the BLM over the last several decades. Although the Fickeisen plains cactus have persisted during past years of overgrazing, we do not have information to describe any historical effects grazing may have had to the plant.

All habitat occupied by the Fickeisen plains cactus on the Arizona Strip occurs within active grazing allotments (BLM 2007b, p. 67). The Dutchman Draw plot is located in the Mainstreet Allotment and within a transitional pasture that is used in May for 2 to 4 weeks; the Clayhole Ridge plot is located within a single pasture of the White Pockets Allotment and has season-long grazing from mid-October to June; the Sunshine Ridge plot is within the Wildband pasture of the Wildband Allotment that is used from mid-June to September; and the North Canyon plot is within Rider Point pasture of the Soap Creek Allotment that has winter–spring use (Roaque 2011, pers. comm.). The Salaratus Draw population is in the Salaratus pasture that is used in the winter season. Plants in the Temple Trail cluster plot are in the Temple Trail Allotment, Beanhole Well plants are in the Beanhole Allotment, and Toquer Tank plants are in the Toquer Tank Allotment (BLM 2008a, Appendix C). We do not have information about the season of use for these allotments.

The Beanhole, Soap Creek, Temple Trail, and Wildband Allotments are categorized as ''improve allotments.'' These are ''managed to improve resource conditions or conflicts and receive the highest priority for funding and management actions'' (BLM 2007a, p. 3–124). The Mainstreet, Toquer Tank, and White Pockets Allotments are managed as ''maintain allotments.'' These allotments are managed ''to maintain current satisfactory resource conditions and are actively managed to ensure that resource values do not decline'' (BLM 2007a, p. 3–124). The Mainstreet Allotment is managed under a best pasture system, which attempts to match cattle movements with variable precipitation patterns and seasonal forage production rather than strict rotational schedules (Howery *et al.* 2000, entire). Forage utilization levels for key species are authorized at the 50 percent average of the current years' growth (BLM 2007a, p. 3–125). Trend data for some allotments containing the Fickeisen plains cactus was recorded in various years between 1981 through 2011 (Hughes 2012b, pp. 2–7). The information provided stated that the Twin Tanks Pasture in the Mainstreet Allotment, the Wildband Allotment, Toquer Allotment, and Soap Creek is ranked static and its condition is late seral in plant composition. Information regarding utilization indicates varying levels of grazing use across occupied habitat on the Arizona Strip (Service 1995, p. 1; Roaque 2011, pers. comm.).

Impacts associated with livestock grazing have documented direct mortality to the Fickeisen plains cactus from trampling. Over a 17-year period, monitoring by the BLM detected 12 Fickeisen plains cacti killed from trampling. Three plants died at Clayhole Ridge following heavy spring rains. Hughes (1988, p. 2) documented cattle had congregated in the area of the Fickeisen plains cactus, and it appeared that considerable bull fighting occurred, resulting in disturbance to the plant and the soil. Seven plants died from trampling at Sunshine Ridge, including a large mature plant and five seedlings in 2001 (Hughes 2004, p. 2), and two plants died from trampling at Dutchman Draw (Hughes 2000a, p. 2). In House Rock Valley, the risk of trampling to the Fickeisen plains cactus may be greatest during the wet winter months when rainfall is sufficient to provide water for cattle on the canyon rims and into

occupied habitat (Hughes 2001, pers. comm.). Because not all plants retract completely underground, directly stepping on the plant can damage the meristem and prevent flower production in the future.

Evidence from other monitored *Pediocactus* species indicates that trampling can impact numerous plants and often results in direct mortality. For example, the BLM conducts similar monitoring for the Brady pincushion cactus as they do for the Fickeisen plains cactus. Over a 15-year period, demographic monitoring identified three incidences when plants had been stepped on or harmed by cattle. One account occurred in 2001 where Hughes (2001, pers. comm.) reported a Brady pincushion cactus with an intact seed pod had been stepped on but the plant appeared to have survived; the second account was in 1990 when two plants were killed as a result of trampling. However, in response to the Service's concern for grazing impacts to the Brady pincushion cactus, the BLM established linear transects to determine livestock damage to the cactus along the rim of Marble Canyon (Service 2001b, entire). The purpose of the damage transects were to capture data on mortality/damage effects on the plant that were being missed through demographic monitoring. During the 4 years transects were walked, the BLM recorded 18 Brady pincushion cacti stepped on by cattle (Hughes 2002, p. 5; Hughes 2004, p. 6; Hughes 2005b, p. 17; Hughes 2012b, p. 1). Fifteen of those were reported as uninjured and three were killed, in which the soil was wet and hoofprints were deep in the soil thus pushing the plants into the ground resulting in mortality. Those plants found in shallow hoofprints were observed to be alive and bloomed or fruited (Hughes 2012b, p.1), noting that the timing of when cacti were stepped on coincided with their flowering period.

Clark and Clark (2008, p. 3), monitoring the *Pediocactus winkleri* (Winkler pincushion cactus), found that 58 of 107 (54 percent) plants were stepped on directly by cattle over a 13-year period, with some plants stepped on more than once. Thirty-five of those plants died immediately from being trampled, while, of those that survived, 60 percent eventually died within 4 years of their trampling injury. This provides some evidence that damage caused to plants from trampling may not be readily apparent immediately after the event. Thus, we anticipate that more Fickeisen plains cacti have been injured or died after being stepped on, either immediately or later in time, but the impacts are not being detected through the current monitoring methods used by the BLM (Service 2000, p. 2; Service 2007a, p. 8).

In the House Rock Valley, the Fickeisen plains cactus occurs within the Kane Ranch on the Soap Creek Allotment (formerly the Cram Allotment). Historically and up until 1996, the BLM had identified the western half of the Cram Allotment as having a severe overgrazing problem. The North Canyon population occurred in the area heavily grazed (Hughes 2000b, p. 21). An October 1995 site visit to the Cram Allotment by Service staff reported that the number of cattle had been reduced from 150 head yearlong to 50 head in the winter–spring season due to the poor condition of the allotment (Service 1995, p. 1). During that same year, the BLM installed new water sources on the eastern half of the allotment and blocked water tanks from filling up on the western half. This was anticipated to reduce livestock use on the western half and help to alleviate grazing pressure within occupied Fickeisen plains cactus habitat (Hughes 2000b, p. 22). In 2003 to 2005, all livestock were removed from the Cram Allotment, now Soap Creek Allotment, and grazing ceased on the Kane Ranch for two years. During the period from 2003 to 2005, the Fickeisen plains cactus in the North Canyon plot experienced the greatest increase in the number of plants observed in the plot since 1986.

In 2005, the Grand Canyon Trust (GCT) and The Conservation Fund purchased the grazing lease for the Kane Ranch and currently maintain a reduced number of cattle on the allotment compared to previous levels (GCT 2011). They conducted an extensive ecological assessment to ''provide a context for management and to establish a baseline for tracking changes and inform management'' (Sisk *et al.* 2010, pp. 45–47). They found that past heavy use of the range, in conjunction with arid conditions and drought, have resulted in degradation of the rangeland and slowed grassland regeneration. In order to improve the rangelands but also to discover if they could achieve a landscape-level grassland restoration and conservation within an active cattle ranch, the GCT began an experimental native cool-season grass reseeding project on the Kane Ranch in House Rock Valley. Preliminary results showed that seedling recruitment was low overall and small-scale disturbances to the soil associated with some of the different reseedling methods employed had the unintentional consequence of proliferating nonnative, invasive plants while decreasing soil stability. One method investigated the soil seedbank in response to cattle trampling; results showed little support that germination of native grass could be improved by this form of disturbance (Sisk *et al.* 2010, p. 58). However, if these efforts successfully achieve native grassland recovery in the long term, it would improve the quality of habitat that supports the Fickeisen plains cactus.

In summary, the four monitored Fickeisen plains cactus populations on BLM lands are within active grazing allotments. The timing of when cattle are present within occupied Fickeisen plains cactus habitat varies among the 14 total populations, but corresponds to the periods when the plants are emergent and also when they flower and produce fruit. Direct mortality from trampling has resulted in the documented loss of 12 plants within the monitoring plots, but more plants have likely been affected. The extent of damage or mortality to the plants caused by livestock trampling is unknown. No comprehensive monitoring, designed to detect and measure the extent of damage or mortality has been conducted. Over time, losses to mature individuals or damage caused by trampling that prevents future reproduction will result in population declines of the Fickeisen plains cactus.

The rangeland that supports habitat for the Fickeisen plains cactus experienced past overgrazing. Although current grazing levels are far reduced from historic levels, portions of the rangeland have been grazed during periods of drought and we have no information to suggest at present that grazing during a drought is at a reduced stocking rate. Information from the BLM and GCT suggests that the seasonal variation and changes in the timing of precipitation have resulted in slow recovery of the rangelands from historic overgrazing and heavy, winter grazing over the past few years. The effects from the culmination of past grazing levels with hot and dry climate conditions have likely diminished the quality of suitable habitat, particularly in the Sunshine Ridge and North Canyon Wash plots that are being managed to improve resource conditions or conflicts. Both of these plots have shown great fluctuations in plant numbers that may be correlated with habitat deterioration from livestock grazing coupled with climate conditions. In addition, cattle grazing in areas where the Fickeisen plains cactus is present and during times when the plant may already be stressed from drought may be contributing to the plant's poor or nonexistent germination

and recruitment. The Fickeisen plains cactus population in the North Canyon plot appeared to rebound during the period of time when the allotment was rested. Although the reasons for the increased numbers are unclear, the cactus may be sensitive to some level of ground disturbance. However, if the numbers of individuals within a population are too low—such as the Dutchman Draw plot—recovery may be very slow, or may not occur.

Navajo Nation Lands—Livestock grazing on the Navajo Nation has occurred since the 1880s, primary by domestic sheep and cattle. Stocking rates and the impact of grazing on the landscape have varied over the years (NNHP 2011a, p. 2). Overgrazing was documented in the past (Libecap and Johnson 1980, pp. 71–75; Richmond and Baron 1989, entire) and remained problematic through the mid-1990s (High Country News (HCN) 1996, p. 2). We do not have information on the current grazing levels, but, similar to the BLM land, drought conditions have compounded rangeland recovery from past heavy use necessitating balancing rangeland capacity, family-owned herd sizes, and local economies (Redsteer *et al.* 2010, pp. 5–6, 11). Navajo Nation also supports an estimated 30,000 feral horses that contribute to and cause overgrazing problems (Navajo Times 2012). Attempts to control the feral horse population continue to be an ongoing issue on the Navajo Nation.

Livestock grazing is managed by the District Grazing Committees, Farm Boards, and Eastern Navajo Land Board members. Oversight and technical assistance is provided by the Grazing Management Office under the Navajo Nation Department of Agriculture. In general, grazing permits are authorized year round on the west side of the Navajo Nation, while the Eastern Navajo authorizes seasonal permits for the mountainous areas (Hazelton 2012c, pers. comm.). Grazing permits are held by individuals for a certain number of animal units. The grazing permits are generally considered permanent and are inherited by the spouse or children within a family. Livestock rotation is at the discretion of the families that own the livestock.

