U.S. FISH & WILDLIFE SERVICE
5-YEAR REVIEW
GENERAL INFORMATION

Species reviewed: (Pima pineapple cactus / *Coryphantha scheeri var. robustispina)*

FR Notice: **70 FR 5460**

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METHODOLOGY

This review was conducted through public review notification and a comprehensive process including several peer reviews. An announcement in the Federal Register was published on February 2, 2005 (70 FR 5460), soliciting new information on Pima pineapple cactus (PPC) from the public. Of specific interest to us (FWS) were two recent studies of geographic variation in characters that included PPC. These two studies reached different conclusions regarding the taxonomic status of PPC. As part of the public review process, we initiated a formal peer review of the two taxonomic studies and solicited comments regarding the methods and conclusions of each study. A separate formal peer review was initiated on a preliminary population estimate that was submitted to us. Peer reviewers were chosen based on their knowledge and experience with Arizona flora, expertise in taxonomic analyses, affiliation with local herbaria, expertise in Cactaceae taxonomy, and expertise in plant population sampling.

Formal requests for peer review were sent to the following individuals (those who responded are marked with an asterisk (*) :

Reviewers for the taxonomic studies:

Dr. Richard Felger Private Consultant

Dr. John Rebman	Herbarium Curator, San Diego Natural History Museum
Dr. Andrew Salywon*	Research Molecular Geneticist, Agricultural Research Service
Dr. Mark Dimmitt	Curator of Plants, Arizona-Sonora Desert Museum
Dr. Tom Van Devender	Research Scientist, Arizona-Sonora Desert Museum
Dr. Richard Worthington*	Department of Biological Sciences, University of Texas, El Paso
Mr. John Anderson*	State Botanist (Arizona) Bureau of Land Management
Ms. Wendy Hodgson (passed it on to Dr. Butterworth)	
Dr. Charles Butterworth*	Research Scientist, Desert Botanical Garden
Dr. Leslie Landrum	Herbarium Curator, Arizona State University
Dr. Donald Pinkava*	Professor Emeritus, Arizona State University
Dr. Steve McLaughlin*	Herbarium Curator, University of Arizona
Dr. Guy McPherson*	Professor, School of Natural Resources, University of Arizona
Dr. Loyal Mehrhoff*	Chief, Biological Resource Management, National Park Service
Dr. Bruce Parfitt*	Biology Department, University of Michigan (co-author of the Flora of North America Cactaceae treatment)
Dr. J. Mark Porter	Research Scientist, Rancho Santa Ana Botanic Garden
Dr. A. Michael Powell	Herbarium Curator, Sul Ross University, Texas
Ms. Sue Rutman	Botanist, Organ Pipe Cactus National Monument
Dr. Robert Steidl	Professor, School of Natural Resources, University of Arizona
Mr. Nigel Taylor	Kew Royal Botanic Gardens, United Kingdom
Dr. Allan Zimmerman*	Private Consultant, (co-author of the Flora of North America Cactaceae treatment)

We also received comments from Dr. Charlie McDonald (U.S.D.A. Forest Southwest Regional Botanist), Ms. Jackie Poole (Botanist, Texas Parks and Wildlife Department), and Mr. Phil Jenkins (Curatorial Specialist Sr., Herbarium, University of Arizona).

Reviewers for the preliminary population estimate:

Dr. Bruce M. Pavlik*	Professor of Biology, Mills College
Mr. John Willoughby*	State Botanist, Bureau of Land Management, Sacramento, California
Dr. Eric S. Menges*	Archbold Biological Station, Lake Placid, Florida
Dr. Joyce Maschinski*	Conservation Ecologist, Fairchild Tropical Botanic Garden, Miami, Florida
Dr. Guy McPherson	Professor, School of Natural Resources, University of Arizona

We received no new information on the species during the public review. We have addressed, below, a preliminary population estimate for PPC (WestLand Resources 2004) that we received earlier this year, before the 5-year review process began. The preliminary population estimate and associated documents were sent out for separate peer review in June 2006.

