RECOVERY PLAN AMENDMENTS FOR ELEVEN SOUTHWEST SPECIES

The U.S. Fish and Wildlife Service identified best available information indicating the need to amend the below species' recovery criteria. Each amendment is recognized as an addendum that supplements the existing recovery plan.

Black Lace Cactus (*Echinocereus reichenbachii* var. *albertii*) Recovery Plan	
Original Recovery Plan Approved:	March 18, 1987
Page(s) Superseded:	24
Little Colorado Spinedace (*Lepidomeda vittata*) Recovery Plan	
Original Recovery Plan Approved:	January 9, 1998
Page(s) Superseded:	8
Loach Minnow (*Tiaroga cobitis*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	20-22
Masked Bobwhite (*Colinus virginianus ridgwayi*) Recovery Plan	
Original Recovery Plan Approved:	April 21, 1995
Page(s) Superseded:	37
Mexican Long-Nosed Bat (*Leptonycteris nivalis*) Recovery Plan	
Original Recovery Plan Approved:	September 8, 1994
Page(s) Superseded:	33-35
Navajo Sedge (*Carex specuicola*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 1987
Page(s) Superseded:	10
Nichol's Turk's Head Cactus (*Echinocactus horizonthalonius* var. *nicholii*) Recovery Plan	
Original Recovery Plan Approved:	April 14, 1986
Page(s) Superseded:	None
San Marcos & Comal Springs & Associated Aquatic Ecosystems (Revised) Recovery Plan	
Original Recovery Plan Approved:	February 14, 1996
Page(s) Superseded:	54-57
Species Included:	Texas wild-rice (*Zizania texana*) fountain darter (*Etheostoma fonticola*) Texas blind salamander (*Typhlomolge rathbuni*)

Sonora[n] Tiger Salamander (*Ambystoma tigrinum stebbinsi*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 2002
Page(s) Superseded:	13
Spikedace (*Meda fulgida*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	19-22
Texas Poppy Mallow (*Callirhoe scabriuscula*) Recovery Plan	
Original Recovery Plan Approved:	March 29, 1985
Page(s) Superseded:	11

For

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: DEC 0 6 2019

Recovery Plan for *Echinocactus horizonthalonius* var. *nicholii* (Nichol's turk's head cactus)
https://ecos.fws.gov/docs/recovery_plan/860414a.pdf

Original Approved: April 14, 1986
Original Prepared by:
Clayton J. May, Pima Community College, Tucson, Arizona;
Thomas R. Van Devender, Arizona Sonora Desert Museum, Tucson, Arizona;
Thomas C. Gibson, University of Arizona, Tucson, Arizona;
Mary Butterwick, Bureau of Land Management, Phoenix, Arizona; and
Peggy Olwell, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for *Echinocactus horizonthalonius* var. *nicholii* (Nichol's turk's head cactus) since the recovery plan was completed. In this proposed modification, we synthesize the adequacy of the existing recovery criteria, show amended recovery criteria, and the rationale supporting the proposed recovery plan modification. The proposed modification is shown as an addendum that supplements the recovery plan, superseding only the Summary (p. iii) and Part II (p. 16) of the recovery plan.

For
U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

BACKGROUND INFORMATION

Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if

significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats, or species' response to management. An amendment could serve a critical function while awaiting a revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can, therefore, efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

The recovery criteria were developed by conducting a comprehensive review of all documents pertaining to *Echinocactus horizonthalonius* var. *nicholii* (herein referred to as var. *nicholii*) on file at the Arizona Ecological Services Field Office. The most recent var. *nicholii* documents compiling life history and status information are from the 5-year Status Review (Service 2009), Schmazel and Francisco (2000), and McIntosh et al. (2019). We sought and reviewed all var. *nicholii* historical and current location and monitoring information. We summarized var. *nicholii* monitoring data from 1986 to 2018 on the Bureau of Land Management (BLM) (McIntosh et al. 2011, 2019; Nichol's Turk's Head Cactus Working Group 2019) and Tohono O'odham Nation (Schmazel and Francisco 2000; Service 2009) to estimate its abundance in Arizona, approximate life span, and generation time (e.g., the length of time when an adult produces an offspring). In 2018, Service and BLM biologists visited occupied areas on Federal land within Ironwood Forest National Monument (IFNM). We collected preliminary data on the cactus (e.g., alive or dead, tissue color, height and diameter) to assess its current observed condition and habitat to help determine appropriate recovery needs. The recovery criteria were designed to be objective and quantifiable, in order to meet the conditions needed to ensure species viability through sustaining populations in the wild that demonstrate resiliency, redundancy, and representation (Shaffer and Stein 2000). We conducted peer review of this amendment concurrent with publication of a Notice of Availability for the draft amendment in the *Federal Register*.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list." Legal challenges to recovery plans (see Fund for Animals v. Babbitt, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) have also affirmed the need to frame recovery criteria in terms of threats assessed under the five threat factors (Act 4(a)(1)).

