

**Lee Pincushion Cactus (*Coryphantha sneedii* var. *leei*)
and
Sneed Pincushion Cactus (*Coryphantha sneedii* var. *sneedii*)**

**5-Year Review
Summary and Evaluation**



Lee pincushion cactus



Sneed pincushion cactus

Photos: Robert Sivinski

**U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
Albuquerque, New Mexico
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5-YEAR REVIEW
Lee pincushion cactus / *Coryphantha sneedii* var. *leei*
Sneed pincushion cactus / *Coryphantha sneedii* var. *sneedii*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest Regional Office, Region 2

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1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act as amended (Act)(16 USC 1531 et seq.) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.3 Methodology used to complete the review

The Service conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Act. We provided notice of this status review via the Federal Register (75 FR 15454), which requested information on the status of *Coryphantha sneedii* var. *leei* (Lee pincushion cactus) and *Coryphantha sneedii* var. *sneedii* (Sneed pincushion cactus). This review was a collaborative effort by biologists from the Service's Region 2 Regional Office, New Mexico and Texas Ecological Services Field Offices; New Mexico Energy, Minerals, and Natural Resources Department; National Park Service (NPS), Carlsbad Caverns National Park; U.S. Forest Service, Lincoln National Forest (Lincoln NF); and Bureau of Land Management (BLM), Carlsbad and Las Cruces Field Offices. Phil Tonne, Collection Manager, University of New Mexico Herbarium, was contracted through

a section 6 grant to gather the relevant information and prepare a draft of the review. The final review and recommended classification was prepared by the New Mexico Ecological Services Field Office.

1.4 Background

1.4.1 FR Notice Citation Announcing Initiation of This Review:

75 FR 15454; March 29, 2010

1.4.2 Listing History:

Proposed Listing

FR Notice: 41 FR 24523

Date proposed: June 16, 1976

Entity proposed: Species, *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii*

Classification: Proposed Endangered Status for 1700 Plants

Original Listing

FR Notice: 44 FR 61554

Date listed: October 25, 1979

Entity listed: Species, *Coryphantha sneedii* var. *leei*

Classification: Threatened, without critical habitat

FR Notice: 44 FR 61554

Date listed: November 7, 1979

Entity listed: Species, *Coryphantha sneedii* var. *sneedii*

Classification: Endangered, without critical habitat

1.4.3 Associated Rulemakings: None

1.4.4 Review History:

A 5-year review was initiated on November 6, 1991 (56 FR 56882) for all species listed before 1991, but no document was prepared for these species.

In 2010, a 5-year review notice of initiation was published for both of these species (75 FR 15454). This is the first 5-year review for these cacti.

1.4.5 Species' Recovery Priority Number at start of 5-year review:

Coryphantha sneedii var. *leei*: 3

Coryphantha sneedii var. *sneedii*: 9

The recovery priority number of 3 indicates a high degree of threat and recovery potential and the listed entity is a subspecies. High recovery potential refers to the fact that the

biological and ecological limiting factors, and threats to the species' existence, are well understood and easily alleviated. The recovery priority number of 9 indicates a moderate degree of threat, a high recovery potential, and the listed entity is a subspecies.

1.4.6 Recovery Plan or Outline

Name of plan or outline: Sneed and Lee Pincushion Cacti (*Coryphantha sneedii* var. *sneedii* and *Coryphantha sneedii* var. *leei*) Recovery Plan

Date issued: March 21, 1986

Dates of previous revisions: The recovery plan has not been revised.

2.0 REVIEW ANALYSIS

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

The Distinct Population Segment policy does not apply to *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* because neither are a vertebrate animal.

2.2 Recovery Criteria

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

Although there is a final recovery plan, it does not reflect the most up-to-date information on the species' biology, nor does it address all five listing factors that are relevant to the species. When the recovery plan was finalized in 1986, limited data made it difficult to quantify habitat requirements with enough precision to establish detailed and measurable recovery criteria.

