

Pebbles Navajo Cactus
(Pediocactus peeblesianus var. peeblesianus)

**5-Year Review:
Summary and Evaluation**



**U.S. Fish and Wildlife Service
Arizona Ecological Services Office
Phoenix, Arizona**

5-YEAR REVIEW
Pebbles Navajo Cactus
(Pediocactus peeblesianus var. peeblesianus)

1.0 GENERAL INFORMATION

1.1 Reviewers: Jeff Servoss, Fish and Wildlife Biologist, Arizona Ecological Services Office, Phoenix, Arizona, 602/242-0210 x237.

Debra Bills, Assistant Field Supervisor, Arizona Ecological Services Office, Phoenix, Arizona, 602/242-0210 x239.

Mima Falk, Plant Ecologist, Arizona Ecological Services Sub-Office, Tucson, Arizona, 520/670-6144 x225.

Lead Regional or Headquarters Office: Region 2, Southwest
Contact: Susan Jacobsen, Chief, Threatened and Endangered Species Division, 505/248-6641; Wendy Brown, Recovery Coordinator, 505/248-6664.

Lead Field Office: Arizona Ecological Services Office
Contact: Steven L. Spangle, Field Supervisor, 602/242-0210.

Cooperating Field Office(s): None

Cooperating Regional Office(s): None

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (USFWS) 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 Endangered Species Act (Act) (16 U.S.C. 1531 *et seq.*). We provided notice of this status review via the Federal Register (71 FR 20714) requesting information on the status of the Pebbles Navajo cactus (*Pediocactus peeblesianus peeblesianus*). No comments from the public were received. This 5-year review was completed using the best available information contained in USFWS files including the Pebbles Navajo Cactus (PNC) Recovery Plan (1984); survey/monitoring reports compiled since the taxon's listing in 1979, and other technical reports and peer-reviewed journal articles. We used this information to provide a historical context of the species' status, a synopsis of its status and threats, and as a basis for our final status recommendation.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 71 FR 20714, April 21, 2006.

1.3.2 Listing history

Original Listing

FR notice: 44 FR 61922

Date listed: November 28, 1979

Entity listed: Peebles Navajo Cactus (*Pediocactus peeblesianus* var. *peeblesianus*)

Classification: Endangered

1.3.3 Associated rulemakings: None

1.3.4 Review History: A 5-year review was initiated on July 22, 1985 (50 FR 29901) for all species listed before 1976, and in 1979-1980; a notice of completion with no change in status was published on July 7, 1987 (52 FR 25522). Another 5-year review was initiated on November 6, 1991 (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

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

Recovery priority number is 3; the degree of threat is high, the potential for recovery is high, and the listed entity is a subspecies (48 FR 43098).

1.3.6 Recovery Plan or Outline:

Name of plan or outline: Peebles Navajo Cactus (*Pediocactus peeblesianus peeblesianus*) Recovery Plan

Date issued: March 30, 1984

Dates of previous revisions, if applicable: Not Applicable

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes
 No (plan completed in 1984; recovery criteria are insufficient)

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes
 No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

Recovery criteria for the PNC are:

1. Maintain, protect, and enhance all existing natural populations.

Two core, high-density population areas are known for this species in Navajo County, Arizona. The larger population is approximately one mile east of Joseph City and the other, approximately 1.5 miles west-northwest of Holbrook (USFWS 1984). Scattered individuals occur with decreasing density within the immediate vicinity of these core populations.

The population closest to Joseph City occurs on U.S. Bureau of Land Management (BLM) lands although individuals may also occur on Arizona State Trust lands. Joseph City monitoring plots occur in areas of high species density and are fenced. Fencing has effectively addressed initial concerns about adverse effects such as trampling or crushing from land use activities such as off-highway vehicle (OHV) use, gravel mining, and livestock grazing within the monitoring plots, but PNC occurring outside these fenced areas do not receive these protections.

The second core population area near the community of Holbrook, Arizona occurs on private lands. Approximately 70 percent of suitable habitat for the PNC occurs on privately-owned lands (pers. comm. Jony Cockman, BLM Safford Field Office). The occupied habitat on private land occurs on a large, single family-owned parcel but may also occur on State Trust lands. Conservation groups such as The Nature Conservancy (TNC) have been actively working with the private landowner on conservation of PNC. However, changes in staffing at TNC have affected relationships between parties. Additionally, family members who recently inherited the land have differing opinions on how the land should be managed (pers. comm. Mima Falk, USFWS).