All areas occupied by the Fickeisen plains cactus on the Navajo Nation are potentially subjected to impacts associated with this grazing (NNHP 2011a, p. 1). However, monitoring has not been conducted in such a way to assess the overall impacts of grazing to the Fickeisen plains cactus and its habitat. Notes from the Navajo Nation Heritage Program pertaining to the 15 known Fickeisen plains cactus populations indicate some livestock impacts have been observed within the three largest populations (Hellhole Bend, Salt Trail Canyon, and Blue Spring) (NNHP 2011a, p. 4). Livestock impacts at Hellhole Bend and Blue Spring referred to the appearance of the range being heavily grazed, but no mortality or direct damage to the Fickeisen plains cactus from livestock was recorded at the time (NNHP 2013, p. 13). Hellhole Bend was visited in 2012. The habitat appeared to have been disturbed by feral horses and sheep. Some of the native vegetation within occupied habitat appeared to have been heavily grazed, likely attributable to animals seeking forage following a dry winter. Most of the Fickeisen plains cacti were retracted with some flushed with the soil surface. No impacts to the individuals were noted at that time (Robertson 2012, p. 1).

Livestock disturbance has been documented in the Salt Trail Canyon population. Damage by sheep was observed in 2005 (Roth 2007, p. 2) and again in 2008, with six livestock-related mortalities. Roth (2008, p. 2) documented that the six dead plants were located within a depression in the ground that was believed to have been dug by sheep that bedded down on top of the plants. In 2011, monitoring of the plot found some evidence that the plot had been disturbed by an animal (i.e., one plant appeared to have been partly eaten), which may have contributed to the high mortality that year (NNHP 2011b, p. 4). An October 2011 site visit by the Service observed the habitat had been disturbed by feral horses and sheep concentrating in the area. We do not know at this time how frequently this site is used by feral horses or sheep or how long this site may be used by either of these animals. Other available information pertaining to livestock and the Fickeisen plains cactus was a documented observance of hoofprints of cattle and sheep near some individuals in the Shinumo area in 1991, but only one cactus was directly impacted. The cactus was lying in a hoofprint and partially uprooted (NNHP 1994, p. 5).

Kaibab National Forest Lands—The South Canyon population is within the Grand Canyon National Game Preserve, now known as the Buffalo Ranch Management Area. Livestock grazing by cattle is not authorized in the management area, and thus no impacts to the Fickeisen plains cactus from cattle would occur. The Buffalo Ranch Management Area supports forage for a bison herd and other game species, which are managed by the Arizona Game and Fish Department. The bison are known to spend much of their time in the remote forested areas of the Kaibab Plateau. Researchers with the Kaibab National Forest did not observe any current use at South Canyon and no evidence that bison had been in areas where the Fickeisen plains cactus occurs. Because of the loose soils at this site, historic bison tracks or trailing would have been evident (Hannemann 2013, pers. comm.). Additionally, developed water for bison is over 4 km (2.4 mi) from occupied Fickeisen plains cactus habitat that would reduce the potential to attract bison or wildlife to the site where plants could potentially be trampled. No signs of disturbance were observed within occupied habitat in spring of 2013 due to the isolation of the area, and wildlife does not appear to pose a threat to the plants.

State and Private Lands—The Cataract Canyon population is on an active cattle ranch that has been utilized for livestock grazing for well over 100 years. The management of livestock grazing by cattle and horses occurs within occupied Fickeisen plains cactus habitat on State and private lands. While the cattle operations are vital to the Cataract Ranch, livestock grazing is managed in a manner that is consistent with the philosophies, values, and conservation ethic of the Babbitt Ranches. For example, cattle operations are one component of the Cataract Ranch, but the Ranch and the other Babbitt Ranches are managed in a holistic manner that incorporates ecology (wildlife habitat, vegetation diversity, watershed health, historical preservation, cultural values, and recreation), the local and regional economies, and the local and regional human community (Babbitt Ranches 2012, entire). Therefore, herd sizes are not adjusted in response to seasonal availability of water and forage due to drought but are managed together with rangeland health, watershed, and wildlife habitat. More specific to the Fickeisen plains cactus, Goodwin (2011a, p. 8) noted no habitat impacts from grazing in occupied habitat while conducting searches for the plant from 2006 to 2011. Additionally, a land assessment by TNC determined that much of Cataract Ranch remains in an undisturbed, natural state (TNC 2000, p. 1), and the general ecological conditions of the land are excellent (TNC 2011, p. 9). While the Fickeisen plains cactus remains vulnerable to being stepped on by cattle or horses, livestock grazing under the system used on Cataract Ranch is not a threat to the Fickeisen plains cactus and its habitat.

In summary, the majority of habitat for the Fickeisen plains cactus occurs in areas that have been grazed and will

continue to be grazed in the future. Grazing on Navajo Nations lands is largely unregulated. Although current grazing pressures across the range of the Fickeisen plains cactus are far below the levels of the late 1800s, the rangelands are still recovering from this past heavy grazing in many areas of the range of the Fickeisen plains cactus. Continued grazing on the BLM and Navajo Nation during the prolonged drought in the late 1990s and local droughts in the 2000s has added to rangeland deterioration and changes to the vegetation community. While changes in seasonality, timing, and intensity of grazing have been implemented on the Arizona Strip to improve rangeland conditions from past use, the warmer and drier climate is compounding recovery of the grasslands that support habitat for the Fickeisen plains cactus.

Long-term monitoring has documented direct mortality to the Fickeisen plains cactus from livestock grazing. More plants on the BLM lands have likely been killed or damaged from trampling, but for which the effects have not been captured during the monitoring period. While trampling occurs infrequently, it has removed adult individuals from the population and contributes to population declines exacerbating the effects of small population size (see *Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence section*). We recognize that in some areas occupied by the Fickeisen plains cactus, livestock grazing in combination with other factors appears to be contributing to the decline of the cactus and low recruitment. In other occupied areas, livestock grazing and the Fickeisen plains cactus coexist and the populations have a diverse age-class and are reproducing. The differences between areas experiencing population declines and those with reproducing populations may be due to the intensity, timing, and other factors of livestock grazing management. Thus, livestock grazing, in and of itself, may not rise to a population-level threat for the Fickeisen plains cactus, but when combined with additional stressors such as drought and climate change, and rodent and rabbit predation (discussed below), the combined effect is producing population-level impacts to the Fickeisen plains cactus. Therefore, we conclude that livestock grazing, in conjunction with other factors, is a threat to the Fickeisen plains cactus and its habitat.

Nonnative, Invasive Plant Species

A potential threat to the Fickeisen plains cactus and its habitat is nonnative, invasive species. The spread of nonnative, invasive species is considered the second largest threat to imperiled plants in the United States (Wilcove *et al.* 1998, pp. 608–609). Nonnative, invasive plants—specifically annuals—negatively affect native vegetation, including rare plants. One of the most substantial effects of nonnative plant invasion is the change in vegetation fuel properties that, in turn, alter fire frequency, intensity, extent, type, and seasonality (Menakis *et al.* 2003, pp. 282–283; Brooks *et al.* 2004, p. 677; McKenzie *et al.* 2004, p. 898). The resulting unnaturally shortened fire-return intervals make it difficult for native plants to reestablish or compete with invasive plants (D'Antonio and Vitousek 1992, p. 73). Invasive plants can also exclude native plants through competition for space, soil nutrients, moisture, and light, and by altering pollinator behaviors (D'Antonio and Vitousek 1992, pp. 74–75; DiTomaso 2000, p. 257; Traveset and Richardson 2006, pp. 211–213; Cane 2011, pp. 27–32).

Nonnative, invasive annual species have been identified as potential future threats to other *Pediocactus* species due to their ability to deplete available soil moisture, particularly during the early spring growing season, and causing the habitat to be at risk of a fire when the habitat is not historically fire adapted (USFWS 2007, p. 5; Spence 2008, p. 5; USFWS 2008, pp. 13–14). Due to these concerns, nonnative, invasive species may also be a potential threat to the Fickeisen plains cactus and its habitat.

On the Arizona Strip, the BLM identified 15 nonnative, invasive species which occur; five of these species are listed by the State of Arizona as noxious weeds (BLM 2007a, pp. 3–34; NRCS 2009, entire). These five are: *Acroptilon repens* (Russian knapweed), *Alhagi maurorum* (camelthorn), *Centaureau diffusa* (diffuse knapweed), *Halogeton glomeratus* (halogeton), and *Onopordum acanthium* (scotch thistle). In addition, the species *Taeniatherum caput-medusae* (medusahead) is a species of concern, and the species is moving into the region from the north and may occur on the Arizona Strip in the future. Three additional nonnative, invasive species that occur on the Arizona Strip include *Bromus tectorum* (cheatgrass), *B. rubens* (red brome), and *Centaurea melitensis* (Malta starthistle). With the exception of Medusahead, these nonnative, invasive species are also found on the Kaibab National Forest (USFS 2005, pp. 16–17). On the Navajo Nation, red brome and *Erodium cicutarium* (red filaree) have been observed in Fickeisen plains cactus habitat (Roth 2007, p. 2). Nonnative, invasive species found on the Coconino Plateau and which may occur within Fickeisen plains cactus habitat include cheatgrass and *Salsola tragus* (Russian thistle) (Thomas et al. 1998, p. 43).

Cheatgrass is the most widespread nonnative, invasive annual within the range of the Fickeisen plains cactus followed by red brome and redstem filaree. Cheatgrass is an erect winter and spring annual grass from Europe and is a prolific seed producer. Red brome can dominate a landscape by emerging prior to native annuals in response to early season precipitation events (Salo 2004, p. 293). It is known to deplete soil water faster and at greater depths than native annual species (Brooks 2009, p. 118). If already present in the vegetative community, cheatgrass and red brome increase in abundance after a wildfire, increasing the risk for more frequent wildfires on the landscape (D'Antonio and Vitousek 1992, pp. 74–75). In addition, cheatgrass invades areas in response to surface disturbances (Hobbs and Huenneke 1992, pp. 324–325, 329, 330), in which density is correlated with the availability of bare soil for germination, rather than the number of seeds produced (USFS 2005, p. 63). Additionally, livestock have been implicated in spreading nonnative, invasive species such as cheatgrass and red brome, although we do not know the extent to which livestock contribute to the spread of these two grasses. Both cheatgrass and red brome are likely to increase in quantity and distribution due to climate change (see ''Drought and Climate Change'' discussion, below) because these species increase biomass and seed production at elevated levels of carbon dioxide (Smith *et al.* 2000, pp. 80–81; Ziska *et al.* 2005, p. 1328). Seeds of redstem filaree can also be prolific following wet winters and remain viable in the soil for years. Redstem filaree can rapidly form dense ground cover, crowding out native species, and competing with them for soil moisture and nutrients.