2.2.1.1 Does the recovery plan contain objective, measurable criteria? No.

The recovery plan contains one main goal which is to remove *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* from the Federal list of endangered and threatened species by managing their essential habitat to sustain natural populations in the wild. The recovery criteria for downlisting *Coryphantha sneedii* var. *sneedii* in the recovery plan are to establish at least six secure populations with a total of at least 20,000 plants. At least three populations should be in the Franklin Mountains or southern Organ Mountains of New Mexico and Texas, and three populations in the Guadalupe Mountains of New Mexico and Texas. Specific criteria for delisting *Coryphantha sneedii* var. *leei* and *Coryphantha sneedii* var. *sneedii* were not determined in the Recovery Plan due to a lack of data and information necessary to quantify delisting criteria.

Major actions needed to meet the recovery criteria include:

- (1) development and implementation of habitat management plans that alleviate the threats of collecting and habitat modification;

- (2) enforcement of existing regulations on collecting and trade;
- (3) study of population biology to develop the understanding needed to sustain healthy populations in their natural habitat; and,
- (4) development of public awareness, appreciation and support for preservation of the *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii*.

The first major action has been partially implemented by the designation of an Area of Critical Environmental Concern (ACEC) within BLM lands (Las Cruces Field Office) containing populations of *C. sneedii* var. *sneedii*. The Organ and Franklin Mountains ACEC was formally established in 1993 through the BLM Las Cruces Resource Management Plan (RMP) and covers 22,857 hectares (56,480 acres) (BLM 1993). The ACEC designation protects the habitat for threatened, endangered, proposed, or other sensitive plant species. *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* are also classified as a Special Status Species by BLM which provides protection and management of habitat, and assist in the recovery thereof, for known populations of Federal listed species. As of 2015, both BLM Field Offices (Carlsbad and Las Cruces) are in the process of updating their RMPs.

U.S. Forest Service, Lincoln NF, did not include *Coryphantha sneedii* var. *sneedii* in their 1986 Land and Resource Management Plan (LRMP), but provided a 1987 letter to the Service outlining their 5-year recovery strategy for this species (Forest Service 1986, 1987). Knight (1992) found *Coryphantha sneedii* var. *sneedii* in the upper parts of Black and Gunsight Canyons on the Lincoln NF, Guadalupe Ranger District. These two canyons have grazing allotments (North and South), but the upper parts of the Canyons seem excluded from allotments.

Carlsbad Caverns National Park (CAVE) has included *Coryphantha sneedii* var. *leei* in the 1996 General Management Plan (GMP) and their 2005 Fire Management Plan with protective and conservation measures (NPS 1996, 2005).

Though *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* conservation measures are discussed by the BLM, the Lincoln NF, and CAVE, there is still potential for threats to negatively impact populations. Without a systematic monitoring plan in place, the short-term and long-term statuses of these plants are basically unknown. Thus, the first major action required to meet the recovery criteria has not yet been fully met.

Currently, the second major action which addresses collection and trade of these cacti, may no longer be relevant. There is no information currently available that clearly substantiates whether or not these cacti are still being collected or traded, and although there has been evidence of cactus removal in the past, this threat does not seem to be predominant at this time. Nevertheless, the germination and propagation of *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* remains an important recovery and research component that could increase the number of individuals in the population overall. Thus, the second major action required to

meet the recovery criteria needs to be revised or could be assumed met, based on collection of these cacti no longer considered a threat.

The third major action, study of the population biology of *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* in their respective locations, is relatively sporadic (when labor and funding is available) and difficult due to their sparse distribution. In addition, taxonomic questions arising from determinations based solely on morphology have made it difficult, particularly for CAVE, to definitively identify *Coryphantha sneedii* var. *leei* versus *C. sneedii* var. *sneedii*. Without a comprehensive genomic analysis in addition to the morphological and ecological factors, clear identification and differentiation of these cacti remain uncertain. Thus, the third major action required to meet the recovery criteria has not been sufficiently met.

The fourth major action, development of public awareness and support, is ongoing mostly through non-Federal entities and their websites such as the Native Plant Society of New Mexico, New Mexico Rare Plant Technical Council, and the New Mexico State Forestry Endangered Plant Program. Further work could be done to involve the public and academia in inventory, monitoring, and recovery activities. Thus, the fourth major action required to meet the recovery criteria has been partially met.