Recovery Criteria

The final Recovery Plan includes one objective, measurable criterion to reclassify var. *nicholii* from endangered to threatened (Service 1986). It does not reflect the most up-to-date information on the taxon's biology, nor does it address all five delisting factors that are relevant to the taxon. When the Recovery Plan was finalized in 1986, there were limited data available to quantify the taxon's total population abundance or other biological and ecological requirements;

therefore criteria for delisting the taxon were not established (Service 1986). The existing downlisting criteria can be found on pages iii and 16 in the Recovery Plan and will remain unchanged.

Synthesis

Our understanding of var. *nicholii* has not changed substantially since completion of the 5-year Status Review (Service 2009). Most of what is known about the taxon in Arizona is described in the Recovery Plan (Service 1986), Schmazel and Francisco (2000), and McIntosh et al., (2007, 2011, 2019). Below we summarize its status, including recent genetic studies; sites discovered in Arizona and Sonora, Mexico; and a 2018 population assessment.

Life History

The most recent genetic study of *Echinocactus horizonthalonius* suggests variety *nicholii* is distinct from the common variety *horizonthalonius*. Vargas et al. (2018) concluded that there is molecular evidence to recognize *E. horizonthalonius* subsp. *nicholii* as a unique entity, separating it from subsp. *horizonthalonius* by seedlings having four spines per areole rather than one to two. Mature adults of subsp. *nicholii* have short cylindrical stems with curved spines and pink to crimson flowers, rather than the depressed stems, straight spines, and light pink flowers of subsp. *horizonthalonius*.

In 2012, Van Devender and Reina-Guerrero (2012) found 83 *E. horizonthalonius* individuals near Mazatán and Nácori Grande in central Sonora, Mexico, which are approximately 380 km (236 miles) south-southeast from the Waterman Mountains in Arizona. The plants are believed to be var. *nicholii* and may possibly comprise a fifth population depending on a taxonomic analyses.

In 2018, biologists with the Service, BLM, and Department of Defense (DOD) documented 62 individual var. *nicholii* on approximately 16.2 ha (40 acres) of DOD land adjacent to IFNM. Their occurrence is believed to have been known and recorded by DOD just recently. The plants appear to be a continuation of those growing on a northeast bajada of the main Waterman range, but are separated by a utility right-of-way and unpaved road.

Waterman Mountains Site-Visits

In the spring and summer of 2018, BLM and Service biologists visited six var. *nicholii* areas on the Waterman Mountains to assess the taxon's current status. Our efforts were not exhaustive and we did not record the location of every var. *nicholii* observed. We did not attempt to relocate plants documented on state trust land given restricted access, nor did we visit areas where monitoring data is currently being collected (Nichol's Turk's Head Cactus Working Group 2019). In total, we found 781 individual var. *nicholii,* consisting of 541 live and 240 dead plants. This included 66 total plants on DOD land and 715 total plants on BLM land. Eighty-eight of total plants found were equal or less than 7.5 cm (3 in) tall and considered a seedling or immature plant. Forty-six of the total plants had tissue discoloration such as half black and half red, plum, orange, white or gray; all red, yellow, or orange; were wholly or partially uprooted; dead but intact; or as a hollow spine basket. Many of the discolored plants appeared to be dying and may not survive through spring of 2019. Surrounding native cactus species such as *Opuntia*

sp., and trees also appeared to be dying or drought stressed (K. Robertson, pers. observation 2018).

We visited BLM's North and South Waterman Mountains monitoring plots that were established in the late 1980s. Each var. *nicholii* was given a numerical metal tag, and its height, width, and reproductive status was recorded until 1999 when the plots were last visited. Based on a hand-drawn diagram, we attempted to relocate all tagged and untagged var. *nicholii* in these plots and record their location using GPS technology. We compared our findings on their condition to past monitoring data (Schmazel and Francisco 2000).