In 1984, the BLM completed a Habitat Management Plan (HMP) for the PNC as recommended in the recovery plan. Several management actions were prescribed in the HMP to help address threats to PNC. Specifically, these actions called for 1) construction of a 30-acre enclosure to protect PNC from livestock and OHV use; 2) initiation of the withdrawal of 420 acres of occupied habitat from mineral removal; 3) monitoring of PNC populations on BLM lands for a minimum of ten years; 4) initiation of an intensive inquiry into BLM lands for the purpose of identifying new populations to include in withdrawn lands; 5) maintenance of fences; 6) conducting a fecal analysis of resident rabbit (*Sylvilagus* sp. and *Lepus* sp.) and rodent (*Neotoma* sp.) species to determine predation risk to PNC; 7) providing aerial surveillance of area habitat to determine potential PNC; 8) investigating feasibility of OHV road designations to protect occupied PNC habitat; and 9) investigation of land acquisition of occupied habitat. As of 2005, items 1-4, 7, and 9 had been completed.

In 1985, 420 acres [within what came to be the Tanner Wash Area of Critical Environmental Concern (ACEC), described below] were classified as the HMP Area for the PNC where specific management was to occur. The HMP area incorporated all known occupied PNC habitat at the time of its designation. Since that time, however, an additional 10 acres of occupied habitat were discovered in 1996 and up to 160 acres of occupied habitat were discovered from 2004 to 2005, although thorough surveys from the most recent discovery are still needed.

In 1989, the BLM created the 4,650 acre Tanner Wash ACEC to help protect several populations of PNC. The ACEC is comprised by 950 acres of Federal land, 1,280 acres of State Trust land, and 2,420 acres of private land. Encompassing all known PNC occupied habitat on Federal land, the ACEC closed 30 acres to motorized vehicles and limited motorized travel elsewhere to existing roads and trails, prohibited land use authorizations, initiated mineral withdrawal on 950 acres, and prohibited oil and natural gas development. However, ACEC designation does not specifically exclude some land activities including gravel mining and livestock grazing, unless specifically requested. The outcomes of such management requests are not guaranteed.

2. Increase the present number of individuals from approximately 1,000 to 10,000.

Repeated inventory and monitoring work indicates that the PNC is comprised of few populations with low numbers of cacti. Agency and species experts concur that a ten-fold increase may not be a reasonable expectation or otherwise representative of species recovery. Instead, species experts intend for research efforts to focus on population viability rather than population density analyses.

Inventories performed in 2004 and 2005 discovered sparsely populated, but occupied PNC habitat in six different locations within the immediate vicinity of previously known locations. A minimum of 3, 12, 20, 23, 28, and 30 cacti were counted in these six locations which consisted of two locations on private land and the remaining four were on BLM lands (pers. comm. Jony Cockman, BLM Safford Field Office).

3. Curtail collecting through enforcement programs and through development of a program to assist commercial propagation.

Illegal collecting pressure originally suspected at the time the PNC recovery plan was drafted was suspected to be high due to the relative rarity of PNC. However, monitoring and inventory work indicate that collection has not been documented. The main threats to PNC are ground disturbance activities such as livestock grazing and OHV use. Often, OHV use in occupied habitat is associated with petrified wood collecting which is a legal practice within the Tanner Wash ACEC.

Furthermore, managers at the Mesa Garden nursery in Belen, New Mexico have successfully propagated the PNC in captivity and supply seeds to cactus collectors interested in this species. Agency and species experts believe the majority of cactus collectors use this means to acquire the PNC for their private collections as it is both permitted and does not affect wild populations (pers. comm. Steve Brack, Owner, Mesa Garden).

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:

Since the last official review of this species' status, investigations into ecological requirements and the life history of the PNC have occurred, as recommended by the recovery plan. Discussion of new information is presented below in the appropriate subheading.

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:

Twenty years of monitoring data have been collected and analyzed on this species, primarily by Phillips and Phillips (1985; 1995; 1997; 2004), Phillips et al. (1985; 1988; 1989; 1990), and others. Monitoring data from 2005 through 2007 have been collected but not yet analyzed. The following is a summary of the information established for the PNC since the 1985 review.

The PNC is an endemic species to Arizona occupying a very small geographic area (7 miles in length by 1 mile in width) extending northwest to southeast within the immediate vicinity of Joseph City and Holbrook, Navajo County, Arizona (see Figure 1.) (USFWS 1984). The PNC occupies low hills in the Plains and Great Basin Grassland biotic community from near Joseph City extending northwest to the Marcou Mesa region northwest of Holbrook (Brown and Lowe 1980; ARPC 2001; AGFD 2004). The PNC occurs between 5,100 and 5,650 feet above sea level on gentle slopes on all facing aspects (Stuart et al. 1972; USFWS 1984; AGFD 2004).