Although these major actions provide some broad guidance for recovery, they do not specifically describe on-the-ground methodology needed to determine threat and trend analysis, both short-term and long-term. Captive propagation of these cacti may still be useful to the species' recovery, and can be used to provide stock for supplementation purposes. Growing and exhibiting these cacti in public arenas (with appropriate permits) could also serve to inform the public of the existence, beauty, and importance of our native cactus flora of the Chihuahuan Desert. Though the original listing factors remain relevant to this species, climate change, (specifically severe and long-term drought), is recognized as an additional threat to this species' recovery.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history

Other than the general treatment given in the 1986 recovery plan, little has been done to further document this taxon's life history (Service 1986).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends

Coryphantha sneedii var. *leei*

Coryphantha sneedii var. *leei* is known only from the Guadalupe Mountains within, and immediately adjacent to, CAVE. At the time of listing, it was known to only occur in “several canyons” (Weniger 1969). The current view is that this subspecies includes individuals from six canyons scattered in populations of low abundance over approximately 22 kilometers (14 miles) of the Guadalupe Mountains including BLM lands (Carlsbad District). These populations are not consistently monitored; therefore, there is no dataset for determining population trends. CAVE has an accurate database developed by Natural Heritage of New Mexico that could be used for monitoring in the future (Tonne 2002, 2003, and 2005).

After the Loop Fire at CAVE in 2011, the park staff collected baseline plant data on mortality (NPS 2011). In 2012, CAVE initiated a post-fire monitoring project for the second year post-fire (Muldavin et al. 2012). Results showed a 40.5 percent mortality. Then in 2014, permanent monitoring plots (burned and unburned) were installed with tagged individual plants to continue the post-fire study of *C. sneedii* var. *leei*. Measurements were taken on survival, reproduction, vigor, and recruitment (Roth 2014). This 2014 project was designed to be monitored annually for a minimum of 5 years. First-year results revealed 30 percent mortality in burned plots with 50 percent of live plants being reproductive. In the unburned plots, there was 14 percent mortality and 69 percent of live plants were reproductive. Unburned plot mortality most likely resulted from drought. All remaining live plants were in excellent to good condition.

Coryphantha sneedii var. *sneedii*

Coryphantha sneedii var. *sneedii* has no long-term trend data, but BLM does try to monitor plant populations for mortality and reproduction. BLM will survey and monitor immediately after a wild fire event, but only if there is funding available. Most survey and monitoring on BLM land is done infrequently, and the methodology has not been standardized. Tonne (2002) concluded that the BLM plant populations appeared stable in 2001, but additional data has not been collected or analyzed since that time.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

BLM initiated a genetics study for *C. sneedii* var. *sneedii* in 2012 (Hodsen et al. 2012). Tissue samples were collected for analysis from the entire spectrum of *Escobaria* spp. and varieties on BLM, CAVE, and state lands. Dr. J. Mark Porter at Rancho Santa Ana Botanical Gardens in Claremont, California received the tissue samples and will provide the final report which has not been received at the time of this review. No other studies of this kind have been conducted.

2.3.1.4 Taxonomic classification or changes in nomenclature

The main question regarding the rarity of *Coryphantha sneedii* var. *leei* comes down to taxonomy. Tonne (2009) provided to the Service a comprehensive history of taxonomy. If all of the previously proposed (*Coryphantha* spp.) and named subspecies are lumped into one large and polymorphic species, then collectively, these cacti are not particularly rare. However, some of the named infraspecific taxa are quite rare and isolated (Zimmerman 1985; New Mexico Rare Plant Technical Council (NMRPTC) 1999) including *C. sneedii* var. *leei*. Our understanding of taxonomic boundaries within this group of cacti is quite limited and the taxonomic discussions and publications concerning this species complex are somewhat subjective.

In the recent taxonomic publications (Kartesz 1999; Baker and Johnson 2000; Anderson 2001), both varieties of *Coryphantha sneedii* are placed in the genus *Escobaria* Britton and Rose. Baker and Johnson (2000) note that this genus is sometimes considered a subgenus of *Coryphantha*. Anderson (2001) uses the genus *Escobaria* in his book "The Cactus Family," stating that the International Cactaceae Systematics Group has accepted this genus.

