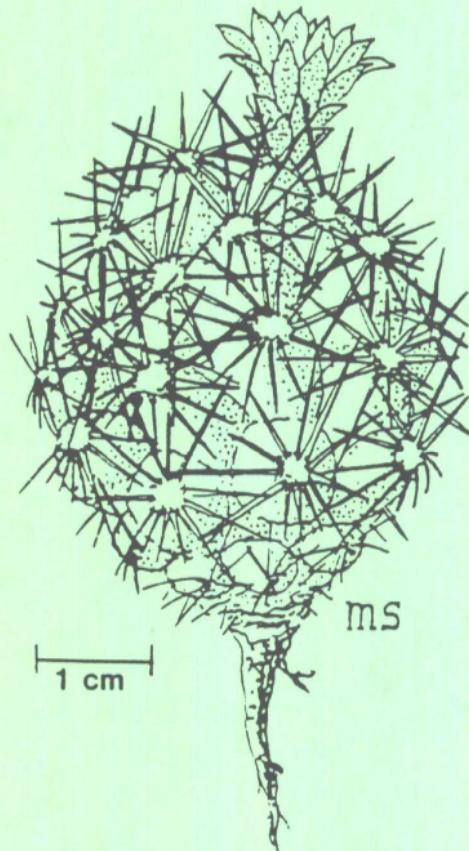


COCHISE PINCUSHION CACTUS

(Coryphantha robbinsorum)

RECOVERY PLAN



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

1993

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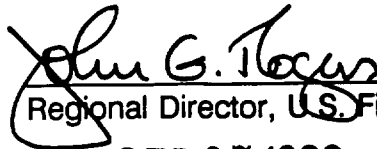
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Region 2
U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Approved:


Regional Director, U.S. Fish and Wildlife Service

Date:

SEP 27 1993

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1993. Cochise Pincushion Cactus (*Coryphantha robbinsorum*) Recovery Plan. USDI Fish and Wildlife Service, Albuquerque, New Mexico. 44 pp.

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5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814

301/492-6403 or 1-800-582-3421

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EXECUTIVE SUMMARY

Current Status: The Cochise pincushion cactus is listed as threatened. It is found on several limestone hills in the San Bernardino Valley of Cochise County, Arizona, and extreme northern Sonora, Mexico.

Habitat Requirements and Limiting Factors: The species is found only on the bedrock and stony soils of the Permian Limestone Formation. Cactus collecting, potential minerals exploration, and habitat degradation by cattle, wildlife, and feral animals are the principal threats.

Recovery Objective: Delisting.

Recovery Criteria: Recovery of this species will require permanent protection and management of the habitat, trade protection through retention of the species on the Highly Safeguarded List of the Arizona Native Plant Law and CITES list following delisting, and demonstration through ten years of monitoring that viable populations are being maintained.

Actions Needed:

1. Develop and implement a habitat management plan in cooperation with the private landowner and Arizona State Land Department.
2. Study the population biology of Cochise pincushion cactus to determine the effects of management.
3. Protect Cochise pincushion cactus from loss of individuals and habitat.
4. Establish an *ex situ* conservation and research program.
5. Define the range and distribution of Cochise pincushion cactus.
6. Conduct biological studies necessary for effective management of the species.

Costs (Thousands of \$):

<u>Year</u>	<u>Need 1</u>	<u>Need 2</u>	<u>Need 3</u>	<u>Need 4</u>	<u>Need 5</u>	<u>Need 6</u>	<u>Row Total</u>
1994	5.0	4.0	19.5	2.0	12.0	48.0	90.0
1995	5.0	4.0	11.5	2.0	12.0	32.0	68.0
1996	-0-	4.0	13.5	2.0	-0-	13.0	37.0
1997	-0-	4.0	14.5	2.0	-0-	6.0	13.0
1998	-0-	8.0	8.5	2.0	-0-	6.0	26.0
1999	-0-	4.0	14.5	2.0	-0-	-0-	4.0
2000	-0-	4.0	8.5	2.0	-0-	-0-	11.0
2001	-0-	4.0	14.5	2.0	-0-	-0-	4.0
2002	-0-	4.0	8.5	2.0	-0-	-0-	11.0
2003	-0-	10.0	14.5	2.0	-0-	-0-	12.0
<u>Recovery</u>							
<u>Cost</u>	10.0	50.0	126.0	20.0	24.0	105.0	276.0

Date of Recovery: Delisting should be initiated 10 years following the approval of this plan if recovery criteria are met.