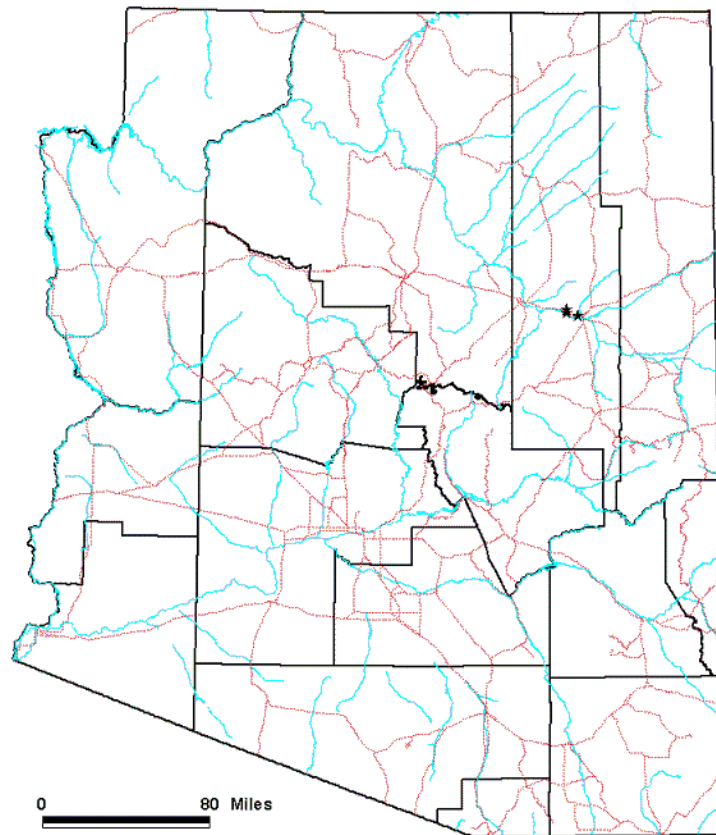


Figure 1. Distribution map for Peebles Navajo cactus. Courtesy of the Heritage Database Management System, Arizona Game and Fish Department.

PNC occurs at low to moderate densities that are often widely scattered, sometimes in clumps, even when apparently suitable habitat is contiguous (Heil et al. 1981). There are several factors that effect the density and distribution of PNC populations including 1) specialized soil requirements; 2) cold winters; 3) moist, cool springs; 4) summer dormancy; and 5) drying-out periods [Phillips et al. 1979; Heil et al. 1981; Benson 1982; Brack (unpublished manuscript); USFWS 1984]. Clusters of this species can vary widely from less than 30 to over 200 individuals, usually have adequate size class distribution, and are influenced greatly by the timing and amount of precipitation. Approximately 30 percent of PNC populations occur on public lands administered by the BLM or the Arizona State Lands Department with the remaining populations occurring on private lands. In the mid-1980s, we determined there to be eight known populations of PNC representing approximately 1,000 – 1,200 individual plants. However, this species can be difficult to detect due to its small stature and its ability to retract into the ground during dry periods.

Population demographic data generated by annual monitoring of core population areas from 1985 through 2004 provides a 20-year period for which to examine population trends of PNC over time and is summarized in Phillips and Phillips (2004). For year-to-year examination of monitoring data over the 20-year time frame and for historical background, please refer to the various monitoring reports on file. We use Phillips and Phillips (2004) exclusively to summarize the population trends for PNC in meeting the objectives of this status review.

The 20-year population trend for PNC can best be described by population increases in wet years, followed by high mortality stemming from long-term drought conditions and increased herbivory. As of 2004, population trends in cactus numbers have stabilized to some degree, but overall population status has declined and is best described by lower total numbers of cacti and on-going mortality rates that are suspected to exceed recruitment of sexually mature adults (see Table 1) (Butterwick 1985; Phillips and Phillips 1985; 1995; 1997; 2004; Phillips et al. 1985; 1988; 1989; 1990).

Over the 20-year period, Phillips and Phillips (2004) described the most “striking change” as the “heavy loss of adult individuals in all plots occurring between 1998 and 1999 in Plot 4, between 1998 and 2000 in Plot 3, and between 2000 and 2001 in Plots 1 and 2.” Lesser declines also occurred during this period in the seedling and juvenile size classes (Phillips and Phillips 2004). The number of total plants in all three plots near Joseph City declined by a total 77.7% between 1998 and 2001, whereas the total number of plants per plot near Holbrook decreased in number by 44.4 percent in two steps between 1998 and 2001 (Phillips and Phillips 2004). Monitoring data of these plots during the years 2003 and 2004 marked increases in total individual adults as compared to 2001; a 19.3% increase at the three Joseph City plots and 11.1% increase at the Holbrook plot.