We have very limited information on the distribution and density of cheatgrass, red brome, and redstem filaree in respect to Fickeisen plains cactus populations. The BLM identified general locations where noxious weeds are found on the Arizona Strip (BLM 2007a, Figure 3.12). Based on the identified areas, noxious weeds appear to be in the vicinity of, or within, Fickeisen plains cactus habitat, although the specific information identifying which species and their densities or abundance are unknown. In House Rock Valley, the GCT identified 34 nonnative, invasive species during

their baseline ecological assessment of Kane Ranch, with cheatgrass being the most widely distributed (Sisk *et al.* 2012, p. 59). Sisk *et al.* (2012, pp. 61–63) developed a preliminary computer model of cheatgrass occurrence based on 606 random vegetation plots (baseline assessment plots) for the Kane and Two Mile Ranches in 2005. Preliminary results from the model predicted a low to moderate (25 to 35 percent) probability of cheatgrass occurrence in occupied areas near North Canyon Wash and along Marble Canyon, but a high probability (greater than 65 percent) of a cheatgrass occurrence near the Beanhole Well population. There is a potential for cheatgrass to spread into Fickeisen plains cactus populations by means of a wildfire. There is also the potential of cheatgrass to facilitate or provide the right conditions for another nonnative, invasive species to thrive within Fickeisen plains cactus habitat and negatively impact the plant.

On the Kaibab National Forest, cheatgrass was not observed in occupied Fickeisen plains cactus habitat at South Canyon. Small pockets of cheatgrass are located within a quarter mile from the rim of South Canyon with a potential for it to spread into occupied habitat if the area is burned from a wildfire in the future. However, there is minimal ground cover or low fuel load along the rim of South Canyon and little ground disturbance due to the isolation of the area. Therefore, the potential fire risk along the rim of South Canyon is considered to be low. If a wildfire were to ignite in the vicinity of the Fickeisen plains cactus and cheatgrass invades, then control measures would be taken to ensure cheatgrass does not move into occupied habitat.

On the Navajo Nation, past and present botanists have expressed differing opinions on whether nonnative, invasive species are having an impact on the Fickeisen plains cactus. Roth (2005, p. 1) observed high densities of red brome and redstem filaree in Fickeisen plains cactus habitat during a wet spring season in 2005 in which she found more cacti in places with fewer nonnative, invasive plants. She hypothesized that low recruitment may be related in part to the invasion of red brome, cheatgrass, and redstem filaree. These nonnative, invasive species dominate the habitat during wet years (Roth 2008, p. 4; Roth 2011, pers. comm.), but impacts on the germination and establishment of Fickeisen plains cactus seedlings are unclear and warrant more study. More recently, the Navajo Nation recognizes that redstem filaree and red brome become abundant in some parts of the cactus' range on the Nation during the spring growing season that is unusually wet. However, they feel no data currently supports a negative correlation between abundance of exotic annual species and declines in the Fickeisen plains cactus (NNDFW 2013, p. 14). The effects that red brome and redstem filaree may have on the cactus or the underlying mechanisms they may have within the native vegetation community or the cactus itself have not been investigated.

The threat of fire from nonnative, invasive species may be localized to areas where the Fickeisen plains cactus is found in dense grasses, such as those populations in Mohave County (Mainstreet Valley). A range fire could easily impact or eliminate one or all populations in the Mainstreet Valley and Hurricane Cliffs area and degrade Fickeisen plains cactus habitat to the point that it will no longer be suitable for the plant. The loss of one of these populations and associated suitable habitat would be a significant loss to the plant when considering its small population size and wide but disjunct distribution. The Fickeisen plains cactus populations in Coconino County occur on canyon rims, terraces, or in gravelly soils with sparse vegetation, thereby occupying sites with a low fuel source. Lacking sufficient information on the distribution of nonnative, invasive species to areas occupied by the Fickeisen plains cactus, it is difficult to approximate the likelihood of the cactus being adversely affected by wildfires caused by litter derived from nonnative, invasive annuals. Due to its diminutive size, the Fickeisen plains cactus likely would be killed from a wildfire. Monitoring of the Kaibab plains cactus exposed to different fire intensities indicated high-intensity fires resulted in plant mortality (Warren *et al.* 1992, abstract). Evidence also suggests that invasion and dominance of cheatgrass following a past fire may have contributed to the decline or loss of some Kaibab plains cacti in the House Rock Valley (USFS 2007, p. 47), suggesting that fire could impact the Fickeisen plains cactus in a similar manner.

We acknowledge the amount of peer-reviewed literature describing the negative effects nonnative, invasive species have on native plants, including rare plants. However, we do not have sufficient information that describes the direct and indirect effects cheatgrass, red brome, and redstem filaree have on the Fickeisen plains cactus or how their presence and distribution contribute to the decline in the Fickeisen plains cactus. The habitat of the Fickeisen plains cactus is not homogenous in that some populations are in dense grass where nonnative, invasive plants may be more prevalent or at risk to invasion while other populations are located in gravelly soil near canyon rims that have sparse vegetation. Moreover, while some of the Fickeisen plains cactus habitat may be more susceptible to impacts posed by nonnative, invasive grasses, few or none have been observed in occupied areas at South Canyon and on the Babbitt Ranches. As previously mentioned, little is known about nonnative, invasive species on the remaining 14 populations on the Navajo Nation who manages for a large number of Fickeisen plains cacti. Cheatgrass and redstem filaree have been documented in contributing to the decline of other listed plant species indirectly. Indirect competition includes increase in litter accumulation that altered the soil condition and enabled other nonnative, invasive plants to invade and increased siltation, distribution of seed and loss of microphyltic plants (Rosentreter 1994, pp. 170–175).

In summary, nonnative, invasive species such as cheatgrass, red brome, and redstem filaree grow rapidly and are prolific seed producers in wet years. At this time, we lack site-specific information on the abundance, density, and distribution of nonnative, invasive species in relation to Fickeisen plains cactus populations and evidence of the cactus being negatively affected by exotic species. Landowners also have conflicting opinions on whether nonnative, invasive species are impacting the cactus because of the direct lack of evidence, differing land management practices, and/or existing vegetation conditions. We know that, in general, they occur in varying densities within or near some Fickeisen plains cactus populations or within its habitat. We acknowledge that nonnative, invasive species are stressors on the landscape within the range of the Fickeisen plains cactus. Ample evidence documents the adverse effects cheatgrass, red brome, and redstem filaree pose to native species and native pollinators. With climate change, we anticipate that the density of these species will increase in the future and negatively impact the Fickeisen plains cactus, but we lack sufficient information that these nonnative, invasive species are contributing to the decline of the Fickeisen plains cactus either directly or indirectly. Additionally, we do not have information to find that high densities of cheatgrass, red brome, and redstem filaree would increase the risk of fire in Fickeisen plains cactus habitat

rangewide. Therefore, we conclude that nonnative, invasive species are not a threat to the Fickeisen plains cactus at this time.

Uranium Mining

High-quality uranium ore deposits are found on the Arizona Strip and on the Coconino Plateau. Interest in the region's uranium deposits increased in 2008, as the price for uranium ore rose, and applications for new mining claims were sought on public lands surrounding the Grand Canyon. In response, the Secretary of the Interior signed Public Land Order Number 7787 (PLO 7787) effectively withdrawing 407,335 ha (1,006,545 ac) of Federal mineral estates within three parcels from any individual or company making a new mining claim under the Mining Law of 1872 (30 U.S.C. 22 *et seq.*) for a 20-year period (BLM 2012a, pp. 1–4). Existing locatable mineral operations in the withdrawal area will continue to be managed under the current Federal land agency regulations.

Notices of intent or plans of operations submitted after the effective date of the withdrawal for mineral exploration or development on BLM and National Forest System lands on claims pre-dating the withdrawal would not be able to proceed unless the mining claim was determined to be valid under the Mining Law of 1872 as of the date of the segregation from new mining claims (July 21, 2009). Sampling may still occur on claims pre-dating the withdrawal to support the mineral examination. In the event the claims are determined to be valid, mining activities could occur at some point in the future (BLM 2011a, p. 2–14).

There are two Fickeisen plains cactus populations in two parcels of the withdrawal area boundary. The North Canyon population and the South Canyon population on the Kaibab National Forest are in the East parcel; the Sunshine Ridge population is in the North parcel (BLM 2011a, Figure 3–8.1). The mineral withdrawal essentially removed the potential for negative effects on the Fickeisen plains cactus and its habitat that would be associated with the location and development of new mining claims for the longevity of PLO 7787. If the development of existing valid mining claims in the East parcel were to proceed, we anticipate that the potential for adverse effects from development of a mine to the Fickeisen plains cactus along the North Canyon wash on the Arizona Strip would be low. This is primarily due to plants growing on limestone soils along ledges and canyon rims where mineral activity would not likely occur.

On the Kaibab National Forest, lands in the Grand Canyon National Game Preserve were withdrawn from locatable mineral entry in 1906 when the Preserve was designated (BLM 2012a, p. 2; USFS 2013a, p. 48). The Grand Canyon National Game Preserve is available for saleable and leasable mineral development on a case-by-case basis where the purpose is consistent with the management of the Preserve. The Kaibab National Forest has proposed to implement a guideline in their revised Land and Resource Management Plan that use and occupancy should be restricted yearlong in areas supporting populations of threatened, endangered, and sensitive plant species (USFS 2013b, p. 2).

On the North Parcel, there are six mines surrounding the Sunshine Ridge population (BLM 2011a, Figure 2.4–2). Two mines (Hack Canyon and Hermit mines) are located in close proximity to the Sunshine Ridge population but are currently in reclamation status and no impacts to the Fickeisen plain cactus are anticipated. Three mines (Arizona 1, Kanab North, and Pinenut) have an approved plan of operation and pre-date the withdrawal. All three are located well outside of occupied Fickeisen plains cactus habitat. The Arizona 1 mine has been operating since late 2009 (BLM 2012b, p. 6), and no impacts to the plants have been documented by the BLM. It is expected to cease production and enter into reclamation in late 2013 (Florence 2013, pers. comm.). The Pinenut mine is scheduled to begin operations in 2013, but due to its distance from the Sunshine Ridge population, no impacts are anticipated. The Kanab North mine has started initial reclamation activities, which include removal of buildings or structures as of the summer of 2013 (Florence 2013, pers. comm.). The sixth mine, EZ Mine, is located to the west of the population. Development of the mine has not started and is not expected to happen until at least 2016 or longer.