In 2000, Baker and Johnson of Arizona State University used discriminant analysis of four quantitative morphological variables of closely related taxa (*Escobaria sneedii* var. *sneedii*, *E. sneedii* var. *leei*, and *E. guadalupensis*) to determine the status and taxonomic boundaries of each taxon. Baker and Johnson's (2000) study supported the groupings of all named taxa. All *E. guadalupensis* individuals in their study were correctly classified "suggesting it should be retained at the species level" (Baker and Johnson 2000). The two varieties of *Coryphantha sneedii* were found to be distinct, but 7-13 percent of the individuals from these taxa were misclassified, suggesting a closer taxonomic relationship between these taxa. Therefore, their subspecies status was supported and retained (Baker and Johnson 2000).

Baker and Johnson's (2000) study also identified populations of morphological intermediates in the New Mexico portion of the Guadalupe Mountains. These populations would not group neatly into one of the three taxa, but rather tended to place a large percentage of individuals into each of two taxa with populations displaying morphological intermediates. Their findings suggested that the Cottonwood Canyon population appears to be intermediate between *Escobaria guadalupensis* and *E. sneedii* var. *sneedii*, and the Rattlesnake and Yucca Canyon populations appear to be intermediate between *E. sneedii* var. *sneedii* and *E. sneedii* var. *leei* (Baker and Johnson 2000). These populations of morphological intermediates may be the result of hybridization (Baker and Johnson 2000).

It should be noted that due to the range of morphologies in members of this group, assigning individuals or populations to a specific taxon is difficult and no clear consensus has been established. Cacti, in general, have a fair amount of phenotypic plasticity and it is acknowledged that geographically separated varieties will have morphological variation

within populations. Since there has been varied application of names to populations and individuals, there has necessarily been disagreement and confusion as to the distribution and abundance of the named taxa. In *Flora of North America*, Volume 4 (Zimmerman and Parfitt 2003), all taxa in the *Escobaria sneedii* complex, which includes *Escobaria sneedii* var. *leei*, have been submerged into a single highly variable species, *Coryphantha sneedii*, without recognition of subspecific taxa. This complicates matters when attempting to assess the rarity and vulnerability of members of the *Coryphantha sneedii* complex.

Presently, everything within CAVE and the adjacent BLM lands are treated as *C. sneedii* var. *leei* though other botanists have argued that this subspecies is much more restricted. The northern populations within CAVE best fit the description of *C. sneedii* var. *leei*, but as you examine plants further south in the Guadalupe Mountains they start to resemble *C. sneedii* var. *sneedii* or *C. guadalupensis*. The forms come together and intergrade within this species complex and it produces taxonomic confusion about certain populations. This review reflects a broad definition for *C. sneedii* var. *leei*, incorporating plants that others have argued should be placed into either *C. sneedii* var. *sneedii* or possibly even *C. guadalupensis*.

In summary, due to the range of morphologies in members of this group, assigning individuals or populations to a specific taxon is difficult and no clear consensus has been established to identify subspecies taxa. Cacti, in general, have a fair amount of phenotypic plasticity (ability to change their physical characteristics in response to environmental conditions) and it is known that geographically separated subspecies will have morphological variation within populations. Most treatments have regarded members of this group at the subspecific level and that appears to be a reasonable conclusion (Zimmerman 1985; Baker and Johnson 2000; Tonne 2002, 2003, 2005). If future studies find substantial reason to believe that all, or enough, subspecies or species within this species complex are not distinct and not scientifically defensible, then *C. sneedii* var. *leei* could be delisted based on taxonomy alone.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historical range (e.g. corrections to the historical range, change in distribution of the species' within its historical range, etc.)

In the 1986 Recovery Plan, a synopsis of distribution and historical range is summarized. In 1986, *Coryphantha sneedii* var. *sneedii* occurred on private lands in the Franklin Mountains, El Paso, Texas; BLM land in Dona Ana County, New Mexico; Lincoln NF, Eddy County, New Mexico; Guadalupe Mountains National Park; CAVE; and Fort Bliss (Service 1986). *Coryphantha sneedii* var. *leei* was known from only CAVE, New Mexico.