BACKGROUND

Species' Recovery Priority Number at start of review:

Recovery priority number was 3 at the start of the review.

Species status:

Species status is unknown (this is a species where additional survey work is required to determine the current trend in status) as of January 2007.

Recovery achieved:

The recovery achieved is 1 (0 – 25 percent recovery achieved) as of January 2007.

Listing history

Original Listing

FR notice: 58 FR 49875
Date listed: September 23, 1993
Classification: Endangered, with no critical habitat.

Review History

This is the first review for this species since its listing in 1993.

Recovery Plan or Outline

PPC has no recovery plan. A recovery team was formed in 1998, but the team has not met in over four years. A draft recovery plan was completed, but was not sent out for public review. There is no recovery outline. A draft recovery plan is scheduled for completion in 2007.

REVIEW ANALYSIS

Current Species Status and Updated Information

Improved Analyses -- Has application of improved analytic methods resulted in relevant new information? Yes.

Since the original listing of Pima pineapple cactus in 1993 there have been significant improvements in Geographic Position System (GPS) technology and associated mapping capabilities. The Arizona Game and Fish Department (AGFD) maintains a database of all known PPC locations on their Natural Heritage database. Known locations have been reported to AGFD voluntarily by the private sector or documented by the Fish and Wildlife Service through section 7 consultations or federally funded surveys. Prior to this database, a system to track or map the locations of PPC was not in place. This central database allows us to evaluate PPC distribution based on land ownership and geographic and jurisdictional boundaries. The database is also used to provide information on PPC populations affected by development.

Biology and Habitat -- Provide an updated status of the species, citing new information about the species and its habitat.

- 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.

  It is difficult to address abundance and population trends for this species. PPC has very general habitat requirements. This species is found at elevations below 4,000 ft, in the desert scrubland or the ecotone between desert scrubland and desert grassland, on relatively flat areas (less than 10 percent slope). It is geographically restricted to southeast Arizona, specifically the valley floors between the Baboquivari Mountains on the west and the Santa Rita Mountains to the east, and in low densities in the northern areas of Sonora, Mexico. Baker (2005) found that there are distinct geographic gaps between the distribution of this subspecies and that of the nearest subspecies in New Mexico. As a consequence of its general habitat requirements, considerable suitable habitat for this species appears to exist in Pima and Santa Cruz counties, much of which is unoccupied. PPC occurs at low densities widely scattered, sometimes in clumps, across the valley bottoms. The species can be difficult to detect, especially in dense grass cover. For this reason, systematic surveys are expensive and have not been conducted in much of its range. Therefore, location information in the database has been gathered opportunistically, either through small systematic surveys, usually associated with specific development projects, or larger surveys that are typically only conducted in areas that seem highly suited for the species. Furthermore, our knowledge of this species is gathered primarily through the section 7 process; therefore, we only see projects that require a Federal permit or have Federal funding. There are many projects that occur within the range of PPC that do not undergo section 7 consultation, and we have no information regarding the status or loss of plants or habitat associated with those projects.

  A preliminary population estimate of 100,000 to 150,000 individuals of PPC (WestLand Resources 2004) was submitted to us prior to the initiation of the 5-year review. The work was not solicited by us. We have evaluated the methods used to derive these estimates and find several features that greatly limit their reliability and utility. For example, the derivation of range-wide population estimates from the densities of individuals detected on individual survey plots relies on the sampled plots being representative of densities throughout the range-wide population. To ensure that survey plots are representative, they should be selected through a randomizing procedure (Caughley 1977, Seber 1982). The samples used in these population estimates were not selected at random, but appear to be selected based on the need for researchers to have sufficient population densities for demographic studies, or the result of evaluation by landowners and permitting agencies of the risk that the species may be present. These factors would bias the selected plots toward species presence and

abundance and therefore inflate range-wide population estimates. This type of bias can be exacerbated when individuals tend to be clumped in their occurrences, which is the case for PPC. Other problems with these estimates are the relatively small portion (less than 2.5%) of the range that was sampled, and the contribution of relatively few, clumped, plots with "high" PPC densities (5 to 8 plants per acre) to the range-wide population estimate. Most plots had densities of 1 or fewer PPC per acre. We conclude that the utility of the population estimate of 100,000 to 150,000 PPC in evaluating the conservation status of PPC is compromised by these inadequacies in the underlying methodology. All (5) of the peer reviewers made similar comments and came to the same conclusion regarding the methods used and the numbers generated in the preliminary population estimate.