The potential direct and indirect effects to the Fickeisen plains cactus would be the loss, removal, or injury of plants and loss of habitat from the development of the mine but also habitat degradation or fragmentation from road construction, material transport, and new power lines (Payne *et al.* 2010, pp. 8–9; BLM 2011a, p. 2–15). The BLM, however, will complete a project-specific environmental analysis in the near future to develop a plan of operations (BLM 2011a, pp. 2–29—2–30). We anticipate the opportunity to work with BLM and discuss any potential negative impacts that may occur from this mine on the Fickeisen plains cactus at that time. In addition, the North Parcel has seven breccia pipes that are confirmed to have uranium resources, and those uranium resources have been estimated (BLM 2011a, pp. 3–35—3–36; BLM 2012b, p. 7). Any mining claim containing these seven breccia pipes would be able to demonstrate valid existing rights and would be mined. If one of the claims were to be developed into a mine, the BLM would take measures to minimize impacts to the Fickeisen plains cactus, such as conducting preconstruction surveys to flag avoidance areas and minimize impacts to the species (BLM 2007b, pp. 74–76).

Lands on the Arizona Strip that are outside of the withdrawal area boundary are open to uranium mineral development (BLM 2008a, pp. 1–20). Because the Fickeisen plains cactus occurs in small, isolated areas on particular soil types, small disturbances to the vegetation and soils may reduce suitable habitat; increase the erosion potential; enable invasion of nonnative, invasive plants; and increase the risk of mortality from clearing, crushing, or trampling associated with developing mining sites (Service 2007a, p. 90; BLM 2011a, p. 4–154). The BLM anticipates a very low likelihood that any such project would be proposed within the habitat of the Fickeisen plains cactus. If such a project is proposed, the BLM would take measures to minimize impacts to the Fickeisen plains cactus as described above (BLM 2007b, pp. 74–76).

On the Coconino Plateau, just south of the Grand Canyon National Park, there is a continued interest in uranium mining on State land. The company VANE Minerals holds mineral rights (or mineral interest to mine uranium) on a large number of properties that are spread over an area of approximately 16,187 sq km (6,250 sq mi) (VANE Minerals 2012) and that include occupied Fickeisen plains cactus habitat on State land within the Cataract Ranch. The company has completed surface drilling for their Wate Uranium Breccia Pipe—located 9 miles south of the Grand Canyon National Park and near the Hualapai Indian Reservation. The company is pursuing a mineral lease from the Arizona State Land Department for uranium exploitation of the Wate deposit and for preliminary efforts regarding development of the mine. No Fickeisen plains cactus has been documented in this general area; therefore, the plant would not be affected by development of a mine.

Exploration drilling has been conducted for 12 additional uranium mineralized breccia pipes that are

located within 32 km (20 mi) of the Wate deposit (SRK Consulting 2011, p. 14–1). No mineral resources for these have been established as of 2011, but if a uranium resource is confirmed, a potential exists for a mine to be developed. If that occurs and depending on location information, there is a potential for construction and operations to impact some Fickeisen plains cactus on State land within Cataract Ranch. Direct and indirect impacts would be the same as those identified for the Sunshine Ridge population. However, any development, including mining and associated roads from State land that would need to cross onto land in the Cataract Natural Reserve Land, would be prohibited.

Additionally, the Arizona State Lands Department issued two mineral closure orders for land surrounding the rims of Cataract Canyon that total 65,644.72 acres (Williams 2013, pers. comm.). Closure order 551–86/87 became effective December 30, 1986, by issuance of the State Land Commissioner. This order closes State trust land to mineral location and mineral prospecting permit application (mineral claim location, new mineral prospecting permit applications, and new mineral lease applications). Closure 251–2010/2011 became effective June 27, 2011, and closes State subsurface lands that were not included in the prior closure order. The 2010/2011 order closes State subsurface land to mineral claim location, new mineral exploration permit applications, and new mineral lease applications. Both orders do not close the land to renewal applications for exploration permits. They remain in effect until further order of the State Land commissioner. All of the known Fickeisen plains cacti on State land are located within the mineral closure order areas. Unless an interested applicant locates a mineral resource, we do not anticipate impacts to the Fickeisen plains cactus from mineral exploration as most of the techniques can be done without causing ground disturbances. If a mineral deposit is located, the applicant must apply for a mineral lease, which includes a pre-construction Native Plant survey prior to any surface disturbance. The purpose of the Native Plant Survey is to calculate the compensation that must be paid to the State for the removal of specific cacti, succulents, trees, shrubs, and sub-shrubs, including ''highly safeguarded protected'' plants. If the Fickeisen plains cactus is within the construction area, the State would not deny a mine based on its presence or that of any listed plant. The State would likely write allowances into the mineral lease or mining company's reclamation plan to require preservation measures or mitigation for listed plant species (ASLD 2013). For all of this to happen, it would require the mineral closure order to be lifted and a discovery of a mineral resource. Because the 551–86/87 closure order has been in effect for over 25 years, we anticipate that they will remain in effect in the near future.

In summary, PLO 7787 effectively withdrew over 407,335 ha (1,006,545 ac) of federal mineral estates for a 20-year period; this action removes the immediate threat of habitat loss or degradation associated with development of new uranium mines to the Fickeisen plains cactus populations at Sunshine Ridge and in House Rock Valley. Populations on the North Kaibab Ranger District would not be impacted by mineral development as they are located in areas that were historically withdrawn from mineral location and entry. We acknowledge the possibilities that valid existing mining claims in the withdrawal area boundary could result in the development of a uranium mine in the future and result in adverse impacts to the Fickeisen plains cactus on BLM lands, though these two populations occur near canyon rims and are less likely to be adversely affected.

For land on the Arizona Strip that is outside of the withdrawal boundary area, we anticipate a low probability that Fickeisen plains cactus populations would be impacted by future uranium development. If a mine were to be developed near occupied habitat, the BLM would implement avoidance measures to reduce or minimize impacts to the Fickeisen plains cactus, which we anticipate would be incorporated into their analyses for the development of the EZ Mine. On State land, the potential for uranium mining could result in direct mortality and loss of habitat within the Cataract Canyon population. However, most plants on State land are located in close proximity to the rim of Cataract Canyon and occur in areas included in the mineral closure order. As discussed above, these plants would not likely be affected by construction or development associated with uranium extraction. Additional protection to the plant is provided through the terms of the conservation easement on the private parcels, which prohibits any new development, including construction of any new roads or right-of-ways from State lands crossing onto private lands.

Therefore, based on the best scientific and commercial data available, we do not anticipate that development of a uranium mine would rise to the level of significance and meaningfully impact the Fickeisen plains cactus and its habitat. Thus, we conclude that uranium mining is not a threat to the Fickeisen plains cactus or its habitat.

Road Construction and Road Maintenance

Roads can destroy or modify habitat and increase human access that may lead to trampling (discussed below). Additionally, road construction can lead to increased erosion, and vehicle traffic on unimproved roads can result in increased atmospheric dust and dust deposition on vegetation. Road maintenance on U.S. Highway 64 near the Navajo Nation resulted in three Fickeisen plains cacti being salvaged from the existing right-of-way and a fourth cactus protected by fencing (Arizona Department of Transportation 1992, p. 1). Road maintenance also contributed to an unknown amount of habitat loss or disturbance, which was likely small in size.

We analyzed road maintenance and considered it a potential threat to the Fickeisen plains cactus in the November 9, 2009, Candidate Notice of Review (74 FR 57804). On the Arizona Strip, the Fickeisen plains cactus occurs next to roads that receive routine maintenance. The cactus grows close to and, in some cases, in the middle of existing unpaved but well-maintained roads, making it highly vulnerable to becoming crushed or injured by motorized vehicles. Road maintenance activities had resulted in the mortality of a few individuals of the Fickeisen plains cactus on BLM land. These appear to have been isolated occurrences that happen infrequently and impacted a small number of individual plants. Future road construction associated with both uranium and urban development may impact plants that occur on non-BLM lands. However, future road construction is anticipated to be localized in time and space and would not rise to the level of becoming a significant threat to the Fickeisen plains cactus. Therefore, we do not consider road construction and road maintenance to be a threat to the Fickeisen plains cactus.

Off-Road Vehicle Use and Recreation

Off-road vehicles are a means of transportation and a form of recreation in the range of the Fickeisen plains cactus. On the Arizona Strip, the BLM limits motorized and mechanized vehicle use within Fickeisen plains cactus habitat to existing routes and trails. However, motorized vehicles may pull off a designated route up to 30.5 m

(100 ft) on either side of the centerline to camp. There is the potential for vehicles to injure or kill a Fickeisen plains cactus and impact its habitat by pulling off the roadway to park or turn around (BLM 2007b, p. 75). Plants growing along the Navajo Trail near Mainstreet Valley have been affected by drivers pulling off designated routes in the past (Hughes 2005, pers. comm.). Disturbance from ORV use associated with unauthorized camping was documented in House Rock Valley, where a driver drove off-road toward the canyon rim near the South Canyon population (Service 2007b, p. 1). These are the two documented reports that we have of the Fickeisen plains cactus being impacted by ORV use on BLM lands since 2005. In reviewing the BLM's monitoring reports, there were no documented mortalities of Fickeisen plains cactus associated with ORV use over the 23 years the plant was monitored.

Most of the Fickeisen plains cactus habitat on the Navajo Nation is accessible by dirt two-track roads. Although traffic in these areas is light and there is an extensive network of existing dirt roads, new roads are continually being created, presumably by locals herding livestock (NNHP 2011a, p. 1). No plants have reportedly been impacted, but there is potential for habitat degradation as a result. In addition, 9 of the known 15 populations are located along the scenic canyon rims of Marble Canyon and the Little Colorado River gorge, where tourist traffic is concentrated. Car tires and foot traffic have been documented as damaging the Fickeisen plains cactus at some of these sites (NNHP 1994, p. 5; NNHP 2011a, p. 1). These impacts are likely to increase in the future as there are future plans to develop tourist activities on Navajo land near Marble Canyon and the Little Colorado River gorge (NNHP 2011a, p. 1).

On the Cataract Ranch, increased recreation, primarily associated with hunting, has been observed since 2006. Hunting practices often rely on the use of ORVs to retrieve wildlife and access camp sites. However, no impacts to the Fickeisen plains cactus related to recreational activities or ORV use have been observed while conducting searches for the plant on the Cataract Ranch (Goodwin 2011a, p. 8).

In summary, the habitat of the Fickeisen plains cactus is mostly open with flat topography. With most plants growing along scenic canyon rims, there is an increased risk of plants being destroyed or damaged by vehicles driving off-road for recreational purposes. We identified ORV use as a potential threat to the Fickeisen plains cactus in our annual assessment for candidate species (most recently at 75 FR 69222, November 10, 2012). At this time, however, we cannot quantify the extent of ORV use impacts on the taxon or its habitat, but they continue at some unknown level. Most documented occurrences happened in the past and were isolated occurrences. ORV use may become a threat to the Fickeisen plains cactus in the future, but, at this time, we do not consider it to be a threat to the plant or its habitat.