Plot	Year																			
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04
H1-A	24	25	29	31	31	30		35	35		40	40	50	54	39	40	41	30	39	36
JC1-A	35	36	35	40	39	39	39	41	38	51	48	45	56	66	44	66	10	11	19	22
JC2-A	27	32	33	36	36	37	43	43	42	45	44	46	54	58	53	63	17	17	18	30
JC3-A		18	20	22	19	22	24	26	28	30	36	35	35	37	10	3	4	3	5	10
H1-J	8	12	9	10	11	21		27	28		32	26	18	12	20	15	14	17	12	16
JC1-J	5	10	15	21	21	27	27	22	25	28	36	41	37	34	42	30	17	15	7	16
JC2-J	11	15	17	18	20	19	17	26	27	37	47	47	55	51	42	34	15	17	21	11
JC3-J		9	10	10	10	9	13	11	12	8	9	17	24	25	20	8	4	4	3	6
H1-S	3	12	10	19	22	21		13	15		11	10	10	5	4	5	7	8	8	4
JC1-S	15	26	22	65	86	50	45	49	62	79	88	23	16	17	14	16	8	10	9	4
JC2-S	17	27	23	60	75	68	52	56	88	85	85	34	18	16	11	23	6	4	2	2
JC3-S		12	9	24	24	25	21	22	19	24	22	13	17	15	0	1	0	0	0	1

Table1. Numbers of plants from 1985 through 2004 on monitoring plots Holbrook 1 (H1), Joseph City 1 (JC1), Joseph City 2 (JC2), and Joseph City 3 (JC3); Adult (A), juvenile (J), seedling (S). Source: Phillips and Phillips (2004).

Causes for these significant population declines were not been determined, but persistent drought conditions and subsequent increases in herbivory were noted as likely causes (Phillips and Phillips 2004). Where dead plants were observed in place, drought was the presumed source of mortality, however in most cases; plants were simply missing with small depressions remaining in the soil indicating plant removal (Phillips and Phillips 2004). Spine clusters and individual spines were observed at many sites where plants had been removed leading Phillips and Phillips (2004) to conclude that rodent or rabbit herbivory removed the plants rather than collection by humans. Further supporting evidence for herbivory included a preponderance of rabbit feces in the area and missing seedlings w in the immediate vicinity of missing adult plants. Phillips and Phillips (2004) hypothesized that drought conditions instigated higher predation on PNC and other cacti species (which is normally a secondary source of food and water during wet years). Predator control was also cited as a potential indirect factor that favored artificially high rabbit populations (Phillips and Phillips 2004).

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

We found no information available for this species pertaining to genetics, genetic variation, or trends in genetic variation.

2.3.1.4 Taxonomic classification or changes in nomenclature:

The genus *Pediocactus* consists of a small group of mostly cold-hardy, globose to cylindrical stemmed cacti in the western and southwestern United States with considerable variation in morphology and high endemism (Benson 1962; 1969; 1982; Heil et al. 1981).

Porter (2002) conducted a phylogenetic study of *Pediocactus* with special reference to *Pediocactus peeblesianus*. DNA sequencing analysis statistically supports the inclusion of nine species under the monophyletic genus *Pediocactus* (*P. bradyi*, *P. despainii*, *P. knowltonii*, *P. nigrispinus*, *P. paradenei*, *P. peeblesianus*, *P. sileri*, *P. simpsonii*, and *P. winkleri*) (Porter 2002). However, recent questions have been raised about the genetic distinctiveness of the two varieties under *P. peeblesianus* due to the similarity of morphological characteristics of both races in some populations (Porter 2002). Porter (2002) concluded that *P. peeblesianus* var. *peeblesianus* possessed a unique chloroplast type as compared to *P. peeblesianus* var. *fickeiseniae*. Therefore, Porter (2002) concluded that adequate genetic support exists for the maintenance of both races as distinct under *P. peeblesianus*.

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

PNC is an endemic species to Arizona occupying a very small geographic area (7 miles in length by 1 mile in width) extending northwest to southeast within the immediate vicinity of Joseph City and Holbrook, Arizona (USFWS 1984) (see Figure 1). The cacti that occur on public lands occur in Township 18 North, Range 19 East, Sections 24 and 14. The spatial distribution of PNC has remained largely the same since listing of this species (Phillips and Phillips 2004). However, new areas of low-density PNC occupation, adjacent to previously known core population centers, were detected in 1996 and from 2004 to 2005; both instances were in Section 14.