Presently, the Service is following the idea set forth by Zimmerman (1985) and adopted by the NMRPTC (1999) that all cacti of this species in CAVE and the Guadalupe Mountains belong to the subspecies *Coryphantha sneedii* var. *leei*. As noted above, this represents the collective understanding of New Mexico's botanical community. If plants in this area that resemble subspecies *sneedii* are subtracted from those in this area, fewer individuals and occurrences constituting ssp. *leei* remain, and it appears they are even more limited than the approach proposed above. Known locations are quite limited (36 hectares (90 acres) based on GIS, reports, and herbarium specimens) (Tonne 2009). This area represents what is known and reflects the best information available, but it should be noted that no population of this plant has been accurately delimited and mapped. This is a narrow endemic with limited occupied habitat.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

In the 1986 Recovery Plan, habitat and ecosystem conditions are defined for both species.

Presently, *Coryphantha sneedii* var. *leei* is known from very limited portions of six canyons in the Guadalupe Mountains. While there appears to be suitable habitat in and around known locations, the presence of the cactus drops out abruptly in habitat that appears to be continuous. This makes it difficult to infer where occupied habitat might exist beyond known colonies. We lack the ability to understand why this cactus does not occur when suitable habitat appears relatively common.

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

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range – Factor A

In the 1986 Recovery Plan, threats for both *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* were listed as direct collection, destruction or modification of habitat, and natural limiting factors and threats such as seed predation, grazing, competition for space, or special edaphic requirement. For *Corphantha sneedii* var. *leei*, wild fires are discussed as both positive and negative. However, the 1986 Recovery Plan also said that both species are too poorly understood to identify specific natural threats.

Fire

Presently, the threat of wild and prescribed fires in or around occupied *Coryphantha sneedii* var. *leei* habitat could prove problematic to its survival.

Most of the park has burned since 1941 (NPS 2005, map, p. 6). While lightning ignitions probably took place frequently in the Guadalupe Mountains, most fires were likely quite localized and less intense prior to fire suppression (NPS 2005). Fire suppression in many ecosystems creates more uniform fuel loads that support more landscape-scale high intensity fires (NPS 2005). However, specific impacts of wild and prescribed fire on *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* are still inconclusive.

The CAVE's 2005 Fire Management Plan allows the use of prescribed fire in designated zones within the park, but states that no prescribed fire will be used in areas that contain listed or proposed threatened or endangered species without prior consultation and approval by the Service. BLM has similar restrictions on its use of prescribed fire (BLM 1993) and also attempts to monitor post-fire effects as funding allows.

CAVE initiated the foundation for a long-term monitoring program of *Coryphantha sneedii* var. *leei* after the 2011 Loop Fire (Muldavin et al. 2012). Post-fire results in 2012 field studies after the Loop Fire in 2011 have indicated thus far that survival rates and reproduction percentage of the remaining populations are both lower in areas post-burn (see section 2.3.1.2 above). Following this initial effort, permanent plots were installed and individual plants were tagged in 2014 to provide a basis for annual long-term monitoring to assess survival, reproduction, vigor, and recruitment after a wild fire (Roth 2014). Continued monitoring of the burned and unburned plots will reveal a more long-term response to fire.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational Purposes – Factor B

This type of use does not appear to be a significant threat at this time.

2.3.2.3 Disease or predation – Factor C

Observations of disease or predation are relatively rare. There has been one observation of adult *Moneilema armatum* (longhorn cactus beetle) on *C. sneedii* var. *leei*, pictured below, eating portions of this cactus. We lack enough information to assess what impact, if any, longhorn beetles have on subspecies *leei* or its close relatives.



Longhorn cactus beetle, *Moneilema armatum*, on *C. sneedii* var. *leei*,

2.3.2.4 Inadequacy of existing regulatory mechanisms – Factor D

Existing regulatory mechanisms for BLM, Lincoln NF, and CAVE provide protections afforded to federally-listed threatened and endangered species including *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii*, respectively.