Commercial Development

The Navajo Nation is currently interested in developing its land along the canyon rims of Marble Canyon and the Little Colorado River gorge to increase tourism and create more jobs that would boost their local economy (NNHP 2011a, p. 1; Navajo-Hopi Observer 2012). The Navajo Nation President recently signed a nonbinding agreement with a local Arizona developer that lists a resort hotel and spa, restaurant, half-mile river walk, and recreational vehicle park among the attractions that would enable tourists to easily descend into the Grand Canyon. While we do not have specific information about these plans, development along the rim of the Little Colorado River has the potential to impact the Salt Trail Canyon population located nearby. Trampling of plants by people and loss of plants and habitat to make way for development are both of concern. Available information suggests that plans for the proposed development have not begun (NNHP 2011a, p. 1) and may still be in the early design phase.

The Salt Trail Canyon is a known recreational site located to the north of areas occupied by the Fickeisen plains cactus. Aside from use by hikers, the area is used by Federal and State agencies as a point of entry to conduct native fish surveys in the Little Colorado River. Overall use of the area appears to be minimal, and no recreational impacts to the Fickeisen plains cactus have been observed.

A popular tourist destination that has existed for many years occurs within occupied Fickeisen plains cactus habitat that is adjacent to a Little Colorado River overlook. This population was last visited in 1997, and contained 15 plants distributed among 2 ridges (NNHP 2011a, p. 4). The Navajo Nation Heritage Program identified abundant foot traffic within occupied habitat as a threat to the Fickeisen plains cactus located there. Although the tourism at this site will continue in the future, most foot traffic is confined to paved sidewalks leading toward the canyon rim and outside of occupied habitat. An additional area occupied by the Fickeisen plains cactus occurs east of the overlook area that is also well known among plant enthusiasts and, consequently, is frequently visited (NNHP 1994, p. 5). This population was last visited in 1999, and one individual was located (Table 1). The timing of the visit was outside of the flowering season, making it difficult to locate plants (NNHP 2011a, p. 4). Both of these areas are easily accessible from the highway and receive a large number of visitors. Trampling of plants and habitat disturbance associated with tourism may increase in the future simply due to the popularity of this site and the accessibility of plants next to the highway. Although habitat disturbances to the Fickeisen plains cactus have occurred here in the past and may be occurring presently, we have no information to be able to quantify this threat.

Human development could expand into or next to the Fickeisen plains cactus habitat on the Navajo Nation. A land dispute between the Navajo and Hopi Tribes resulted in the implementation of a construction ban in 1966 that limited development (Maxx 2012, p. 2). That ban was lifted in 2009, but no development has occurred due to the poor economy. The land has remained mostly undeveloped, but the ability to construct new homes or make improvements provides tribal members access to areas previously restricted. If this occurs, we do not anticipate the Fickeisen plains cactus to be significantly impacted because new home locations would not be near the canyon rim where the plant occurs. Additionally, the Fickeisen plains cactus is listed as a Group 3 species on the Navajo Endangered Species List, which is a species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the near future (NNDFW 2008, entire). Its listed status on Tribal land, in addition to the location of the Salt Trail Canyon population within an area designated as a Preserve, would likely reduce or minimize impacts to the population (see *Factor D. The Inadequacy of Existing Regulatory Mechanisms,* below).

In addition to urban development, some of the land surrounding the town of Gray Mountain is currently opened to oil and gas leasing. The BLM proposes to lease, through competitive lease sale, four parcels that total 3,596 ha (8.887 ac) of split estate lands for the purpose of oil and gas exploration and development. The parcels are located on both sides of Highway 89 and include 3,343 ha (8,263 ac) of surface lands

administered by the State of Arizona, and 252 ha (624 ac) of private holdings. The lease sale allows private individuals or companies to explore for and potentially develop oil and gas resources for sale on public markets. The Arizona State Office has received an Expression of Interest from an exploration company for consideration of competitive oil and gas lease sale (BLM 2013a, pp. 1–41). Some of the parcels that will be offered for lease sale occur on limestone soils that are suitable to support the Fickeisen plains cactus. A few scattered plants are known to occur nearby these parcels but the entire area has not been searched to confirm occupancy. Several requirements would have to be met prior to any oil and gas development. For instance, parcels that are located to the southeast of Highway 89 lack any access roads. Therefore, if a mineral resource was identified, the project proponent would be responsible for securing a right-of-way from the State and/or private landowners. The BLM has published an Environmental Assessment indicating no significant impacts from the leasing decision (BLM 2013b, pp.1–44). At this time, it would be too speculative to assess what impacts would occur to the Fickeisen plains cactus. Any future development of the lease would be analyzed by the BLM at the time of the site-specific Application for Permit to Drill. The BLM would be required to enter into a section 7 consultation if actions they authorize, permit, or carry out adversely affect a listed species.

In summary, commercial development for urban development and mineral development is planned within the range of the Fickeisen plains cactus. Commercial development associated with tourism activities has impacted Fickeisen plains cactus habitat. Impacts to occupied habitat near the Little Colorado River overlook were documented in the past and are ongoing. This population is small and would benefit from a current site visit. Plans for future commercial development near Marble Canyon and the Little Colorado River gorge may substantially impact the Salt Trail Canyon population through potential habitat loss or disturbance. Areas occupied at Salt Trail Canyon support one of the larger number of Fickeisen plains cactus on the Navajo Nation and rangewide. Losses of individuals at Salt Trail Canyon would result in further declines to the rangewide population. However, the protected status of the Fickeisen plains cactus on the Navajo Nation Endangered Species List and its occurrence within a designated Preserve would serve to minimize or reduce potential impacts from future commercial development. In addition, we do not have any information to indicate whether plans to develop commercial properties will occur in the future. Therefore, the threat of commercial development is not impending, and we do not consider this a threat at this time or within the near future.

Drought and Climate Change

For background information, please refer to the first paragraph of the ''Drought and Climate Change'' discussion under *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range* in the Summary of Factors Affecting the Acuña Cactus. As previously discussed, the Fickeisen plains cactus is an endemic species that exists in isolated, small populations. In addition, the Fickeisen plains cactus is restricted to very specific geologic formations. Global climate change exacerbates the risk of extinction for species that are already vulnerable due to low population numbers and restricted habitat requirements. Predicted changes in climatic conditions include increases in temperature, decreases in rainfall, and increases in atmospheric carbon dioxide in the American Southwest (Easterling *et al.* 2000, pp. 2072–2073; IPCC 2007, p. 48; Archer and Predick 2008, pp. 23–24; Karl *et al.* 2009, p. 129). Although we have no information on how the Fickeisen plains cactus will respond to effects related to climate change, persistent or prolonged drought conditions are likely to reduce the frequency and duration of flowering and germination events; lower the recruitment of individual plants; compromise the viability of populations; and impact pollinator availability, as pollinators have been documented to become locally extinct during periods of drought (Memmott *et al.* 2007, pp. 713–715). The smallest change in environmental factors, especially precipitation, plays a decisive role in plant survival in arid regions (Jordan and Nobel 1981, pp. 904–905; Nobel 1984, pp. 310, 316).

In the last 30 years, the Colorado Plateau has experienced a 0.2 to 0.5 °C (0.36 to 0.9 °F) increase in average temperature, particularly in average fall-winter temperatures (Schwinning *et al.* 2008, p. 4). Future climate projections forecast increases in both the average and extreme temperatures that are expected to result in less available soil moisture for plants (Schwinning *et al.* 2008, p. 4). In addition, the Colorado Plateau may be shifting toward a climate of reduced winter precipitation over the next 20 to 30 years. Winter accumulation, which recharges the soil moisture needed for spring vegetative growth, was below average in 11 years from 1996 to 2007. Similarly, spring precipitation was below average in 8 years from 1996 to 2006 (Hereford 2007, p. 6). By 2090, precipitation is predicted to decline by as much as 5 percent across the Colorado Plateau, placing greater stress on native plants and resulting in a greater susceptibility of existing ecosystems to be replaced by nonnative, invasive plant species (BLM 2011b, entire).

The Fickeisen plains cactus is adapted to the semi-arid climate of the Colorado Plateau by retracting underground in response to dry and cold climatic conditions. Weather patterns, timing of precipitation, and cool nighttime low temperatures influence germination and seedling establishment of the Fickeisen plains cactus (Brack 2012, pers. comm.). If climate patterns move toward more aridity, the reproductive output of the Fickeisen plains cactus may be reduced. Increases in summer temperatures may lead to longer periods of time that the plant remains retracted underground, and temperatures may rise to a level that is beyond the plants' natural threshold for survival. Studies on cacti seedling survival have shown that seedlings are able to survive long periods of drought when they are larger and have the capacity to store enough water to endure their first dry season (Nobel 1984, p. 316). Seedlings of the Fickeisen plains cactus have been observed under mature plants, which act as nurse plants; the shading provided by a parent or nurse rock may increase their survival (NNHP 1994, p. 4). Increases in soil temperatures, however, coupled with below-average precipitation, may increase seedling mortality.

A study published in 2012 modeled the species' distribution of endemic plants on the Colorado Plateau (Krause and Pennington 2012, entire). It identified limiting factors that define the habitat needs of the species and the top-five predictor variables that influence their distribution. In level of importance, the model included the Fickeisen plains cactus' and ranked the minimum temperature of the coldest month second, precipitation of driest quarter third, and isothermality fourth in predicting Fickeisen plains cactus distribution (Krause and Pennington 2012, p. 140). Of emphasis was the variable isothermality, the mean day-to-night temperature range compared to

the annual temperature range, in predicting endemism on the Colorado Plateau. As nighttime low temperatures during the winter season are predicted to increase, isothermality or the reduction in daily temperature variance may hinder seedling germination for the Fickeisen plains cactus for reasons discussed above.

On BLM lands, observed trend information from the four monitoring plots appear to correlate with changes in climate patterns. Increases in plant numbers and observed seedlings were documented between 1986 and roughly 1992. These years were characterized as a wet period where the annual precipitation was above the regional median on the Colorado Plateau (United States Geological Survey 2002, p. 2). After 1992 through approximately 2005, when the region experienced a prolonged drought, the Fickeisen plains cactus among the plots experienced variable decreases in plant numbers. Monitoring of the Fickeisen plains cactus during years with below-average precipitation documented low recruitment, increased rodent predation, and an increase in the number of plants retracted or missing (Hughes 1988, p. 1; Hughes 1996c, p. 1; Roaque 2012, pers. comm.). In total, 817 plants were recorded as missing or retracted over the 13 years when this parameter was recorded. The years with the highest number of missing plants were from 1999 to 2007, the time period that corresponds to the drought in the Southwest. We do not believe all 817 missing plants are attributed solely to drought, but drought is likely a significant contributing factor to the observed decline in the number of individuals among Fickeisen plains cactus populations.