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PART I - INTRODUCTION

Brief Overview

The Cochise pincushion cactus [*Coryphantha robbinsorum* (Earle) A.D. Zimmerman] was listed as a threatened species under the Endangered Species Act of 1973 (ESA), as amended, on January 9, 1986 (U.S. Fish and Wildlife Service 1986). Critical habitat was not designated. The Cochise pincushion cactus has a recovery priority of 8. Recovery priorities for listed species range from 1 to 18, with species ranking 1 having the highest recovery priority.

The Cochise pincushion cactus is a small, unbranched plant inhabiting the transition zone between the Chihuahuan Desert Scrub and Semidesert Grassland (Brown 1982) on limestone hills in southeastern Cochise County, Arizona, and northern Sonora, Mexico. Threats to the species include collecting, potential minerals exploration and development, and habitat degradation from cattle, wildlife, and feral animals.

Description

The Cochise pincushion cactus was originally named *Cochiseia robbinsorum* by W.H. Earle (1976). The holotype collected by James A., Jimmy, and John Robbins is deposited at the Arizona State University herbarium. The genus *Cochiseia* was rejected almost immediately. Dr. A.D. Zimmerman (1978) assigned the species to the genus *Coryphantha*, which is currently the most frequently accepted placement. The only other synonym for the species is *Escobaria robbinsorum*, which is subject to an unresolved controversy.

Coryphantha robbinsorum is unbranched, suborbicular, and 1.4-6 centimeters (cm) (0.6-2.4 inches) in diameter when mature. The white, elliptical, cottony

areoles of these plants are their most striking feature. The tubercles are rather tightly packed into 8-13 spirals. Central spines are usually absent. Radial spines are stiff and brittle, 8-18 millimeters (mm) (0.3-0.7 inch) long, and number 11-20 per areole. The radial spines overlap with those of adjacent areoles and thus largely obscure the stem surface, giving the plant a whitish overall appearance. The flower tepals are pale yellow or parchment color, with a slight greenish or bronze cast. The flowers are funnelform or campanulate, 10-18.5 mm (0.4-0.7 inch) long and 12-29 mm (0.5-1.1 inch) in diameter. The fruits are spheroidal to obovoid, 6.0-8.5 mm (0.2-0.3 inch) long and 3.0-4.5 mm (0.1-0.2 inch) thick. Fruits are orange-red to scarlet but quickly dry and turn brownish. They contain about 20 globular, very dark brown or black seeds (adapted from Zimmerman 1978 and 1985).

Most of the stem is underground, with usually only the top 1 cm (0.4 inch) protruding above ground level. During the spring and fall, when droughts normally occur, the plants shrink. The proportion of plant exposed during drought periods depends on the microsite. Plants growing on bedrock will shrink during droughts but can not retract into the soil. In microsites with some accumulated soil, the plant surface can be flush with the substrate surface when retracted.

Range and Distribution

The Cochise pincushion cactus is known from the San Bernardino Valley, southwestern Cochise County, Arizona, and northern Sonora, Mexico (Lopresti 1984). The populations in Cochise County, Arizona, are found on several isolated hills within an area of 10-16 square kilometers (4-6 square miles). The density of plants on these limestone hills varies greatly. Plants are rare and scattered throughout most of the hilly area but small, isolated clusters of 100-

1,000 plants occur sporadically. The vast majority of individuals are concentrated in a small percent of the total area (Zimmerman 1985). The exact number and location of these dense clusters is unknown. All known populations in Arizona are on privately owned lands or public land held in trust and managed by the Arizona State Land Department.