In the North Plot, we found 166 individuals consisting of 115 live and 51 dead plants (Table 1). We located most of the plant tags which were found either next to a live, dead, or missing plant or spine cluster. In some instances, we believe tagged plants found in 2018 are the same living plants tagged and recorded from the late 1980s. For example, a plant tagged as number 20 was 2 cm (0.8 in) tall in 1988 and was 20 cm (7.8 in) in 2018; and plant 58 was 7 cm (2.7 in) tall in 1988 and is now 28 cm (11 in) tall (Schmazel and Francisco 2000; Arizona Game and Fish Department 2018). In other cases, if a small sized plant (less than 15 cm (5.9 in)) or seedling was growing next to a tag, we assumed that the original tagged plant had died.

In the South Plot, we relocated 148 var. *nicholii* individuals consisting of 63 live and 110 dead plants. The number of mortalities include 53 dead plants, 25 missing plants next to a tag, and a pile of 32 tags lying outside of the plot. We also found 16 tags belonging to plants that died between 1994 and 1998, which we excluded from the mortality total. Observations of dead plants included collapsed or wholly uprooted plants, spine baskets lacking tissue, partial plant remains, or tags to a missing plant. Based on our findings, plant numbers appeared to have declined since 1999 and drought is likely a contributing factor.

Table 1. *Echinocactus horizonthalonius* var. *nicholii* census information (1987 to 2018) from the North and South Waterman Mountains monitoring plots on Ironwood Forest National Monument in Arizona

North Plot	**1988**	**1989**	**1990**	**1991**	**1994**	**1997**	**1998**	**1999**	**2018**
Alive Plants	103	105	101	---	---	102	109	115	115
Dead Plants	0	7	6	---	---	16	2	4	51
South Plot	**1987**	**1989**	**1990**	**1991**	**1994**	**1997**	**1998**	**1999**	**2018**
Alive Plants	114	123	133	131	119	120	124	121	63
Dead Plants	0	4	3	2	9	22	7	4	110

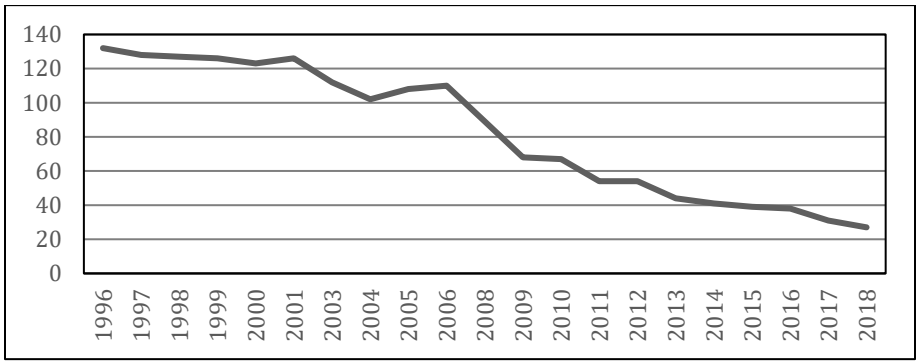
[1]Source: (Schmazel and Francisco 2000, Arizona Game and Fish Department 2018).
[2]Data for years 1997, 1998, and 1999 were collected two or more times and the average is reported.

Service biologists visited the south-facing slopes and southeast ridges on the Waterman Mountains in June 2018, to ground-truth the area for var. *nicholii.* Preliminary counts from early 2000s suggested there were 175 to 298 individual plants present (Service 2009). Our search focused within a polygon used to derive earlier abundance estimates (Dimmit and Van Devender 2003) but was not exhaustive due to the steep, rocky terrain and surface reflectivity from limestone. On two separate trips we located 44 live and 28 dead individuals in a 1.21 ha (3-ac) area. The majority of plants were less than 15 cm (6 in) in height with green tissue. Several of

the mortalities consisted of uprooted plants, the top of the stem broken off, or spine clusters next to a tag.