The Navajo Nation is in one of the driest areas in the southwest. About 45 percent of all annual precipitation occurs during the warmer months of July through September. Climate data are variable on the reservation, but long-term information shows a drying trend has occurred since 1944, and a warming trend has occurred since the mid-1970s (Navajo Times 2011). The drought in the Four Corners region was officially recorded from 1999 to 2009, although many residents believe it began in 1996, which would make it the longest drought in Navajo history. The effects of the last drought have been particularly extreme on the Navajo population. For example, from 2001 to 2002, Navajo officials reported 30,000 cattle mortalities from lack of water and forage. Many traditional people on the reservation live in subsistence lifestyles. Over half of the population lives without indoor plumbing and are dependent on hauling water. Their water supplies are derived from shallow aquifers and are sensitive to dry conditions. When availability is low, families often use water supplies intended for livestock (Redsteer *et al.* 2010, p. 2).

In interviews with 50 tribal elders, Redsteer *et al.* (2010, p. 7) summarized the most common observations regarding drought: (1) Long-term decreases in the amount of annual snowfall over the past century; (2) decline in surface water features and water availability; (3) disappearance of springs and of plant and animal populations; and (4) changes in the frequency of wind, sand, and dust storms. These have been corroborated with other findings. Weiss *et al.* (2009, p. 5923) found that a significant increase in evapotranspiration occurred during the warmer months of the 2000s drought due to higher temperatures. Above-average spring temperatures are likely linked to a decrease in the amount of new growth among plants. It has been suggested that warmer spring temperatures could lead to early germination. Plants respond by ending dormancy and begin using available soil moisture earlier and more quickly in the season. Then, they must survive longer dry periods before the start of the monsoons (Redsteer *et al.* 2010, p. 7).

Seasonal increases in temperature and changes in the timing of precipitation have likely influenced the observed 49 percent decline in the Salt Trail Canyon population. The observed low recruitment, high number of plants missing between years, and mortality can thus be partly attributed to the drought (NNHP 2011b, pp. 4–5). Corresponding with regional climate patterns, annual precipitation during the monitoring period was below average for each year except for 2007. Winter precipitation was uncommonly high during 2005, the year before the monitoring plots were installed, and in 2010, the year that the plots were not monitored. While several winter storms came through the region, total rainfall accumulation was still below average during the 2011 monitoring period. Many of the plants that could not be located in 2011 were assumed dead because their vigor during previous surveys was rated as ''poor'' in 2009 (NNHP 2011b, p. 3). Some of these plants may have been retracted at the time. However, many plants observed between 2008 and 2011 failed to produce fruit or flower, and fruit buds were observed to be aborted. This suggests low seed production, which would cause a decline in overall abundance over time.

In summary, the climate on the Colorado Plateau and Navajo Nation is predicted to become warmer with reduced precipitation in the future. We have strong evidence to suggest that the Fickeisen plains cactus is being impacted by drought coupled with increased annual temperatures. We believe that the high number of dead and missing or retracted plants in all plots monitored is influenced by below-average winter or spring precipitation at the time when plants need soil moisture to flower. Poor reproduction in the Fickeisen plains cactus is likely to worsen in the future if climatic patterns shift toward becoming more arid with increased winter nighttime temperatures. With climatic models predicting future regional droughts, it is likely that all populations of the Fickeisen plains cactus will continue to be affected by drought and climate change. However, it is not clear if drought or climate change, of themselves, present population-level threats of extinction. It appears that drought and climate change in combination with rodent predation (see *Factor C. Disease or Predation,* below), as a combined effect, is the more likely scenario for population-level impacts to the plant. Additionally, the small and declining populations of the Fickeisen plains cactus make the species susceptible to natural environmental variability, including climate conditions. Therefore, based on our review of the best scientific and commercial data available, we conclude that the effects of climate change and drought are threats that have significant impacts to the Fickeisen plains cactus and its habitat.

Summary of Factor A

Based on our review of the best scientific and commercial data available, we conclude that fire associated with nonnative, invasive plant species; uranium mining; road construction and road maintenance; ORV use; and commercial development are not threats to the Fickeisen plains cactus and its habitat. We conclude that direct loss of plants and habitat loss and modification due to the direct and indirect effects of livestock grazing and drought and climate change are threats to the Fickeisen plains cactus. These threats, in and of themselves, may not result in significant population-level impacts to the Fickeisen plains cactus. However, the above factors appear to be acting synergistically, placing a major stress on the known plants monitored rangewide with little indication of

population growth and age-class diversity. The populations for which we do not have reliable and current information on their status are likely in decline. These populations are also being impacted by drought and are also susceptible to the same level of threats as the monitored populations. Thus, the combined effects of each threat elevate the intensity and scope of impacts to the Fickeisen plains cactus and its habitat to where these threats are significant over time. Therefore, based on our review of the available information, we conclude that the present or threatened destruction, modification, or curtailment of the Fickeisen plains cactus habitat or range is a threat to the species.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Unauthorized collection is a potential threat for all species of cacti, but it is a specific and definite threat for the genus *Pediocactus.* Their small size, large attractive flower, and rarity make *Pediocactus* species in general highly sought by collectors, growers, or gardens (Benson 1982, p. 243). *Pediocactus* are difficult to grow and maintain in cultivation. As plants grown in backyard gardens die, there is more demand for replacement plants. Unauthorized collection is currently a continuing problem for populations of the threatened *Pediocactus winkleri* (Winkler cactus) in south-central Utah (NPS 2004, p. 1; Borthwick 2012, pers. comm.).

We identified unauthorized collection of the Fickeisen plains cactus as a potential threat in our 2006 Candidate Notice of Review (71 FR 53756) and as a minor threat in our 2010 Species Assessment and Listing Priority Assignment Form. Phillips *et al.* (1982, p. 5) considered the Fickeisen plains cactus to be highly sought after and collected by commercial cactus collectors or hobbyists wherever it was found. For the period 1994 to 1997, the Convention on International Trade in Endangered Species (CITES) annual report documented a total of 5 specimens and 5,015 seeds of Fickeisen plains cactus exported (Service 2001a, p. 4). However, we do not know what impact the unauthorized collection had on the Fickeisen plains cactus during that time. We are not aware of any evidence of unauthorized collection of the Fickeisen plains cactus within the last 10 years. The BLM and the Navajo Nation have not observed or documented incidences of Fickeisen plains cacti being collected on their lands. In addition, we do not have information from the Arizona Native Plant Division indicating that unauthorized collection of Fickeisen plains cactus from their natural habitat has occurred (Reimer 2012, pers. comm.). If it has occurred, apprehension of collectors or enforcement of the law is difficult for *Pediocactus* species considering they occur in remote areas that are not regularly patrolled.

Currently, collection pressure on the Fickeisen plains cactus and demand for plants in the wild appears to be low for several reasons. Over the past 20 years, there has been increased sensitivity toward collection of rare plants from their natural populations among collectors who are satisfied with taking photographs rather than live specimens (Brack 2005, pers. comm.; Brack 2012, pers. comm.). Secondly, the Fickeisen plains cactus has been difficult to grow in cultivation mainly because of its specificity to particular climate conditions (cold winter temperatures) (Brack 2012, pers. comm.). However, more experienced growers have successfully propagated seeds and grown seedlings in captivity. Growers in Europe have successfully grown the Fickeisen plains cactus in cultivation because their climate is similar to that of the Colorado Plateau (Brack 2012, pers. comm.). Currently, the Fickeisen plains cactus is available from commercial vendors who can meet the market demand for this rare plant which has helped alleviate collection pressures. Seeds of the Fickeisen plains cactus are also readily available for sale on the Internet to cactus hobbyists. If evidence of unauthorized collection becomes available or there is information suggesting that the cactus is at risk, we will address prevention measures and conservation through the recovery planning process.

In summary, unauthorized collection is a threat for some *Pediocactus* species and a potential threat for the Fickeisen plains cactus. We acknowledge that illegal collection may occur but go undiscovered due to lack of reporting or enforcement. Based on the best scientific and commercial data available, no evidence at this time suggests that overutilization of the Fickeisen plains cactus for recreational, scientific, or educational purposes has occurred or is presently occurring such that it negatively affects individuals or populations of the Fickeisen plains cactus within its range. We also do not have evidence to suggest that overutilization of the Fickeisen plains cactus is likely to occur in the future to such an extent that the survival of the taxon would be compromised. We conclude that overutilization for commercial, recreational, scientific, or educational purposes would not rise to the level of significance and meaningfully impact the Fickeisen plains cactus and its habitat. Therefore, overutilization for commercial, recreational, scientific, or educational purposes is not considered to be a significant threat to the Fickeisen plains cactus at this time nor do we expect it to be in the future.

Factor C. Disease or Predation

We are not aware of any diseases impacting the Fickeisen plains cactus. Therefore, we do not consider disease to be a threat to the Fickeisen plains cactus.

Insect Predation

Insect predation by flightless beetles in the genus *Moneilma* are common among cactus species in the southwest. The species *Moneilma semipuctatum* that is referred to as the cactus borer beetle is common in northern Arizona and New Mexico. It typically prefers plants in the genus *Opuntia* as its host but it will also use plants in the genus *Sclerocactu*s and *Pediocactus* as well, in which mortality of these species has been reported (Roth 2004, p. 6; USFWS 2007, p. 4). The adult females deposit eggs at the base of the cactus and, after hatching, the larvae burrow into and feed on the plant depositing an orange-red fecal material around the wound. Kass (2001, pp. 495–496) found that the cactus borer beetle appears to select for larger, reproductively mature cacti and infestation will lead to collapse and mortality of the plant. There is one report of insect predation to a Fickeisen plains cactus that was possibly caused by the cactus borer beetle. In 1991, the Navajo Nation had found a large mature plant in the Shinumo Altar population that was retracted and yellow-green in color. When the plant was removed, it had a large hole bored through its caudex (base) with a small amount of orange-red material around the caudex (NNHP 1994, p. 3). Similar damage had been seen on the *Sclerocactus mesa-verde* (Mesa Verde cactus) in New Mexico that helped to identify the cause of the injury. No other land managers have reported observing signs of similar damage to a Fickeisen plains cactus by a cactus borer beetle.

Rodent and Rabbit Predation

Small mammal herbivory on cactus species is known to occur during dry conditions when animals seek available moisture from the plant or available food from cactus fruit (Butterwick 1987, p. 3; Phillips and Phillips 2004, pp. 14–15; Sivinski and McDonald 2007, p.

104). Because of their small size and spongy spines, the Fickeisen plains cactus may be less protected from animals than other spiny cactus species. Herbivory, primarily by rodents, on the Fickeisen plains cactus has been reported only on BLM lands; however, it likely occurs throughout the range.