Due to the tiny physical stature of this species and the difficulty in detecting it during inventory work in suspected locations, the discovery of these previously unknown cacti in close proximity to core population areas likely represents the historical range of the species rather than evidence for an expanding distribution.

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

Data on ecological requirements and microclimatic conditions were collected as part of the long-term monitoring work performed by Phillips et al. (1985; 1988; 1989; 1990) and Phillips and Phillips (1986; 1995; 1997). Because the PNC is of such small stature, special emphasis was attributed to climatic conditions at the soil surface where fluctuations in temperature can be extreme as compared to ambient conditions. In 1986, microclimatic data were gathered weekly over an 11 week period from April 15 through July 6 from six ground-level weather stations located in areas immediately adjacent to dense populations, in regional areas without PNC populations, and near the permanent weather station near Winslow, Arizona (Phillips and Phillips 1995). Similar procedures were completed again in 1987 which included data for other months over the calendar year, and were compared with a 22-year record of weather information obtained from the weather station in Winslow.

Analysis of data collected over different periods of the calendar year indicated air temperatures ranging from 27-32°C (80-90°F) between 1000 hours and 1800 hours every day during the flowering period of April in 1987 and 1988 (Phillips and Phillips 1995). Air temperatures at the soil surface displayed significant fluctuation by May 10 of each year as expected with a range from 13-44°C (55-111°F) (Phillips and Phillips 1995). From June through October, air temperatures at the soil surface continued to occur above 44°C (111°F) (Phillips and Phillips 1995). Air temperatures at the soil surface fluctuated by only 4°C (39°F) during the months of September through October and by mid-November, highs were recorded as ranging from 4-15°C (39-59°F) and lows ranged from -7 to -1°C (19-30°F) (Phillips and Phillips 1995).

Precipitation data from the weather station collected during the 22-year period confirmed that not only were events highly localized in occurrence, they were temporally very sporadic, which resulted in relatively little precipitation occurring in occupied PNC habitat on average. Annual precipitation in the form of rain totaled 3.7 inches at three of four sites and snow persisting on the ground during the winter months at some sites (Phillips and Phillips 1995). Soil moisture levels ranged from 2.05-16.72 percent with strong but temporary correlation to precipitation events which were expected of highly porous soils (Phillips and Phillips 1995).

PNC is a narrow endemic restricted to specialized and localized soils. Mycorrhizal analysis and soil data parameters such as associations, texture, cementing agents, permeability and water availability, gypsum content, and bedrock source were also investigated both immediately adjacent to dense populations of PNC and in habitats where the species does not grow (Phillips and Phillips 1995). PNC was found to occur in soils that were shallow to deep, well to extremely well drained, and that formed in mixed alluvium belonging to the Gypsiorthids-Torriorthents-Haplargids Association (Phillips and Phillips 1995). Microelement values were determined to be low to very low but characteristic for desert soils (Phillips and Phillips 1995). The roots of PNC are heavily colonized

with vesicular-arbuscular endomycorrhizae, including *Glomus deserticola* (Phillips and Phillips 1995).

In summary, PNC has a very narrow distribution and very high specificity in its habitat requirements. The implications therefore stress active management of occupied habitat to prevent adverse impacts (or effects) that may occur from land management activities.

2.3.1.7 Other: None

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:

Progress has been made in identifying and protecting habitat on public and private lands that supports PNC populations since the Federal listing of this species. However, residential and commercial development, and its infrastructure, remains a potential threat to the PNC on private lands. To date, there are no long-term conservation programs, such as conservation easements, in place for these key parcels; but, stakeholders remain optimistic that such programs may be implemented in the future. Non-government organizations continue to negotiate with private property owners to this end.

A total of 40 acres have been fenced from livestock, OHV, and gravel mining activities in the Tanner Wash ACEC which has effectively reduced risks to cacti from trampling or crushing.

In 1984, the BLM completed a Habitat Management Plan (HMP) for the PNC. Several management actions were prescribed in the HMP to address threats to PNC. Specifically, these actions called for 1) construction of a 30-acre enclosure to protect PNC from livestock and OHV use; 2) initiate the withdrawal of 420 acres of occupied habitat from potential mining operations; 3) monitor PNC populations on BLM lands for a minimum of ten years; 4) initiate an intensive inquiry into BLM lands for the purpose of identifying new populations to include in withdrawn lands; 5) maintain fences; 6) conduct a fecal analysis of resident rabbit and rodent species to determine predation risk to PNC; 7) conduct aerial surveys to determine potential for additional PNC habitat in the area; 8) investigate feasibility of OHV road designations to protect occupied PNC habitat; and 9) investigate land acquisition of occupied habitat. As of 2005, items 1-4, 7, and 9 have been completed.