We did not expect to find such a low numbers of var. *nicholii* on the Waterman Mountain's southern slopes. Our search area was close to the four study plots being monitored by researchers affiliated with the University of Arizona for over 23 years (Figure 1). Plant numbers have declined from 132 in 1996 to 40 in 2017, with 100 individuals recruited and 203 dying during the study (McIntosh et al., 2019). Their latest census in 2018 located 31 total plants with two plots having three plants each remaining. The researchers noted abundant evidence of sheep use where plots are located. In 2016, they established two additional plots on the bajadas. Plant numbers so far appear to be stable in these lower plots (Nichol's Turk's Head Cactus Working Group 2019).

Figure 1. Trend information for the *Echinocactus horizonthalonius* var. *nicholii* among four monitoring plots on the south slopes of the Waterman Mountains, Arizona from 1996 to 2018. No census occurred in 2002 and 2007 (McIntosh et al., 2011, 2019; Nichol's Turk's Head Cactus Working Group 2019).



Plants on the Tohono O'odham Nation were last visited in 1999 due to access restrictions. The habitat between the Waterman Mountains and the Tohono O'odham Nation is homogenous and therefore, we assume plants on Vekol Mountain slopes and possibly Koht Kohl Hill likely have also declined.

Threats

The Recovery Plan and 5-Year Status Review identify a variety of threats to var. *nicholii*. In the Recovery Plan, threats were listed as mining, off-road vehicle use (OHV), urban development, and over-collection. The 5-year Status Review listed the threats as: 1) mining on state trust and private lands on IFNM and on the Tohono O'odham; 2) habitat disturbance from illegal immigration, drug smuggling, and law enforcement activities; 3) spread of invasive plant species such as *Cenchrus ciliaris* (buffelgrass) and the resultant competition for resources and increased fire frequency; 4) herbivore depredation; and 5) climate change (Service 2009).

Many of these threats to the Waterman Mountains population are no longer adversely affecting var. *nicholii*. As of 2018, the BLM has completed most of the recovery actions from the Recovery Plan. The establishment of IFNM with the signing of the Presidential Proclamation, permanently protects natural resources within the 906.5 ha (2,240 ac) encompassing var.

nicholii's habitat. In accordance with the proclamation, IFNM is withdrawn from all forms of mineral extraction and recreational off-road vehicles (Service 2009, BLM 2011, 2013). In implementing recovery actions, BLM has acquired 148.9 ha (368 ac) out of 222.5 ha (550 ac) of patented land held by a private owner within occupied habitat and continues to pursue acquisition of remaining private acreages (BLM 2011; D. Tersey BLM, pers. comm. 2018). There has been no observed or documented evidence of illegal collection of var. *nicholii* on the Waterman Mountains.

The Recovery Plan stated that moderate levels of grazing did not appear to affect the var. *nicholii* because cows seem to avoid stepping on the plants (Service 1986). Moderate grazing continues throughout var. *nicholii's* habitat (Service 2012). During the summer months, cattle may congregate under large trees for shade in dense patches of var. *nicholii* and disturb its habitat (K. Robertson, FWS, pers. obs., 2018). We have little evidence (observed or documented) of cows stepping on the cactus or damaging its tissue. BLM manages the Agua Dulce Grazing Allotment to promote var. *nicholii* conservation. Livestock waters are currently located next to existing roads, but BLM will move or replace those that cause habitat impacts. BLM will place any future water developments in locations to move cattle outside of occupied areas with the intent to reduce or minimize any impacts (BLM 2013; Service 2012). However, any potential effects from livestock grazing, as well as bighorn sheep and other small mammals have not been fully evaluated and should be considered in a thorough threats assessment.

Habitat disturbance associated with cross-border activity has been reduced in the Waterman Mountains. There are currently no documented impacts to var. *nicholii's* habitat from abandoned vehicles, trash, or driving off-road.

In the 5-year Status Review, we identified the spread of invasive grass, *Cenchrus ciliaris* as a significant threat to var. *nicholii* habitat. *Cenchrus ciliaris* had expanded into a 7.2 ha (18 ac) area on the north side of Waterman Mountains, including a location near hundreds of var. *nicholii* increasing the fire risk (Service 2009). There have been recurrent efforts to control *Cenchrus ciliaris* by manual removal through various volunteer organizations (2005-2009) and BLM contracted annual herbicide sprayings (2008-2009). In 2010, the BLM organized a mechanical reshaping and contouring of the area that was followed by restoration efforts through 2012 (J. Scheuring, Friends of Ironwood Forest, pers. comm., 2013). *Cenchrus ciliaris* has been effectively brought under control through continued removal and spot treatment which eliminated its threat to nearby var. *nicholii*. In 2016, several var. *nicholii* seedlings were found growing in the restoration area.