In the WestLand Resources (2004) population estimate, references are made to PPC numbers used in our biological opinions. It appears that WestLand incorrectly interpreted our PPC numbers. The numbers used in our documents reflect the known individuals detected to date, based on a few large surveys and project-level surveys associated with section 7 projects. They have never been used as an estimate of the entire PPC population, nor was a population estimate ever extrapolated from these data.

Demographic plots were recently established by contractors funded by the National Fish and Wildlife Foundation. Six plots were established in the Altar Valley in 2002. The results of the first year of monitoring have been summarized (Routson et al. 2004), and we secured funding for an additional 2 years of monitoring, through 2006. The results from the first year (2002-2003) indicate that the populations were stable; out of a total of over 300 PPC measured, only 10 died. Two PPC seedlings were found. The plots were not monitored in 2004, but were visited starting in May 2005. In the two years between September 2003 and September 2005, 35 individuals, or 13.4 percent, of the original population had died. No new seedlings were found in 2005 (Baker 2006). This monitoring program will help us answer critical questions regarding the life cycle of this species, such as the longevity of the plants, how often seeds germinate, the environmental conditions that correlate with germination, and seedling survival.

The AGFD database has 5,553 PPC records, although some records do not include geographic coordinates, leaving 5,449 PPC with coordinates. Some of the records are quite old, and we have not confirmed whether the plants are still alive. We also cannot determine which plants may be the result of multiple surveys in a given area. Of the known individuals (5,553), approximately 1,340 PPC plants are documented in the database as extirpated. We do know the number of PPC that have been detected during surveys for projects that have undergone section 7 consultation. For projects that we have been able to track between 1997 and 2003, approximately 1,168 PPC (21% of the known individuals) have been destroyed, removed, or transplanted as a result of residential and commercial development, indicating that development is a continuing threat for the species. There have been additional losses since 2003, but that information is still being

compiled in the database. The database is dynamic, based on periodic entry of new information, as time and staffing allows. As such, the numbers used from one biological opinion to the next may vary and should be viewed as a snapshot in time at any given moment. We have not recorded the loss of habitat because very few biological assessments quantify habitat for PPC. Prior to 1997, we are not able to quantify the loss of PPC, as much of the information is survey-based as opposed to project-based. We know the fate of PPC detected on project sites associated with section 7 consultations; we do not know if PPC detected during pre-1997 surveys are still present because the surveys are not repeated.

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

  We have no information on genetic factors, but we have contracted Dr. Charlie Butterworth of the Desert Botanical Garden to conduct DNA microsatellite work on PPC and its closest relatives to supplement the morphological investigations of this taxon.

- Taxonomic classification or changes in nomenclature.

  There is much confusion regarding the nomenclature of *Coryphantha*. For simplicity, we follow the nomenclature of Taylor (1998). Taylor recognizes three subspecies within *Coryphantha robustispina* (Engelm.) Britton & Rose: *C. robustispina* ssp. *robustispina*, *C. robustispina* ssp. *uncinata* (L.D. Benson) N. P. Taylor and *C. robustispina* ssp. *scheeri* (Lemaire) N. P. Taylor. For the purposes of this discussion, *C. scheeri* var. *robustispina* (PPC) and *C. robustispina* ssp. *robustispina* are synonyms. Taylor's classification follows the varieties of Benson (1982), but does not recognize Benson's *C. scheeri* var. *valida*.