In 1985, 420 acres within the Tanner Wash ACEC was classified as the HMP area for PNC specific management. The HMP area incorporated all known occupied PNC habitat at the time of its designation. Since 1985, an additional 10 acres of

occupied habitat were discovered in 1996, and up to 160 acres of occupied habitat were discovered from 2004 to 2005, although thorough surveys to establish population density have not been conducted (pers. comm. Dr. Barbara Phillips, Zone Botanist, Coconino, Kaibab and Prescott National Forests).

In 1989, the BLM created the 4,650 acre Tanner Wash Area of Critical Environmental Concern (ACEC) to help protect several populations of PNC. The ACEC is comprised by 950 acres of Federal land, 1,280 acres of State Trust land, and 2,420 acres of private land. The ACEC encompasses all known PNC occupied habitat on Federal land, closed 30 acres to motorized vehicles, limited motorized travel to some existing roads and trails, prohibited land use authorizations, initiated mineral withdrawal on 950 acres, and prohibited oil and natural gas development. However, ACEC designation does not specifically preclude certain land activities, such as gravel mining and livestock grazing, unless specifically requested and the outcomes of such management decisions are not guaranteed.

Distribution of the PNC lies wholly within the Apache Butte Allotment, which is currently undergoing consultation under section 7 of the Endangered Species Act. The proposed action includes grazing of 756 animal unit months year-round under authority of the BLM Phoenix District RMP (BLM 1988).

The Apache Butte allotment contains 32,496 total acres with 6,703 acres (20.6%) of BLM-owned lands; private lands represent 68.7% and state lands represent 10.6% of the allotment. The allotment is divided by Interstate 40. The parcel north of Interstate 40 contains occupied PNC habitat and is approximately 9,920 total acres of which 14.5% is state land, 48.4% is private land, and 37.1% is BLM land (pers. comm. Jony Cockman, BLM Safford Field Office).

The 1996 Safford Grazing Biological Evaluation (BE) and the subsequent 1997 Safford Grazing Biological Opinion (BO) did not address PNC. However, it was later addressed under the Phoenix District Portion of the Eastern Arizona Grazing Environmental Impact Statement (EIS), where it was determined that livestock grazing was “Not Likely to Adversely Affect” the PNC. According to the first amendment to the BO for the Phoenix District Portion of the Eastern Arizona Grazing EIS, USFWS concurred with that determination (USFWS 1999).

Livestock grazing also occurs in occupied, unprotected PNC habitat on private lands.

Nonnative species, most notably camelthorn (*Alhagi maurorum*), have been identified as a potential future threat to the PNC (pers. comm. Dr. Barbara Phillips, Zone Botanist, Coconino, Kaibab, and Prescott National Forests). Commonly observed with other nonnative invasive plant species in the southwest, camelthorn may out-compete the PNC and other native species. A secondary risk of increased ground cover caused by a nonnative species is the enhanced risk of

fire. The habitat in which the PNC occurs is not fire adapted and has not experienced significant fire losses to date (pers. comm. Dr. Barbara Phillips, Zone Botanist, Coconino, Kaibab and Prescott National Forests). Camelthorn has not been identified in habitat on the mesas that is occupied by PNC, but it has been observed “down below the mesas very abundantly, however, and spreading” (pers. comm. Dr. Barbara Phillips, Zone Botanist, Coconino, Kaibab and Prescott National Forests).

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

Illegal collection of PNC was of initial concern at time the PNC was listed due to its extreme rarity and subsequent appeal for collectors. Currently, we do not suspect illegal collection to be a significant concern. The PNC is being artificially propagated and is readily available to cactus collectors through legal channels, which has diminished this threat to wild populations (pers. comm. Steve Brack, Owner, Mesa Garden). Although PNC collection from Federal lands is prohibited, BLM does not specifically enforce against wild collection of the PNC, nor does the agency monitor collecting pressure on this species on its lands (pers. comm. Jony Cockman, BLM Safford District).

No other form of collection (scientific, educational, etc.) is perceived as a current threat to PNC populations.

2.3.2.3 Disease or predation:

We are not aware of any research on disease in PNC or related species that is available and therefore have no information on significant threats of disease to PNC.