2.3.2.5 Other natural or manmade factors affecting its continued existence – Factor E

Climate change

Based on the unequivocal evidence of warming of the earth's climate from observations of increases in average global air and ocean temperatures, widespread melting of glaciers and polar ice caps, and rising sea levels recorded in the Intergovernmental Panel on Climate Change Report (IPCC 2007, 2013),

climate change is now a consideration for Federal agency analysis (GAO 2007). The Service will incorporate climate change into our ESA decision making (Service 2010). The earth's surface has warmed by an average of 0.74 ° C (1.3 ° F) during the 20th century (IPCC 2007). The IPCC (2007, 2013) projects that there will very likely be an increase in the frequency of hot extremes, heat waves, and heavy precipitation events as a result of climate change.

The IPCC (2007, 2013) projects that there will be an increase in the frequency of extreme weather events that are temporally and spatially more variable as a result of climate change. The most recent drought (2002-2003) spanning southwestern North America was anomalously dry with unusually high temperatures (Breshears et al. 2005). Six of the last 10 years there has been moderate to exceptional drought conditions in the cacti area (National Drought Mitigation Center 2015).

Climate change also involves an increase in atmospheric carbon dioxide which is commonly associated with increased temperatures and the greenhouse effect. This increased carbon dioxide directly affects plant photosynthesis (Huxman and Scott 2007). At the plant level, adapting to drought involves the ability to balance carbon sequestration (the uptake and storage of carbon), carbon respiration (efflux back into the atmosphere), and maintain sustainable evapotranspiration rates (Huxman and Scott 2007). Adaptation would also require a plant to change its phenology (timing of life cycle events) to coincide successfully with extreme shifts in temperature, precipitation, and soil moisture (Walther et al. 2002) which are all part of the evapotranspiration equation. The potential for rapid climate change, which is predicted for the future, could pose significant challenges for plants because they may not be able to adjust their phenology or photosynthetic mechanisms quickly enough.

Cacti have a unique photosynthetic pathway referred to as Crassulacean acid metabolism (CAM) which is most effective in low soil moisture, intense sunlight, and high daytime temperature conditions, and is considered to be a desert adaptation (Barbour et al. 1999). CAM plants may have an advantage under drier conditions predicted by climate change (Reyes-Garcia and Andrade 2009). If atypical cactus mortality occurs, this could be evidence that a climatic severity threshold may have been crossed even for this well-adapted CAM species.

Growing seasons are becoming longer and warmer in many regions (Parmesan 2007) including the southwest (Cayan et al. 2001; Easterling 2002; Lenart et al. 2007; Enquist and Gory 2008). Earlier soil moisture stress would result in decreased flowering and reproduction, and because this cactus has a limited distribution, we would predict a substantial population reduction with a long-term warming trend. Munson et al. (2014) predicts declines in vegetative cover including cacti in Chihuahuan Desert habitats due to climate change.

Coryphantha spp. are likely to have experienced and rebounded from periods of drought in the past. However, should substantial climate change materialize with

increased severity and frequency of drought, it would likely reduce the long-term survivorship of this species. However, without sufficient monitoring in place to assess trends, the severity of this threat can only be surmised based on other cacti and drought research.

2.4 Synthesis

Because of the limited knowledge, questions remain about *Coryphantha sneedii* var. *leei*'s taxonomic status. Is it a distinct subspecies, and what separates it from its nearby conspecifics? The answer to the first question has generally been that it is distinct at the subspecies level based on morphology, and as such, it may be rarer than its endangered relative, *Coryphantha sneedii* var. *sneedii*. The second question is more problematic. Our best understanding, based on publications and the discussions of the New Mexico Rare Plant Technical Council, is that this is a distinct entity. There appears to be something genetic driving the morphological differences that identify this cactus and it is appropriately distinct at the subspecific level.