  The precise geographic distribution of the three subspecies is a matter of debate, but the three subspecies are found in the following general areas: *C. robustispina* ssp. *robustispina* is found in south-central Arizona (Pima and Santa Cruz counties) and northern Sonora, Mexico, *C. robustispina* ssp. *uncinata* is found in Cochise County, Arizona to Doña Ana County, New Mexico, El Paso County, Texas, and northern Chihuahua, Mexico. Finally, *C. robustispina* ssp. *scheeri* is located in Eddy County, New Mexico, south-central Texas, and into Chihuahua and Coahuila, Mexico.

  Two independent morphological studies were completed in 2004: Schmalzel et al. (2004) and Baker (2004). The Schmalzel et al. study analyzed morphological variation within *C. robustispina* along a longitudinal gradient from Arizona to Texas to determine if *C. robustispina* exists as a single variable species without taxonomically valid subspecies. The Baker study evaluated taxonomic relationships within *C. robustispina* to determine if any of the known populations are morphologically distinct and, if so, whether the groupings are associated with specific geographic areas.

Although Schmalzel et al. (2004) draw conclusions regarding the taxonomy of *Coryphantha* varieties, nearly all reviewers found that the study did not test a taxonomic hypothesis, and thus that statements in the study regarding taxonomy of *C. robustispina* are not supported by the data presented. The Baker study, by contrast, is an explicit taxonomic analysis, and the conclusions are supported by the data analyzed. This critical difference between the two studies was touched on by most of the reviewers. Several of the reviewers state that the taxonomic conclusions in the Schmalzel et al. work are "incorrect", "erroneous", and "unconvincing". One reviewer summarizes the point: "Perhaps, most importantly, there is no connection between the data, analyses, and conclusions in the paper by Schmalzel et. al."

Most of the reviewers noted the definition of a subspecies (as defined by Stebbins (1950) or Stussey (1990) in their comments. In general, a subspecies is defined as a population(s) with certain similar morphological characters that are found in certain geographic areas within the range of the broader species, where contact between individuals in the geographic areas may occur. In other words, overlap in characters between the geographic groups (races, subspecies, or varieties) is acceptable. The Schmalzel et al. study did not identify an acceptable level of overlap in determining if distinct groupings resulted from their analyses. The authors state "In our reassessment of Benson's table of the distinctive characters of the varieties of *C. robustispina*, we conclude that there are no morphological character states unique to any variety of *C. robustispina*." This statement would lead to the conclusion that none of the populations sampled should be recognized as discrete taxonomic units because any amount of character overlap is unacceptable. This does not conform to any acceptable definition of a sub-species.

Both studies were criticized for not evaluating the full suite of characters used by Benson to describe the original varieties. In 2005, Baker revisited the plots used in his 2004 study to evaluate floral characters, and has indicated that he will prepare a full analysis of all the characters he has measured to date, in his 2007 report.

Only one reviewer agreed with Schmalzel et al. that the general clinal pattern of *C. robustispina* from southern Arizona to Texas was a barrier to recognition of varieties within the species. Several peer reviewers noted, however, that a general clinal pattern does not preclude the existence of defined taxonomic groupings. One reviewer noted "Schmalzel *et alia* erroneously assume that a cline cannot be taxonomically divided into formally named taxonomic parts. Moreover, the Schmalzel report assumes that overlap in measurements—apparently any overlap whatsoever—is grounds for completely dismissing taxa as synonyms. That, too, is erroneous."

In summary, both studies employed similar techniques, that is, measuring a set number of vegetative characters from individuals of *C. robustispina*. Schmalzel et al. concluded that varieties were not taxonomically valid because of clinal variation along a longitudinal gradient from Arizona to Texas. All of the reviewers, except one, found that this conclusion was not well supported and that the results (shown graphically in Figure 10 of Schmalzel et al.) appear otherwise. Six reviewers specifically noted that Figure 10 (an outline of polygons resulting from the Principal Component Analysis, PCA) depicts a clear and distinct group of plants in the longitudes of 110-111° (plants from Pima and Santa Cruz counties) with some overlap with plants from Cochise County, Arizona and New Mexico. All reviewers, except one, felt that the amount of overlap graphically depicted was within the allowable range for identifying subspecies.