Small mammalian herbivores such as rabbits and/or rodents have been observed eating PNC as vegetative preferences in diet shift in response to drought conditions (Phillips and Phillips 1997; 2004). Due to the importance of precipitation on germination and recruitment of PNC cohorts, drought conditions not only adversely affect the PNC by limiting these key life history events, but synergistically amplify adverse affects of herbivory. This has the potential to appreciably affect populations of PNC because of the inherent risks associated with this species’ limited recruitment potential. Predicted warming and increased drought conditions in the southwest due to global climate change are likely to accelerate and exacerbate these effects (see discussion under 2.3.2.5, below). As stated previously, predator control may also positively influence populations of rabbits and rodents, which could heighten levels of rabbit and rodent herbivory on PNC, especially during drought conditions. However, more research is necessary to confirm these relationships.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The creation of an ACEC has greatly contributed to the protection of the PNC. This designation increases the conservation potential for the PNC within its boundaries and is a significant enhancement to the previous regulatory mechanisms. Protection of listed plants is provided to the extent that section 9 (a)(2)(B) of the Act requires a Federal permit to “remove or reduce to possession of endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.” No change that pertains to the inadequacy of regulatory mechanisms has been noted since the 1979 listing.

Arizona’s native plant laws provide specific protections for federally listed species on public and private lands. PNC can be salvaged from private property with a permit from the Arizona Department of Agriculture, but can not be sold for commercial purposes. There are no specific protections for occupied habitat under Arizona native plant laws.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Drought is identified above as a significant concern for the conservation and recovery of the PNC. Phillips and Thomas (2005) provided streamflow records that indicate that the drought Arizona experienced between 1999 and 2004 was the worst drought since the early 1940s and possibly earlier. Prolonged drought conditions have been observed in the immediate region where the PNC occurs as well as other areas statewide (Phillips and Phillips 2004). Should current drought conditions persist for several years into the future, the recovery potential for the PNC may become severely compromised. The Intergovernmental Panel on Climate Change (IPCC) stated, “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level” (IPCC 2007). According to 18 of 19 regional climate models, 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 within years or decades and annual mean precipitation levels will continue to decrease over the next century (Seager et al. 2007). Persistent drought conditions over years are likely to reduce the frequency and duration of flowering and/or germination events, lower the recruitment of individuals, compromise the viability of populations, lessen the recovery potential for this species, and therefore adversely affect the long-term persistence of the PNC. Increased risk of invasive species such as camelthorn and an associated increased risk of wildfire in PNC habitat, as well as increased herbivory by rabbits and rodents are identified threats that may be exacerbated by long-term drought conditions associated with climate change.

2.4 Synthesis

In summary, we have been able to develop a more thorough understanding of the status and location of extant PNC populations through survey and long-term monitoring efforts brought about by dedicated researchers and agency staff. Over the 20-year survey period from 1985-2004, the most significant event in population trends within monitoring plots occurred between 1998 and 2001 where significant losses of individual plants was observed in the adult age class (Phillips and Phillips 2004). This period was followed by two years of increases in the total numbers in the adult age class from 2003-2004 (Phillips and Phillips 2004). Additional, low-density populations were discovered adjacent to core population centers in 1996 and in 2004-2005. Overall, however, long-term survey and monitoring efforts indicate a downward trend in the status of the PNC in terms of total individual plants, most notably in plots where recruitment is exceeded by mortality in the adult age class.

These efforts have also broadened our understanding of this species' ecological and physical requirements as well as enhanced our understanding of what habitat parameters most influence PNC population dynamics. Habitat requirements for the PNC have been determined to include well to extremely well drained soils that formed in mixed alluvium belonging to the Gypsiorthids-Torriorthents-Haplargids Association, low soil microelement values, and the presence of vesicular-arbuscular endomycorrhizae, such as *Glomus deserticola*, for colonization of the roots (Phillips and Phillips 1995). The PNC occurs between 5,100 and 5,650 feet above sea level on gentle slopes on all facing aspects (Stuart et al. 1972; USFWS 1984; AGFD 2004). These attributes of the species' habitat and distribution are all important for the PNC and indicative of a narrow endemic and habitat specialist. Collectively, this information allows land managers a better opportunity to effectively manage lands for the continued existence and recovery of this species and important recovery activities have been implemented and continue to contribute to conservation of this species.

Recent investigation of this species' taxonomy described by Porter (2002) has also confirmed the uniqueness and genetic distinctiveness of the PNC and strengthened incentives for conservation and recovery.