Coryphantha sneedii var. *sneedii* is a regional endemic along the Texas/New Mexico border, occurring between Las Cruces and El Paso, and possibly in the Guadalupe Mountains. For this taxon, the main question of rarity is a taxonomic one. Further elucidation of the taxonomic relationships of the *C. sneedii* complex, including *Escobaria guadalupensis*, is needed in order to understand the distribution and abundance of *C. sneedii* var. *sneedii*.

Our current taxonomic understanding, though limited, leads us to conclude that *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* are rare, and in conjunction with the unknown effects from fire and climate change, both varieties deserve the protections afforded by the Act.

Upon reviewing the combined significance of current threats, we recommend that the status of these cacti as federally threatened (*Coryphantha sneedii* var. *leei*) and endangered (*C. sneedii* var. *sneedii*) remain unchanged at this time. However, we also recommend that the cactus be closely monitored for future population trends, new population discoveries, and any new threats. We note that all previously identified threats are still continuing including: (1) wild and prescribed fire; and (2) climate change and drought. We also note that there is an increased level of impacts from threats due to its restricted distributional range. If these threats notably increase in the near future, or if population trends decline and lack evidence of recovery, consideration of reclassification of these species may be necessary.

3.0 RESULTS

- 3.1 Recommended Classification:** No change; remain as threatened (*Coryphantha sneedii* var. *leei*) and endangered (*Coryphantha sneedii* var. *sneedii*) respectively. Due to the lack of quantitative scientific data specific to both taxons together and separately, it is difficult to ascertain any trends that could recommend a change in classification.
- 3.2 New Recovery Priority Number:** Not applicable
- 3.3 Listing and Reclassification Priority Number:** Not applicable

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Determine if the genus associated with these two plant species needs to be changed from *Coryphantha* to *Escobaria* on all future Service documents.
- Revise the recovery plan for these species to incorporate new information on taxonomy, biology, ecology, and threats with management recommendations. Objective and measurable recovery criteria for down and delisting of the species should be developed which address all listing factors relevant to this species.
- Develop a *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* multi-agency working group to share and disseminate information regarding this listed species to promote education, protection, and recovery.
- Develop standardized survey and monitoring protocols for these species to be conducted annually by well trained personnel. Continue monitoring of known sites as well as adding new sites to provide a robust dataset for long-term trend analysis. Incorporate fire and climate change factors into long-term monitoring data collection.
- Develop a mitigation banking requirement (a system whereby project proponents pay for plants to be preserved in an area suitable for their preservation as mitigation for losses incurred during projects).
- Implement and monitor new transplant projects with experimental manipulations (watering, shading, planting depth, etc.) and controls to determine required establishment needs.
- Provide legally grown seeds and plants of *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii*, as the known populations allow, to the commercial succulent trade, but law enforcement must remain vigilant against the theft of cacti throughout its range.
- Provide viable *Coryphantha sneedii* var. *leei* and *C. sneedii* var. *sneedii* seeds to a seed bank operating under the Center for Plant Conservation guidelines.
- Collect data on seed dispersal and growth past the germination stage, timing of seed set, and seedling establishment to more clearly define the vulnerable life history stages of these species.
- Determine microhabitat needs of these species (“nurse” plants, pollinators, precipitation needs - amount and timing, slope and aspect requirements, disturbance patterns, etc.) to further quantify potential habitat for a transplant and mitigation site.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Lee and Sneed Pincushion Cactus
(Coryphantha sneedii var. leei and Coryphantha sneedii var. sneedii)

Current Classification: Lee pincushion cactus – Threatened
Sneed pincushion cactus – Endangered

Recommendation Resulting from the 5-Year Review:

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

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

Review Conducted By: Laura Hudson, Vegetation Ecologist, New Mexico Ecological Services Field Office.

FIELD OFFICE APPROVAL:

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

WALLY MURPHY

Digitally signed by WALLY MURPHY
DN: c=US, o=U.S. Government, ou=Department of the Interior, ou=U.S. Fish and Wildlife Service, cn=WALLY MURPHY, o.9.2342.19200300.100.1.1=14001000589970
Date: 2015.08.11 10:47:05 -0600

Approve _____ Date _____

REGIONAL OFFICE APPROVAL:

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

Approve Michelle Strayhnesey Date 8/25/15