The BLM reported a total of 56 plant mortalities associated with rodent predation in the years 1988, 1989, 1990, and 1992. All of the four plots have had reported rodent predation. The greatest losses were reported at Dutchman Draw plot, with 21 plants lost between 1988 and 1990 (Hughes 1988, p. 2; Hughes 1989, p. 2; Hughes 1990, p. 2), and 26 plants at the North Canyon plot in 1992 (Roaque 2012, pers. comm.). Correspondingly, the winter-spring precipitation in 1992 was below average. Small mammal burrows have been observed at the Dutchman Draw, Clayhole Ridge (Robertson 2011, p. 1), and South Canyon (Travis 1987, p. 4) populations. During the 2012 monitoring period, Hughes (2012a, p. 6) observed ground squirrel burrows underneath the cactus at the Sunshine Ridge population. While no mortalities from rodent predation were recorded, 28 plants were missing or retracted. Hughes noted that the Sunshine Ridge area was very dry during the spring, which, in addition to ground squirrels, probably contributed to the high number of missing/retracted plants. We do not have information about the small mammal burrows found in the Arizona Strip populations. Moreover, Hughes (1996a, p. 51) believed that heavy cattle grazing may in some part contribute to high incidences of rodent predation through competition for available forage, particularly during periods of drought that, in turn, cause rodents to eat the cactus. While the relationship between drought and small mammal predation is less obvious on BLM lands, mortality associated with small mammal herbivory on other *Pediocactus* species suggests that the Fickeisen plains cactus is likely being impacted rangewide in a similar fashion.

Monitoring efforts on other *Pediocactus* species reported high rates of plant mortality associated with rodent or rabbit herbivory. The BLM found that rodent predation resulted in 81 Brady pincushion cactus mortalities over a 15-year period (BLM 2007b, p. 55). Phillips and Phillips (1995, p. 7) reported 23 Peebles Navajo cactus individuals were lost due to herbivory in 1989, which was attributed to a dry and warmer than normal winter. Sivinski and McDonald (Service 2010, p. 5) identified rabbit and rodent predation as a significant cause of mortality on the *Pediocactus knowltonii* (Knowlton's cactus). They also found that predation rates increase during periods of drought, and no significant germination events had been observed over a 14-year period (Service 2010, p. 12). They infer that low recruitment may be due to high seed predation by rodents in 1993, and they find that seeds of mature fruit are readily eaten by rodents as the fruit ripens, resulting in little seed left to mature.

In summary, insect predation and rodent and rabbit predation are identified threats to the Fickeisen plains cactus. Infestation by the cactus borer beetle is a cause of death among *Pediocactus* species, but damage to the Fickeisen plains cactus has only been observed to an individual in 1991. With little evidence that the cactus borer beetle is affecting larger numbers of Fickeisen plains cacti rangewide, we do not find that insect predation is a significant threat to the plant. Rodent or rabbit predation is a cause of mortality for the plant on the Arizona Strip. Small mammal predation on cacti in general is natural under drought conditions (Kelly and Olsen 2011, pp. 8–9). While the data are variable for the Fickeisen plains cactus, there is adequate evidence from monitoring studies on this species and other *Pediocactus* species that rodent predation is high in drought years, which has affected a large number of individuals, either by direct mortality or contributing to the number of missing/retracted individuals. Climatic conditions throughout the Southwest are predicted to continue to warm with less precipitation in the future as previously discussed. We, therefore, anticipate that rodent or rabbit herbivory may increase in the future as a result of predicted changes in climate. In addition, mortality caused by rodent predation has contributed to population declines on the Arizona Strip, effectively exacerbating the negative effects that can occur to an already small population. Although we lack clear evidence of the scope of the impact that rodent predation has had on the Fickeisen plains cactus and its seeds, taken in conjunction with other habitat disturbances occurring across its range, low recruitment, and small population size, we find that rodent or rabbit predation is likely to rise to the level where it becomes a significant threat to the plant.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Please refer to the two introductory paragraphs of the *Factor D* discussion presented above for the acuña cactus. In this section, we review existing State, Federal, and tribal regulatory mechanisms to determine whether they effectively reduce or remove threats to the Fickeisen plains cactus.

State Laws or Regulations

Approximately 14 percent of the total documented plants occur on State of Arizona lands. The State of Arizona classifies the Fickeisen plains cactus as a highly safeguarded native plant under the Arizona Native Plant Law (Arizona Revised Statutes, Chapter 7, 2007, entire). Because of this classification, it is unlawful for any person to destroy, dig up, cut, collect, mutilate, harvest or take, and place into possession any of these plants, including their parts, from any lands without permission from the landowner and a permit from the Arizona Department of Agriculture (AZDA 2013). Under the law, private landowners can destroy highly safeguarded protected plants on their property if they notify the Arizona Department of Agriculture up to 60 days in advance of the intended destruction and with certain exceptions. On State lands, highly safeguarded protected plants may be impacted if they are in the footprint of a surface-disturbing activity. The project proponent would have the options of transplanting individuals to adjacent State land and commit to irrigating plants or other measures to insure at least 75 percent survival after 3 years; or purchase the plants according the Native Plant fee schedule and transplant them to private land. The law does not contain any provisions for habitat protection. While the Arizona Native Plant Law may provide some protection to the species on private and State land, it is not designed to protect the species' habitat.

Federal Laws or Regulations

The BLM manages the habitat for about 22 percent of the known Fickeisen plains cactus population. An approved Resource Management Plan (RMP) for the Arizona Strip Field Office was completed in 2008 (BLM 2008, entire; Service consultation number 22410–2002–F–0277–R1), which provides overall direction for management of all resources on BLM-administered land. The approved RMP establishes desired future conditions on BLM-administered lands with associated management actions to achieve those conditions. Management actions include giving priority during planning to priority species and their habitats in conflict resolution. Some of the priority species include federally listed, proposed, or candidate species; and species included on the Arizona BLM sensitive list, which includes the Fickeisen plains

cactus. As described in the BLM Manual section 6840 (BLM 2008b, pp. 37–38), the BLM will focus sensitive species management on maintaining species' habitat in functional ecosystems, ensuring the species is considered in land management decisions, and prioritizing conservation that emphasizes habitat needs for the species, thereby preventing the need to list the species under the Act. Their policy for the management of sensitive species recommends avoidance and minimization of threats to plants and habitat, as well as habitat conservation assessments and conservation agreements (BLM 2008c, pp. 8, 36–38). No habitat conservation agreements have been formalized for the Fickeisen plains cactus between the BLM and the Service.

The BLM has the ability to implement conservation measures and best management practices to reduce the threats to the Fickeisen plains cactus from livestock grazing, but we are not aware of any efforts to minimize cattle impacts to the plant or its habitat. Their approved 2008 RMP identifies the Fickeisen plains cactus as one of six species that will be managed as indicators of the conditions of Plains–Grassland Ecological Zone (BLM 2008a, p. 2–25). The BLM designated vegetative habitat areas at Twist Hills (1,255 acres) and Clayhole Valley (7,362 acres) for the Fickeisen plains cactus that will be managed to meet desired future conditions (BLM 2008a, p. 2–41). Management actions that apply to vegetative habitat areas include increased emphasis on protection of the species; increased consideration during National Environmental Policy Act (42 U.S.C. 4321 *et seq.*) analyses; and the ability to modify, mitigate, postpone, or restrict proposed actions to minimize effects to the species. We are not aware of whether the implementation, status, or effectiveness of these vegetation habitat areas has been beneficial on the health of the Fickeisen plains cactus or its habitat or whether the progress toward desired future conditions has been made; it may be too soon to evaluate. While the BLM has reported drought leading to mortality and/or declines in the Fickeisen plains cactus as well as other sensitive plant species on the Arizona Strip, it is likely that drought also has affected rangeland forage. We are not aware if drought policies were implemented for livestock grazing across the Arizona Strip when below-average precipitation was predicted or for seasons when the southwest region was experiencing prolonged droughts (1996 to 2006). Continued livestock grazing at levels authorized for normal or above-normal precipitation during a drought may exacerbate cattle-related impacts within occupied Fickeisen plains cactus habitat. The baseline ecological assessment for House Rock Valley on the Kane Ranch has shown that heavy grazing during the dry winter seasons prior to 2005 has caused the range to be unproductive and in need of restoration to restore native grasses. These lands are administered by the BLM and subject to management objectives in their RMP.

The Fickeisen plains cactus is also listed as a sensitive species for the U.S. Forest Service's Southwestern Region (USFS 2007, p. 19). The U.S. Forest Service would develop and implement management practices to ensure that designated sensitive species do not become threatened or endangered because of U.S. Forest Service actions. Essentially, sensitive species must receive special management considerations or protection by the U.S. Forest Service to ensure their viability to preclude trends toward endangerment that would result in the need for Federal listing. The U.S. Forest Service recently verified a large population of the Fickeisen plains cactus on the eastern Kaibab National Forest boundary near Marble Canyon, where approximately five percent of all documented individuals occur. The land, including where the cactus is found, was part of the Grand Canyon National Game Preserve. The Preserve was established by presidential proclamation and was withdrawn from locatable mineral entry as a result of this designation. The Grand Canyon Game Preserve is available for saleable and leasable mineral development on a case-by-case basis where the purpose is consistent with the game preserve. The U.S. Forest Service, however, has proposed that use and occupancy should be restricted yearlong in areas supporting populations of threatened, endangered, and sensitive plant species (USFS 2013, p. 1). Occupied areas at South Canyon are now in the Buffalo Range Management Area. The area is not permitted for livestock grazing for cattle, and, due to its isolation, there is very little recreation in the area. The U.S. Forest Service did not find any ground disturbance in occupied habitat from bison.

A Land and Resource Management Plan is currently being revised for the Kaibab National Forest that addresses management of the Fickeisen plains cactus (Forest Service 2013, pp. 43–52). Forest plans must address such issues as recreation, range, timber, biological diversity, and economic and social factors in agency decisionmaking. The revisions to the Kaibab National Forest Plan include a discussion of protection of the Fickeisen plains cactus and its habitat. The U.S. Forest Service would commit to managing the bison herd so it is in balance with the ecological conditions in the Buffalo Range Management Area, thereby meeting the desired future conditions there. The U.S. Forest Service would also continue to monitor the taxon and collect detailed monitoring data to help guide management decisions, as well as survey new areas in suitable habitat for new populations.

Tribal Laws or Regulations

The Navajo Nation lists the Fickeisen plains cactus as a Group 3 species on the Navajo Endangered Species List, which is a ''species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future'' (Navajo Nation Division of Natural Resources 2008). Species listed pursuant to the Navajo Nation Tribal Code 17, Subsection 507 are protected from take (17 N.N.C. § 507). In addition to its listed species protection, 9 of the 15 populations are within areas designated as a Preserve, including the 3 largest populations. No new activity or development is allowed within these Preserves, unless it is compatible with management goals established by the Navajo Nation Department of Fish and Wildlife for that area. Any development project proposed within a Preserve requires a biological evaluation be prepared. The biological evaluation must demonstrate that the development activity is compatible with management goals for the Preserve, as defined by the Navajo Nation Department of Fish and Wildlife Resource Land Use Clearance Policies. These policies are also used by Navajo Nation Department of Fish and Wildlife to ensure that proposed development activity in a Preserve will not negatively affect any listed species, including the Fickeisen plains cactus. It does not, however, apply to daily activities, such as livestock herding and any tourist activities that cannot be easily regulated (e.g., driving and parking at unofficial overlooks) (Hazelton 2012c, pers. comm.). It also does not include approved preexisting activities.