Persistent drought and increased small mammal herbivory have been the most significant threats to PNC in recent years and may increase due to the effects of climatic warming in the southwest. Development and associated land use activities are also considered significant threats to the continued existence of PNC in the foreseeable future. Some protection exists for PNC on Federal lands. However, the relative uncertainty of future private lands management of occupied habitat, where the majority of populations occur, is of particular concern for the recovery of the PNC. Conservation efforts fostered through partnerships and cooperation between private landowners, non-governmental conservation groups, researchers, and Federal agencies offer continued opportunities for conservation and potential recovery of the PNC. Specifically, conservation activities that focus on habitat acquisition and protection will be important elements to reduce anthropogenic threats and will contribute to the long-term viability of this taxon.

In this status review for PNC, we have examined 1) the monitoring data gathered from 1985-2004; 2) the habitat and climatic requirements for this species; 3) the most current taxonomy of the species; 4) declines in population trends within monitoring plots over time in overall numbers of individual plants; 5) the apparent vulnerability of this species to long-term drought that may be further compromised with future climate change; 6) the influence of drought conditions on herbivory rates on PNC; 7) the distribution of the species in relation to land ownership and subsequent management opportunities, in particular the significant percentage of plants that occur on private land with an uncertain future; 8) the threats to the species that are known or suspected; and 9) the status of recovery activities that were prescribed in the 1984 recovery plan for PNC.

The PNC is a highly endemic habitat specialist with a significantly limited distribution, making it highly vulnerable to extinction from anthropogenic threats and localized stochastic events. We have documented an overall decline in the total numbers of individual plants, through twenty years of reading monitoring plots. In addition, little is known about the condition of the seed bank within occupied habitat, although preliminary indicators suggest that it is limited based on recruitment data collected from long-term monitoring plots. We acknowledge the potential for long-term climate change to result in drier conditions regionally, as well as the species' sensitivity to drought conditions and to subsequent increases in herbivory as a result of precipitation declines. Finally, we also recognize the tenuous status of this species with respect to the significant percent of its distribution that occurs on private lands and the tenuous future of those lands. In consideration of all the above, we maintain that the Peebles Navajo cactus remains in danger of becoming extinct throughout its small distribution and recommend its status remain as Endangered.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

3.2 New Recovery Priority Number: 6; the degree of threat is high, the potential for recovery is low, and the listed entity is a subspecies (48 FR 43098).

Brief Rationale: While six of the nine management actions have been completed since the recovery plan for PNC was finalized in 1984, the PNC has suffered from continued declines in total numbers within monitoring plots, and most likely rangewide. Long-term drought is predicted to continue which is likely to continue to result in reduced recruitment and declines in population sizes as well as lead to continued herbivory on the PNC as rabbits and rodents turn to alternative sources of food. Corrective management options for effects from climate change are few considering one of the primary threats is climactic in origin. Another key threat to the species is the uncertain future of PNC that occur on private property. However, unlike threats from long-term drought, opportunities may exist to secure conservation, in the short-term, of PNC on private land.

3.3 Listing and Reclassification Priority Number: N/A

Reclassification (from Threatened to Endangered) Priority Number: ____

Reclassification (from Endangered to Threatened) Priority Number: ____

Delisting (Removal from list regardless of current classification) Priority Number: ____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS:

The recovery plan for this species requires revision. The number of plants and populations referenced in the current recovery plan that are required for long-term viability of the species are unrealistic and should be revised. Recovery criteria should focus on habitat protection and acquisition, seed banking, researching dispersal mechanisms, seed collection and long-term storage, as well as inclusion of this species into the Center for Plant Conservation Collection.

In addition, coordination with species experts needs to occur with an emphasis on conservation planning with respect to implementation of actions in the event of continuing long-term drought. These activities may include, but are not limited to, exploring new areas for transplants, captive propagation and reintroduction, or other means to help secure existing populations using artificial means (water supplementation, etc.).

Because the known historical and current distribution of the PNC is limited, we view these actions as essential, in conjunction with continued management and enforcement of protection measures. We also recommend concerted efforts be implemented to ensure long-term viability of this species on private lands through various conservation incentive programs available to private landowners.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Peebles Navajo Cactus
(*Pediocactus peeblesianus* var. *peeblesianus*)**

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

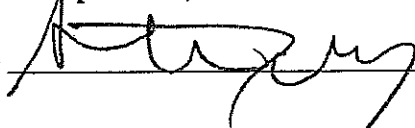
Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Jeff Servoss, U.S. Fish and Wildlife Service, Arizona Ecological Services Office

FIELD OFFICE APPROVAL:

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

Approve



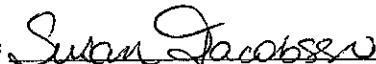
Date

8/11/08

REGIONAL OFFICE APPROVAL:

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

Approve



Date

8.28.08