Habitat

Hunt (1974) defines the habitat of the Cochise pincushion cactus as occurring within the Mexican Highland Section of the Basin and Range Province. The species occurs on hills of Permian Limestone at an elevation of 1,280-1,433 meters (4,200-4,700 feet). Soils are composed of thin, gravelly loam over Permian limestone rock, usually with fist-sized limestone rocks, or rubble, strewn about. The soil is a low nutrient sandy loam (Pritchett-Kozak and Ecker 1992) with a pH of 7.9 to 8.0 (Zimmerman 1985). The average annual precipitation is 30 cm (12 inches) and frost-free days per year average 215 (Sellers and Hill 1974).

In addition to requiring high calcium limestone substrates, plants may also require the well-drained substrate offered by the coarse limestone chips and rock crevices in bedrock. Most individuals of Cochise pincushion cactus are in the open, exposed to full sunlight. The dense colonies of this cactus appear to occur on bedrock or where bedrock is very close to the surface. In these microsites, very little or no soil is present. Where soil occurs in these microsites, a soil crust of lichens, mosses, and algae (cryptogam) is present, indicating undisturbed soil conditions.

Whether or not seedling establishment is more successful under "nurse plants" is uncertain. Zimmerman (1985) notes that young plants frequently occur

beneath nurse plants. Rutman (pers. comm. 1992) has not observed such a relationship in three Fish and Wildlife Service (FWS) monitoring plots. However, seedlings often occur in the near vicinity of reproductive Cochise pincushion cactus plants.

Plant associations are typical of a degraded Grama Grassland as described by Henrickson and Johnston (1986), or of Chihuahuan Desert Scrub transitional to a Semidesert Grassland as described by Brown (1982). Two well-defined plant communities containing elements of the Chihuahuan desert flora exist on these limestone hills. The bedrock or coarse soils of the upper slopes, where *Coryphantha robbinsorum* exists, is dominated by scattered individuals of *Vauquelinia californica* ssp. *pauciflora*, *Fouquieria splendens*, *Opuntia phaeacantha*, *Opuntia spinosior*, *Calliandra eriophylla*, *Agave palmeri*, *Parthenium incanum*, *Echinocereus fendleri* var. *rectispinus*, *Bouteloua hirsuta*, *Muhlenbergia asperifolia*, and other species. The low-density plant community on the limestone hills creates a habitat where inter- and intra-specific plant competition is low and the likelihood of fire is also low (Rutman 1989). Cochise pincushion cactus does not occur on the lower slopes, which are dominated by *Mortonia scabrella*, *Acacia neovernicosa*, *Coldenia mexicana*, *Flourensia cernua*, *Larrea tridentata*, *Parthenium incanum*, *Trixis californica*, *Zinnia* sp., and other species.

The range and distribution of *Coryphantha robbinsorum* is limited primarily by the availability of optimal habitat. The Permian limestone upon which this species depends is exposed in a small area in southeastern Arizona and northern Mexico. Dense colonies of this species are not common on the limestone, implying that microsite requirements are very specific, or some other ecological characteristic, such as predator relationships, limit the local distribution.

Life History/Ecology

Since 1988, the FWS has been annually monitoring plants within permanent plots. Data regarding plant growth rates, recruitment, and survivorship from this long-term monitoring effort will be processed and evaluated in 1993. The purpose of this monitoring effort is to gather data to better understand the ecology of the species, determine if populations are stable and viable, and direct management programs. Other demographic and life history information was collected by Zimmerman (1985).

Some preliminary data from the FWS monitoring plots is available. In 1992, the density of plants within plot A, a high density cluster, was 2.4 per m² (0.2 per yd²). Zimmerman (1985) does not provide numerical data but notes local densities of several per square meter, in areas of only a few meters in extent. The average width of stems was 2.07 cm (0.82 inch) with a range of 0.3-3.4 cm (0.1-1.34 inches) (FWS unpub. data).