Climate change is considered a threat to var. *nicholii* due to effects from hotter temperatures and increased aridity (Service 2009). Climate change has resulted in some species shifting their range to higher elevation or higher latitude (Hannah et al., 2005; Chen et al., 2011). For southwestern plants, scientists are finding migration may occur in all directions depending on the species' ability to adapt, and having available, connected habitat (Stills et al., 2015; Krause and Pennington 2012; Notaro et al., 2012). Variety *nicholii* grows on mountain slopes that could presumably support more plants in the future if they remain cooler and soils retain more moisture than those on the valley floor. Alternatively, as temperatures and aridity increase, these exposed areas may become hotter, drier and ultimately unsuitable in the future. With the limiting

presence of Horquilla limestone on a few mountain ranges, changes in the suitability and amount of available habitat for the taxon could cause dramatic reductions in its range. Gaining a better understanding of its adaptive capacity and conserving the distinct geographic areas where it occurs will allow opportunities for the taxon to endure into the future.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the species is no longer at risk of extinction and may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists). Downlisting is the reclassification of a species from an endangered species to a threatened species. The term "endangered species" means any species (species, sub-species, or DPS) which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely on the basis of the best scientific and commercial data available." Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when we would anticipate that an analysis of the species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan, which triggers rulemaking. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

We establish recovery criteria for *Echinocactus horizonthalonius* var. *nicholii*, which will supplement those included in the Nichol Turk's Head Cactus Recovery Plan as follows:

Downlisting Recovery Criteria

Downlisting criteria remain the same as in the original Recovery Plan for Nichol turk's head cactus (Service 1986, p. iii and p. 16).

Delisting Recovery Criteria

Echinocactus horizonthalonius var. *nicholii* will be considered for delisting when the following conditions are met:

1. Conserve and protect all existing var. *nicholii* individuals and habitat for their pollinators (approximately a 600 meter (0.37 mi) radius around each plant) in three or more extant populations through land protection, land management actions, and restoration techniques (i.e., actions that enhance habitat quality, support increased germination, and establishment). Each var. *nicholii* population must have available habitat of sufficient quality and size for natural population dynamics and long-term expansion, to support a viable seed bank, as well as, habitat for pollinators, allowing pollen exchange within populations. Variety *nicholii* habitat is defined as areas that contain the appropriate geology, elevation, soil type, Sonoran Desert native plants and trees, native pollinators, with minimal ground disturbance and limited non-native invasive grass species.

   Justification: Variety *nicholii* occurs in a small number of populations making it essential to conserve and protect, at minimum, the three extant Arizona populations for redundancy against catastrophic events (e.g., wildfire). Populations are geographically distributed throughout var. *nicholii's* range in Arizona and Mexico separated by distances of over 8.0 km (5 mi). Criteria 1 would preserve the geographic distribution and thus maintain the taxon's representation in its range.

   Variety *nicholii* is dependent on pollinators for seed production, while pollinators need space for nesting sites and food resources. As a means to quantify measurable habitat surrounding individual plants for pollinator habitat, we used the maximum foraging distance of observed pollinators to this taxon (Centris sp., *Apis mellifera*, and possibly *Diadasia rinconis*) (Service 1986, Van Devender and Reina-Guerrero 2012). The maximum distance travelled by small-bodied solitary bees is 600 m (0.37 mi) (Ritchie et al., 2016). Therefore, we chose a 600 m radius to delineate the amount of habitat needed to support pollinator nesting, foraging, and survivorship. As more information becomes available in the future, we would assess the need to revise or replace this distance with another appropriate measure.

2. Each var. *nicholii* population must be self-sustaining, with annual recruitment exceeding mortality over any 20 years of a 30-year period. Long-term monitoring every 3–5 years demonstrates that the annual total estimated population size among three or more extant populations is maintained at or greater than 3,700 individuals for a minimum of 20 years over a 30-year survey period. Threats must be managed so that populations can be maintained at target levels (a minimum of 3,700 total individuals) for a minimum of 20 years over the 30-year period. Expected yearly fluctuations in plant abundance due to changes in precipitation, fire, or other causes, may result in two monitoring events during the time period that does not meet these targets.