The Baker PCA (Figure 4) depicts four distinct groups (including the use of *C. poselgeriana* as an outgroup). Baker further analyzed his data using Discriminant Analysis (DA), a technique used to quantify the discreteness of groups. All individuals occurring in populations of *C. poselgeriana* and *C. robustispina* ssp. *scheeri* were classified correctly 100 percent of the time, indicating that these groups are morphologically distinct. Individuals in *C. robustispina* ssp. *robustispina* were classified correctly 92 percent of the time, and individuals within *C. robustispina* ssp. *uncinata* were correctly classified 94 percent of the time. These results indicate that there is more variability between and among the latter two subspecies, but not so much as to invalidate the sub-specific rank, which is also supported by other morphological characters. The two taxa can be separated taxonomically by geography and all non-age dependent characters that Baker measured, with the exception of central spine curvature and radial spine length. Recent PPC survey work (Baker 2005) in northern Sonora, Mexico and Cochise County, Arizona found these areas do not support populations of PPC, or intermediate individuals between PPC and *C. robustispina* ssp. *uncinata*. A gap of at least 100 km separates these two taxa, lending further support to the conclusions of Baker that the taxa are morphologically discrete and geographically isolated.

We, and nearly all reviewers, conclude that the view of Schmalzel et al. that varieties or subspecies should not be recognized is not supported. While the work of Schmalzel et al. does point out some inconsistencies in Benson's treatment of varieties within the species, it does not support taxonomic reconsideration of the sub-specific groupings within *C. robustispina*. All of the reviewers, except one, recommended no status change for PPC. Four reviewers recommended the Fish and Wildlife Service conduct another status review when Baker's work is complete, a taxonomic key has been formulated to differentiate the subspecies, and the molecular analysis is complete. We concur with these recommendations.

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

Several attempts have been made to delineate suitable habitat within the range of PPC. This has proven difficult. In 2002, McPherson evaluated all the environmental data (substrate type, shrub and herbaceous vegetation, litter, cover, etc.) collected during two PPC surveys to determine if any character (or combination of) was useful in predicting PPC locations. Chi-square analysis revealed significant associations between PPC and several variables. Coppice mounds (piles of fine surface material) were strongly associated with PPC locations. Coppice mounds form around any above-ground feature in areas supporting PPC, including around PPC. PPC were associated with gravel and litter six times more often than expected by chance. The plants were also associated with moderate cover of herbs and woody shrubs. PPC were significantly associated with the following shrub species: desert zinnia (*Zinnia* sp.), snakeweed (*Gutierrezia sarothrae*), burroweed (*Isocoma tenuisectus*), and buckwheat (*Eriogonum* spp.). In summary, the five variables analyzed accounted for 25 percent of the variability in PPC occurrence. As such, the variables studied were poor predictors of PPC locations.

The role of surficial geology in delineating habitat has also been investigated. We reviewed six surficial geology maps within Pima County and overlaid known PPC locations on them. Our analysis found that PPC were associated with alluvium of a wide variety of ages, more than other geological surfaces. High PPC densities were seen on surfaces labeled as Y (active and recently active alluvial fans) and surfaces labeled as QTbf (highly eroded gravelly alluvium, latest Pliocene to early Pleistocene in age) (Jackson 1989, Pearthree and Biggs 1999). Our only conclusion is that PPC has a tendency to be found on alluvial deposits, and since so much of the PPC range is in the valley bottoms, where alluvial deposits are fairly common and widespread, this feature is not particularly useful in predicting PPC occurrence.

In 2005, a model of PCC habitat was developed for Pima County's Multi-Species Conservation Plan (MSCP) (RECON 2006). The parameters used to define habitat were elevation, slope, aspect, and surficial geology type. Parameters were assigned weights based on known occurrences of the species, that is, if the majority of plants were found between elevations of 730 to 1270 ft, the data points were assigned a value of 1; other data points outside of that range were assigned values of zero. In this manner, a map was generated and used for the analysis of effects to PPC for the MSCP. The model captured all of the known PPC locations.