Conservation Agreements

On the Cataract Ranch, privately owned parcels occupied by the Fickeisen plains cactus are under a conservation easement held by TNC (TNC 2000, entire). These deeded lands prohibit any development activities from occurring on these parcels and

protect the inherent value of the land for perpetuity. Daily activities such as livestock grazing and range improvements are permitted but are managed to preserve and maintain the health of the ecosystem within Cataract Ranch. Approximately 146 Fickeisen plains cacti are protected by the conservation easement.

In summary, the existing regulatory mechanisms that are in place appear to provide adequate protection to the Fickeisen plains cactus and its habitat in the manner they were intended to provide; however, they are not minimizing threats to the Fickeisen plains cactus or its habitat. State regulations prohibiting the destruction of highly safeguarded native plants do not address threats to habitat, particularly ground disturbance associated with livestock grazing. While the BLM has the ability to provide habitat protection for the Fickeisen plains cactus, any actions would be voluntary under conservation measures aimed to improve the status of sensitive species. Because most of the threats to the Fickeisen plains cactus are from effects to its habitat including drought and predation, habitat must be protected to ensure the species' long-term conservation and survival.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Small Population Size

The Fickeisen plains cactus is a rare, endemic cactus that is restricted to a particular soil type. Factors such as the small population size, low population density, the isolation of populations between occurrences, and a poor mechanism for seed dispersal renders this cactus vulnerable to extinction from human and natural disturbances. We recognize that this species appears to have always been rare, yet continues to survive, and could be well equipped to continue to exist into the future. Many naturally rare species have persisted for long periods within small geographic areas, and many naturally rare species exhibit traits that allow them to persist despite their small population sizes. Consequently, the fact that a species is rare does not necessarily predispose it to being an endangered or threatened species.

However, this species has shown a marked decline in recent years, and populations across its range do not appear to be recovering. This indicates that there is a heightened risk of extinction, and the contributing factors of ever-decreasing population size, coupled with poor seed dispersal, increase the extinction risk. Small populations that are restricted by habitat requirements are more vulnerable to the effects of climate change, such as prolonged droughts and increased fire frequencies. Although small population size makes the species intrinsically more vulnerable, we are uncertain whether this alone would rise to the level of threat. However, when combined with the threats from livestock grazing, drought and climate change, and rodent and rabbit predation, small population size likely exacerbates the effects of these threats on the Fickeisen plains cactus.

Determination for the Fickeisen Plains Cactus

We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats to the Fickeisen plains cactus. We find that the species is in danger of extinction due to the current and ongoing modification and destruction of its habitat and range (Factor A) from ongoing and future livestock grazing, long-term drought, and warmer winters occurring in the past several decades and projected to continue with the effects of climate change. We find that livestock grazing, in combination with drought and climate change, exacerbate the threats to this species (Factor A). We also find predation (Factor C) and other natural or manmade factors are threats to the Fickeisen plains cactus (Factor E). In addition, no existing regulatory mechanisms address these threats. We find that unauthorized collection (Factor B) does not currently occur to such an extent to warrant a threat to the species.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We find that the Fickeisen plains cactus is presently in danger of extinction throughout its entire range based on documented loss of individuals on the majority of its range, little to no recruitment, and continuation of the threats, as described above. Therefore, on the basis of the best available scientific and commercial information, we find that the Fickeisen plains cactus meets the definition of an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act.

The elevated risk of extinction of the Fickeisen plains cactus is a result of the cumulative stressors on the species and its habitat. We have detailed information about population trends from five of the six large populations that have been monitored, all of which show a significant decline in overall population, reduction in reproductive adults, few to no seedlings, and low representation of age-class diversity. The decline of these five populations is likely indicative of what is occurring in other populations that are smaller, more isolated, and not as well studied. Some of these smaller populations have already shown declines in plant numbers; at some sites, plants no longer are found. Information from the 27 populations would increase our knowledge of the species, but it is uncertain if these populations will be monitored in the future due to resource limitations and access to the land. Losses of adult plants in a naturally rare, endemic species exacerbate the species vulnerability to extinction because the older, larger adults contribute more to the population's growth. In the Fickeisen plains cactus, water and heat stress results in reduced flower and seed production, and seedling survival is dependent on winter precipitation and soil moisture. Climate change is anticipated to increase drought periods and warming winters. This combination is expected to continue the documented trend of mortality exceeding recruitment across all populations. All of these factors contribute together to heighten the risk of extinction and lead to our finding that the Fickeisen plains cactus is in danger of extinction, and thus meets the definition of an endangered species.

Listing the Fickeisen plains cactus as a threatened species is not the appropriate determination because the ongoing threats described above are severe enough to create the immediate risk of extinction. The continued loss of reproductive adults without adequate recruitment poses a significant and immediate risk of extinction to the species throughout the species' range, and is not restricted to any particular significant portion of that range. All of these factors combined lead us to conclude that the threat of extinction is high and immediate, thus warranting a determination of endangered species status rather than threatened species status for the Fickeisen plains cactus.

Under the Act and our implementing regulations, a species may warrant listing if it is an endangered species or a threatened species throughout all or a significant portion of its range. The threats to the survival of the species occur throughout the Fickeisen plains cactus' range and are not restricted to any particular significant portion of that range. Accordingly, our assessment and

final determination applies to the species throughout its entire range.

Available Conservation Measures for the Acuña Cactus and the Fickeisen Plains Cactus

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, tribal, and local agencies; private organizations; and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprising species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Arizona Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and tribal lands.

Once these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost-share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, under section 6 of the Act, the State of Arizona would be eligible for Federal funds to implement management actions that promote the protection and recovery of the acuña cactus and the Fickeisen plains cactus. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.* Please let us know if you are interested in participating in recovery efforts for the acuña cactus or the Fickeisen plains cactus. Additionally, we invite you to submit any new information on these species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Federal agency actions within both species' habitat that may require conference or consultation, or both, as described in the preceding paragraph include any management actions that could result in impacts to soil characteristics or seedbank viability, pollinators or their habitat, and associated native vegetation community, and any other landscape-altering activities on Federal lands administered by Federal agencies, such as: issuance of section 404 Clean Water Act (33 U.S.C. 1251 et seq.) permits by the U.S. Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; reauthorization of grazing permits by the BLM and the U.S. Forest Service, and construction and maintenance of roads or highways by the Federal Highway Administration.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to endangered plants. All prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.61, apply. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or remove and reduce the species to possession from areas under Federal jurisdiction. In addition, for plants listed as an endangered species, the Act prohibits the malicious damage or destruction on areas under Federal jurisdiction and the removal, cutting, digging up, or damaging or destroying of such plants in knowing violation of any State law or regulation, including State criminal trespass law. Certain exceptions to the prohibitions apply to agents of the Service and State conservation agencies. The acuña cactus and the Fickeisen plains cactus are listed under the Arizona Native Plant Law as highly safeguarded protected plants, which makes it unlawful for any person to destroy, dig up, cut, collect, mutilate, harvest or take, and place into possession any of these plants on public lands (Arizona Revised Statutes, Chapter 7, 2007, entire). However, the Arizona Native Plant Law does not prohibit landowners from removing or destroying protected plants on their property or from removing them on State lands. They are required to notify the Arizona Department of Agriculture 20 to 60 days prior to destruction of a protected native plant on their private property. The Arizona Native Plant Law

also does not afford protection to the habitat of either cactus species.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened plant species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.62 for endangered plants, and at 17.72 for threatened plants. With regard to endangered plants, a permit must be issued for the following purposes: for scientific purposes, or for the enhancement of propagation or survival of the species.

Our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), is to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act. Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Arizona Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of the regulations concerning listed plants and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, Southwest Regional Office, P.O. Box 1306, Albuquerque, NM, 87103–1306; telephone (505) 248–6911; facsimile (505) 248–6915.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes.

Please see our statement under this required determination in our October 3, 2012, proposed rule (77 FR 60565–60566) for information regarding the Tribes affected by the determination of endangered status for the acuña cactus and the Fickeisen plains cactus. Since the publication of the proposed rule, we distributed a letter notifying the affected tribes of the proposed listing and critical habitat rule on October 31, 2012, and sent subsequent letters notifying the same tribes of the reopening of the comment period for availability of the draft economic analysis and revisions to the proposed critical habitat rule on April 1, 2013, and July 9, 2013, respectively. As mentioned in the proposed rule, the Navajo Nation and the Tohono O'odham Nation are the main Tribes affected by the determination of endangered status for the acuña cactus and the Fickeisen plains cactus. We specifically sent the Chairmen of the Tohono O'odham Nation and Navajo Nation letters of notification of the proposed rule on May 16, 2012, and May 21, 2012, respectively. Prior to publication of the proposed rule, we coordinated with the Navajo Nation by meeting with their botanist on October 3, 2011, and February 24, 2012, for a site visit to two large populations on their land. We subsequently had a teleconference with the Navajo Nation in July 2012, to discuss information submitted by the Navajo Nation regarding the proposal to list the Fickeisen plains cactus. To coordinate with the Tohono O'odham Nation, we participated in an informal meeting in May 2012, and informal teleconferences in November 2012, January 2013, and February 2013, to discuss the proposed determination of endangered status and designation of critical habitat for the acuña cactus. We also held face-to-face meetings with Tohono O'odham Nation staff informally in February 2013, and formally in April 2013, to discuss the proposed determination of endangered status and designation of critical habitat for the acuña cactus.

References Cited

A complete list of all references cited in this rule is available on the Internet at *http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0061 or upon request from the Field Supervisor, Arizona Ecological Services Office (see **ADDRESSES** section).

Authors

The primary author of this document is staff from the Arizona Ecological Services Office (see **ADDRESSES**).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

■ 2. Amend § 17.12(h) by adding entries for ''*Echinomastus erectocentrus* var. *acunensis''* and ''*Pediocactus peeblesianus* var. *fickeiseniae''* in alphabetical order under FLOWERING PLANTS, to the List of Endangered and Threatened Plants, as follows:

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
FLOWERING PLANTS							
*	*	*	*	*	*	*	
Echinomastus erectocentrus var. *acunensis*.	acuña cactus	U.S.A. (AZ), Mexico	Cactaceae	E	821	NA	NA
*	*	*	*	*	*	*	
Pediocactus peeblesianus var. *fickeiseniae*.	Fickeisen plains cactus.	U.S.A. (AZ)	Cactaceae	E	821	NA	NA
*	*	*	*	*	*	*	

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Dated: September 9, 2013.

Steven D. Guertin,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2013–23124 Filed 9–30–13; 8:45 am]

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