   Justification: Variety *nicholii* are long-lived, with an estimated life span of 30 years or longer. Monitoring data indicates plants become reproductive after 10 years of age and mature plants produce offspring over the subsequent 10-20 years. Therefore, 30 years captures several generation times and allows for the detection of demographic trends, as plants respond to annual and decadal climate variability in temperature, precipitation, and the El Niño Southern Oscillation patterns that are compounded by extreme events (e.g., a severe long term drought or a wildfire). We estimated that a total population of 3,700 individuals would provide resiliency and representation. We chose this number by summarizing plant

abundance data collected from different occupied areas in Arizona by various researchers because no rangewide census has been completed. We believe that 3,700 estimated individuals occurred during the late 1990s in Arizona and therefore, we chose to use this estimate as a rangewide population target threshold to achieve recovery. Having a stable or increasing population trend of this size for a 30-year period would demonstrate the taxon's persistence under changing environmental conditions (representation), and that threats are managed or ameliorated. As more long-term demographic trend information is obtained, the target threshold and the time period needed for recovery may be revised.

3. Develop a long-term ex-situ (off-site) var. *nicholii* conservation program that includes maintenance of seeds for conservation and recovery at seed storage facilities, captive propagation, germination trials, guidelines for supplementing natural populations, and post-introduction monitoring that demonstrates the introduced var. *nicholii* are fully functioning in their environment, including flowering, seed production, and survival.

   Justification: Climate change (hotter temperatures and reduced precipitation) has been documented affecting the Waterman Mountains population and likely is affecting other populations. Predicted climate change will likely alter habitat suitability and potentially result in var. *nicholii* shifting its distribution. An off-site conservation program will allow for viable seeds and plant material to be available for future reintroductions and ensure the survival and persistence of var. *nicholii* in the future.

Rationale for Amended Recovery Criteria

The viability of a species to sustain populations over time can be assessed in terms of the 3R's: resilience, representation, and redundancy (Shaffer and Stein 2000). In general, the greater the resiliency, representation, and redundancy of species, the more protected it is from stochastic events, the better it can tolerate stressors, and better its adaptive capacity is to future changes, and thus more viable it is.

The amended criteria address resiliency, representation, and redundancy by reducing demographic threats such as climate change to var. *nicholii*. Representation is the ability of a species to adapt to changing environmental conditions over time as characterized by the breadth of genetic and environmental diversity within and among populations. Resiliency is the assurance that each population is sufficiently large to withstand most stochastic disturbance events, which usually is directly related to size of the habitat it occupies. Redundancy involves ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events.

Representation

The taxon occurs in four small, disjunct populations. We do not have information describing genetic diversity within populations, however, we know plants occupy unique geographic areas such as bajadas, mountain slopes, and terraces. Representation is therefore, met by conserving and protecting the existing geographic distribution of var. *nicholii* throughout its narrow range. We continue to recognize the need and recommend that genetic studies describing the levels of genetic variation within a population and genetic differentiation between populations are

conducted. Genetic information would provide a better understanding of the taxon's population structure and its adaptive capacity to environmental changes.

Resiliency
Resiliency is met by having enough individuals among all var. *nicholii* populations to withstand demographic stochasticity (random fluctuations in germination rates), environmental stochasticity (variation in the amount and timing of rainfall), or human-caused effects. We do not have sufficient information on the current number of individual var. *nicholii* within each population that is required to achieve population resiliency. Greater resiliency will enable the taxon to better withstand the effects of climate change and other threats that may be acting on populations outside of federal lands. Based on the best available data, var. *nicholii* can achieve resiliency by meeting the target threshold (3,700 individuals among three or more populations) for the time period indicated in criteria 2. As more census and demographic information becomes available, we will revisit the target threshold number.

Redundancy
Redundancy is met by conserving and protecting all existing populations that are broadly distributed over the taxon's range. Because var. *nicholii* occurs in few populations, it may be necessary to supplement or establish additional populations if unoccupied areas become suitable in the future.

The 1986 Recovery Plan noted that a complete var. *nicholii* census was necessary before we could consider delisting. In the intervening 32 years, we have gained little additional information on species life history, distribution, abundance, trends, and threats, as described in the Synthesis section above. The new quantitative delisting criteria are measurable and objective, and tier from the downlisting criterion by ensuring long-term var. *nicholii* habitat protection and viability. Incorporation of the amended criteria will improve the taxon's resiliency, redundancy, and representation.

ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS
Not applicable.

COSTS, TIMING, PRIORITY OF ADDITIONAL RECOVERY ACTIONS
Not applicable.

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APPENDIX A – SUMMARY OF PUBLIC, PARTNER, AND PEER REVIEW COMMENTS RECEIVED

Summary of Public Comments

We published a notice of availability in the *Federal Register* on August 6, 2019 (84 FR 38288-38291) to announce that the draft amendment for the *Echinocactus horizonthalonius* var. *nicholii* (Nichol's turk's head cactus) Recovery Plan (Recovery Plan) was available for public review, and to solicit comments by the scientific community, State and Federal agencies, Tribal governments, and other interested parties on the general information base, assumptions, and conclusions presented in the draft amendment. An electronic version of the draft recovery plan amendment was also posted on the Service's Species Profile website (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=5343).

We did not receive any responses to the request for public comments.

Summary of Peer and Partner Review Comments

In accordance with the requirements of the Act, we solicited independent peer reviews of the draft amendment from qualified representatives from the following: Bureau of Land Management (BLM), Natural Resources Department of the Tohono O'odham Nation, and researchers affiliated with the University of Arizona Herbarium, Arizona-Sonora Desert Museum, and Desert Botanical Gardens. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to the *Echinocactus horizonthalonius* var. *nicholii* (herein referred to as var. *nicholii*), management of its habitat and ecosystem, expertise in botany, genetics, conservation biology, land use or management relative to var. *nicholii* habitat, threats facing the var. *nicholii*, and rare plant propagation techniques. The qualifications of the peer reviewers are in the administrative record for this Recovery Plan amendment.

In total, we solicited review and comment from five peer reviewers and two partner agencies. We received comments from one peer reviewer and one partner agency. In general, the draft amendment was well-received by the peer reviewers and garnered positive comments. We thank the reviewers for their information and we have added specific information where appropriate.

We considered all substantive comments, and to the extent appropriate, we incorporated the applicable information or suggested changes into the final Recovery Plan amendment. Below, we provide a summary of specific comments received from the peer reviewer with our responses; however, we addressed many of the reviewer's specific critiques and incorporated their suggestions as changes to the final amendment. Such comments did not warrant an explicit response, and therefore, are not addressed here. We appreciate the input from all commenters, which helped us to consider and incorporate the best available scientific and commercial information during development and approval of the final Recovery Plan amendment.

Peer/Partner Review Comment (1): Commenter stated that the desert bighorn sheep *(Ovis canadensis*) is a major factor in the decline of the" var. nicholii" in the four study plots. After a water catchment was installed on the Waterman Mountains in 2007, researchers monitoring the

study plots observed an increase in fresh sheep scat near plots, encountered shallow scrapes where plants were missing, and frequent damage consistent with pawing.

Response: We agree that any impacts to the var. *nicholii* from desert bighorn sheep should be evaluated by investigating factors such as their diet and movement patterns within the Waterman Mountains. One of the implementing actions in the Recovery Plan is to 'study the relationship between herbivores and the cactus'. Although this particular action pertains to rodents and lagomorphs, it would be appropriate to also include bighorn sheep. Since the scope of this amendment process is limited to establishing quantitative recovery criteria only, we believe a thorough threat discussion can be developed in the next 5-year Status Review that is scheduled in 2021.

Peer/Partner Review Comment (2): The commenter requested clarification of whether a complete census is no longer necessary because the 3,700 population target threshold fulfills that requirement.

Response: Our estimated target of maintaining 3,700 total individuals over a minimum of 20-years is a threshold that when met, indicates when delisting can be considered. It does not replace the need for a complete population census but rather provides a quantitative and measurable criteria as required under section 4(f)(1)(B)(ii) of the Act.

Peer/Partner Review Comment (3): One peer reviewer commented that our assumption stating 'since individual "var. nicholii" continues to occur in the same areas of the Waterman Mountains for the past 30 years, plants have genetic variability to enable them to adapt' was unfounded.

Response: We agree with the reviewer and have modified our rationale in the final recovery plan amendment to focus on the taxon's geographic distribution. Our intention to justify how representation is met by the amended delisting criteria was to illustrate that no significant changes have occurred in the taxon's past and current distribution in the Waterman Mountains; and some plants are likely the original plant tagged in the 1980.