A Master's dissertation project on PPC pollination was completed in December 2005 (McDonald 2005). This work increases our knowledge of the major pollinator (*Diadasia rinconis*) – a ground-nesting, solitary, native bee. Results from this work indicate that PPC plants need to be within approximately 600 m of each other in order to facilitate effective pollination. PPC plants that are located at distances greater than that from one another become isolated. The species is an obligate outcrosser (not self-pollinating), so it is important for plants to be within

a certain distance to exchange pollen with each other. Also, the study found that pollination was more effective when other species of native cacti are near areas that support PPC. The native bees also pollinate different species of native cacti and the sole presence of PPC may not be enough to attract pollinators. We will use this information to inform our conservation strategy for the species, and also for conserving the habitat of the pollinator.

A. Threats -- For each of the five factors, provide citation(s) and a brief updated summary of any relevant information regarding the magnitude or imminence of previously identified threats to the species, including the effects of implementation of conservation measures (e.g., restoration efforts, invasive species control, outplanting, HCP activities, section 7 conservation recommendations, safe harbor agreements, experimental populations, etc.), as well as relevant information regarding new threats to the species. Note if the species is not affected by a certain threat.

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

  Residential and commercial development, and its infrastructure, is by far the greatest threat to PPC and its habitat. It is difficult to quantify the number of PPC that have been lost to development or the rate of habitat loss. There are two reasons for this: 1) we review only a small portion of development projects within the range of PPC that have Federal involvement and 2) residential development that takes place without any jurisdictional oversight or permit) is not tracked within Pima and Santa Cruz counties. Therefore, we have no way of tracking the cumulative amount of development within the range of PPC. What is known with certainty is that development pressure continues in Pima and Santa Cruz counties.

  One way to project the amount of possible habitat loss is to review the draft analysis in Pima County's Multi-species Conservation Plan (RECON 2006). One of the species proposed for coverage in the MSCP is PPC. The proposed life of the MSCP is 30 years. As such, Pima County must determine the amount of PPC habitat that may be affected by activities the County will undertake. The County, with the help of the Scientific Technical Advisory Team (STAT) delineated a priority conservation area (PCA) for PCC. This area is within the known range of PPC and is considered a subset of the total amount of PPC habitat; it is 140,937 acres in size. The total number of acres within PPC range is 1,506,925; 1,131,879 acres occur in Pima County and 375,046 acres are located within Santa Cruz County. The primary activity that will affect PPC is development. As of the September 2006 analysis, the amount of PPC habitat within the PCA that has been developed to date in the proposed permit area (all lands within Pima County with the exceptions of Arizona State lands, tribal lands, lands within the boundary of Sahuarita, Arizona (a city south of Tucson), and lands owned by the City of Tucson) is 18,067 acres. The amount proposed for development in the next 30 years is 30,194 (not including untracked subdivisions). So, as of September

2006, approximately 13 percent of the PCA has been developed. Over the next thirty years, approximately 39 percent of the PCA will be developed (RECON 2006).

Although we do not have documentation of habitat loss in areas not covered by the MSCP, reports indicate that similar development pressures are present in the rapidly growing areas of Santa Cruz County and Sahuarita. Santa Cruz County population is expected to increase by 50-65 percent by 2020 and Sahuarita is expected to grow from 3,242 residents (2000 census) to 10,685 by 2012 (ESI Corporation 2003, Pima Association of Governments 2002). Therefore, it is reasonable to project loss of habitat similar to that occurring within the MSCP. Ultimately, this projected loss of habitat could result in a severe fragmentation of PPC habitat. The City of Tucson is developing a habitat conservation plan (HCP) that will address PPC. However, other jurisdictional areas are not participating in conservation planning, and PPC habitat loss in those areas may not be mitigated for, as it will be in Pima County and Tucson. We consider the projected loss of PPC habitat to be a continuing threat to the species.