Preliminary data analysis (FWS, unpub. data) indicates that plant survivorship is high for all but the seedling class. In contrast, Zimmerman (1985) noted that mortality was high; 73% of marked plants (excluding seedlings) died over a seven year period. Conversely, between 1978-1979 he found almost no mortality among 20 marked plants. The reason for these conflicting findings is not clear. However, year-to-year fluctuations in abiotic and biotic factors and the size of the data sets may explain differences in mortality rates.

Data and observations indicate the number of flowers and fruits per plant is related to plant size (age), health, and rainfall (FWS, unpub. data). In 1988, 58.6% of marked plants produced flowers, while 33.7% produced flowers in 1989, a year with below-average rainfall (Figure 1). In 1989, the average number of

flowers per plant (0.5) was less than half that produced in 1988 (1.1 flowers per plant). Rutman (1989) found that plants do not flower until they have reached a diameter of 14 mm or larger, with some unusual exceptions. Similarly, Zimmerman (1985) noted that plants are sexually mature when they reach 17-28 mm (0.7-1.1 inch) in diameter. The average number of flowers per plant in 1988 and 1989 was 1.6 - 1.8. Nearly all flowers (94%) produced fruit in 1988 (Rutman 1989). The number of flowers per plant, like the number of ovules per flower, increases with age (Zimmerman 1985 and FWS unpub. data). One flower per year is produced by plants in their first year of maturity. The largest and healthiest plants are capable of producing 8 flowers per year.

Flowering begins in mid-March with the peak bloom occurring on March 22, and extending into mid- to late-April. During the flowering period, day and night time temperatures are variable, with daytime temperatures ranging from 80 degrees Fahrenheit to below freezing with snow. Zimmerman (1978) reported that fruits ripen in July and August, when temperatures commonly reach 100 degrees Fahrenheit (38 degrees Celcius) in the mid-afternoon. Phillips and Brian (1982) found fruits to be dry and ripened during a late September field search.

Several people involved in the FWS's annual monitoring project (Rutman, Warren, and Malusa) have observed during annual data collection that many plants appeared chlorotic or stressed during years of below-average rainfall. Hilsenbeck (pers. com. 1991) also noted that a large percentage of individual Cochise pincushion cactus were stressed in the spring of 1991. All observers presumed the stress was primarily caused by the below-average rainfall that occurred during the winter of 1987/1988 and the winter of 1988/1989 through the summer of 1991. Figure 1 summarizes the rainfall received at a ranch less than three miles from the monitoring plots.

YEAR	WINTER (Oct- March)	SUMMER (June - Sept)
1981		11.26
1982	4.73*	6.44*
1983	12.57	7.99*
1984	7.88*	14.66
1985	20.78	8.58*
1986	10.65	16.89
1987	9.16	10.27
1988	3.94*	14.14
1989	6.57*	7.43*
1990	2.55*	5.69*
1991	7.84*	7.75*
1992	9.63	
AVERAGE	8.75	10.10

Figure 1. Rainfall amounts (in inches measured at the Magoffin Ranch, Cochise County, Arizona. Asterisk indicates seasons with below-average rainfall. Data collected by the local ranching family.

In summary, abiotic factors may affect the abundance and distribution of this species. Drought periods may increase mortality of plants, particularly seedlings and juveniles. Below-average rainfall also affects the amount of fruits and seeds produced, and therefore affects the seed bank and future recruitment. Freezing

temperatures during flowering may adversely affect the number of flowers, fruits, and seeds produced.

Biotic factors may also affect the abundance and distribution of this species. Pollinators, other insects, and seed disseminators are integral parts of the ecosystem of Cochise pincushion cactus. Zimmerman (1985) noted the small bees *Perdita opuntiae*, *Ashmeadiella opuntiae*, and (rarely) *Dialictus* sp. visiting the flowers of *Coryphantha robbinsorum*. During several seasons of casual observation, Zimmerman (1985) noted that these principal pollinators visited only cacti, implying that they are cactus-specialists. Zimmerman speculated that, because there are no other populations of cactus blooming during March and early April within roughly a six-mile (9.7 km) radius, these populations of bees may depend on *Coryphantha robbinsorum* for their survival until other cactus species begin to bloom. He also noted that some of the bees roost overnight within the closed cactus flowers, further emphasizing the symbiosis between these species. The continued existence of *Coryphantha robbinsorum* may depend on the protection of the native pollinators and other beneficial insects and their habitats.