Invasive grass species may be a threat to the habitat of PPC. Habitat in the southern portion of the Altar Valley is now dominated by Lehman's lovegrass (*Eragrostis lehmanniana*). According to Gori and Enquist (2003), Boer lovegrass (*Eragrostis chloromelas*) and Lehman's lovegrass are now common and dominant on 1,470,000 acres in southeastern Arizona. They believe that these two grass species will continue to invade native grasslands to the north, east, and south, into Mexico. These grasses have a completely different fire regime than the native grasses, tending to form dense stands that promote higher intensity fires more frequently. Disturbance (like fire) tends to promote the spread of these non-natives (Anable 1990, Ruyle et al. 1988). Halvorson and Roller (1997) hypothesized that fire-induced mortality of PPC increases with Lehman's lovegrass density. Bufflegrass (*Pennisetum ciliare*) has become quite dominant in vacant areas in the City of Tucson and along roadsides, notably in the rights-of-way along Interstate 10 and State Route 86. Some portions of PPC habitat along these major roadways are already being converted to dense stands of bufflegrass.

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

Pima County regulates the loss of native plant material associated with ground-disturbing activities through their Native Plant Protection Ordinance (NPPO) (Pima County 1998). The NPPO requires inventory of the site and protection and mitigation of certain plant species slated for destruction by the following method: the designation of a minimum of 30 percent of on-site, permanently protected open space with preservation in place or transplanting of certain native plant species from the site. There are various tables that determine the mitigation ratio for different native plant species (e.g. saguaros, ironwood trees, PPC) with the result that mitigation may occur at a 1:1 or 2:1 replacement ratio. Mitigation requirements are met through the development of preservation plans. The

inadvertent consequence of this ordinance is that it has created a "market" for PPC. Any developer who cannot avoid this species or move it to another protected area must replace it. Most local nurseries do not grow PPC (and cannot grow them legally unless seed was collected before the listing). As a result, environmental consultants are collecting PPC seed from existing sites (which can be done with a permit from the Arizona Department of Agriculture and the permission of the private landowner), germinating seed, and placing PPC plants grown from seed back on these sites. This exercise does not contribute to the overall conservation of the species, as it is somewhat of a gardening experiment with very little control or oversight, and a high degree of uncertainty of lasting success. There have been no long-term studies of transplant projects. It also does not address the loss of habitat. Alternative options for PPC conservation should be considered if the NPPO is revised.

- Disease or predation:

  We have no information on significant outbreaks of disease or predation on PPC.

- Inadequacy of existing regulatory mechanisms:

  No change since the 1993 listing.

- Other natural or manmade factors affecting its continued existence:

  There have been some notable conservation developments for this species. There are two established conservation banks for PPC, one on a private ranch in the Altar Valley and another owned by Pima County which includes areas in both the Altar Valley and south of Green Valley. Nine projects have used the bank to mitigate the loss of PPC and habitat from residential and commercial development. Pima County and the City of Tucson's large-scale conservation efforts for this species are not yet complete, but strategies for PPC conservation will likely include additional conservation banks, acquisition of occupied and suitable PPC habitat, a revision of both the City and County ordinances dealing with native plant protection, and provisions for the protection of PPC and habitat within subdivisions.

B. Synthesis -- Provide a synthesis of the information in III.A-C to provide an updated status of the species and its threats. This synthesis will provide the benchmark by which to measure the change in status for the next review.

In summary, we have been able to develop a database of PPC locations with the assistance of AGFD. That database has been useful in the preparation of biological opinions and the development of Pima County's MSCP and City of Tucson's HCP. However, conservation efforts are currently hampered by a lack of information on the species. Specifically, we have not been able to determine exact ecological characters to help us predict locations of PPC or precisely

delineate suitable habitat, and considerable area within the PPC range has not been surveyed. Further, there are still significant gaps in our knowledge of the life history of PPC; for instance, we have yet to observe a good year for seed germination and, with the exception of a few personal observations from researchers, we have not identified the seed dispersal agent(s). Demographic plots have been only recently established, and it will be years before we have enough information to assess population dynamics for PPC.

Recent investigation of taxonomy and geographic distribution has focused in part on assessing the validity of the taxon. Although there is evidence for a general pattern of clinal variation across the range of the species, we concur with the majority of reviewers that this does not preclude the recognition of taxonomic varieties within *C. robustispina.* Baker's morphological and geographic work supports the idea that the sub-specific groups within *C. robustispina* are indeed discrete and merit separate taxonomic status as subspecies. The reviewers overwhelmingly recommend that the taxonomic status for PPC remain unchanged. Based on our analysis of the information, we agree with this recommendation.

Development and associated loss of habitat remains the primary threat to this taxon; our information, along with data analyzed by Pima County, indicates that this threat will continue in the foreseeable future. The expanding threat of non-native grasses and the altered fire regime remain a serious concern for the long-term viability of the species. Conservation efforts that focus on habitat acquisition and protection, like those proposed by Pima County and the City of Tucson, will be important elements that will contribute to the long-term viability of this taxon. Regulatory mechanisms, such as the native plant protection ordinances, will provide conservation direction for PPC habitat protection within subdivisions, and may serve to reduce PPC habitat fragmentation within the urban areas of projected growth.

IV. Results:

A. Classification -- Given your responses to previous sections, do you recommend a change in classification (*briefly summarize the reasons for this result below*)*?*

____ Yes, downlist to Threatened
____ Yes, uplist to Endangered
____ Yes, delist
____ Yes, make a change in entity listed for the reasons described below
__X__ No, no change is needed

Summary:

B. New Recovery Priority Number __3 (no change)___

C. If applicable, indicate the Listing and Reclassification Priority Number (FWS only):

Not applicable.

D. Recommendations for Future Actions:

We await the results from the genetic work, and the completion of Baker's morphological analysis, due in 2007. As additional information is compiled, and the conservation strategies for the HCPs are finalized and implemented, we will undertake another review to determine if a change in status is warranted. We estimate it will be five years before we undertake another review.

Additional work could be done on a population estimate for this species. One peer reviewer has suggested that the population estimate derived by WestLand Resources, Inc. for the Altar Valley may have some value if the statistics used were accurate and the methodology employed for the surveys were random. But, the data cannot be extrapolated to areas beyond the Altar Valley. If the time and resources were available, similar surveys could be done in other areas, such as Green Valley or the Santa Rita Experimental Range, and population estimates derived for those areas. In this way, population estimates can be derived for different areas within the PPC range and may prove useful for conservation planning. On the other hand, given the accelerated rate of habitat destruction and the loss of cacti, it may be more cost-effective to concentrate resources on protecting and acquiring occupied and suitable habitat for conservation in perpetuity.

Given the limited resources available for conservation efforts for this species, priorities should be:

1. Acquisition and protection of habitat
2. Additional survey work to locate new populations
3. Continued funding for the on-going demographic study
4. Continued effort to delineate habitat
5. Estimate the amount of habitat needed for recovery
6. Derive a population estimate for the species

The draft recovery plan will be ready for public review in 2007.

We will continue to update the PPC database and develop a process for quantifying PPC habitat loss and the amount of habitat that will be needed for the recovery of this species.

V. References

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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW DETERMINATION

PIMA PINEAPPLE CACTUS

CURRENT CLASSIFICATION Endangered

RECOMMENDATION resulting from the 5-Year Review

_____ Delist
_____ Threatened to Endangered
__X__ No Change
_____ Endangered to Threatened
_____ Change in entity

APPROPRIATE LISTING/RECLASSIFICATION PRIORITY NUMBER____N/A_____

REVIEW CONDUCTED BY: Region 2 Regional Office and Arizona Ecological Services Field Office

Field Supervisor, Fish and Wildlife Service

Approve _____ Date 1/10/07

Do not Approve_____Date_____

Assistant Regional Director, Ecological Services, Fish and Wildlife Service

Concur Nancy J Gloman Date 2/8/07

Not concur_____Date_____