Zimmerman (1985) speculates that seeds are disseminated by rock wrens (*Salpinctes obsoletus*), cactus wrens (*Campylorhynchus brunneicapillus*), mockingbirds (*Mimus polyglottos*), black-throated sparrows (*Amphispiza bilineata*), thrashers (*Toxostoma* sp.), and house finches (*Carpodacus mexicanus*). The bright red, fleshy fruits probably attract the birds. He notes that his unpublished study of rock wrens in a population of *Coryphantha robbinsorum* showed that these birds fly from one *Coryphantha* population to another during their daily activities.

Woodrats (*Neotoma* spp.) and other rodents, rabbits, and javelina (*Tayassu tajacu*) feed on Cochise pincushion cactus (Zimmerman 1985). The effects of this herbivory on population stability need further study.

Population stability of Cochise pincushion cactus may be affected by predatory insects. Cochise pincushion cactus is a larval food plant of cactus specialist moths (*Yosemitia* sp.) that frequently kill the host plants. Large cactus specialist beetles, probably *Moneilema corrugans*, always kill host plants (Zimmerman 1985). Because other cactus species (*Mammillaria heyderi*, *Mammillaria grahamii*, and *Echinocereus fendleri*) also serve as hosts for these insects, the overall density of these species in the area may effect predation levels on Cochise pincushion cactus. Insect predation involves a complex set of interactions and needs further study.

Management Issues and Concerns

Livestock Grazing

The scant historical record seems to support the conclusion that the current vegetation of the San Bernardino Valley is different today than it was before European settlement and the introduction of livestock. The first explorers and settlers in Arizona described the San Bernardino Valley as being one of the most lush grasslands in the regional area (Davis 1982). One of the members of the Mormon Battalion, passing through the San Bernardino Valley in 1846, noted that "The grass is two feet high as far as the eye can reach, and plenty of water, but no wood barring Musqueet . . ." (Davis 1982). John Bartlett, visiting the area in 1849, described the valley as " . . . a lush 'meadow' some eight or ten miles long and a mile wide . . ." (Davis 1982).

The decline of southern Arizona grasslands probably began after 1870, when cattle and sheep herds reached unprecedented sizes and other environmental manipulations, such as fire suppression, occurred (Bahre 1991). At the turn of the century, the combination of overstocking and below-average rainfall resulted in head cutting, channel entrenching, and the loss of plant cover, topsoil, and perennial streams and cienegas. The formerly dominant grasses were replaced by woody perennials, most notably mesquite (*Prosopis velutina*) and *Acacia neovernicosa*.

Today, herd sizes in southern Arizona are a fraction of herd sizes before the turn of the century. The current effects of livestock grazing, therefore, are small when compared with historic effects. However, an historical perspective of land use can provide a framework that can be used to interpret current landscapes, vegetation, and plant species distributions. Oral histories and written records will help compose the grazing history at or near the site.

It is difficult to assess how historical livestock use affected Cochise pincushion cactus. Whether or not the vegetation and flora of the limestone hills were significantly changed due to historic livestock use will never be known for certain. As a result, interpreting the status of and resolving the threats to Cochise pincushion cactus will be difficult.

Livestock grazing is currently the only human use of the area, with the exception of illegal drug trafficking. To our knowledge, the range condition and trend has never been evaluated. The Arizona limestone rosewood (*Vauquelinia californica* ssp. *pauciflora*) in the area is heavily browsed and the form class of most plants is poor. The combined influences of livestock and mule deer browsing are likely responsible for these effects. In 1988 and 1989, Rutman

(FWS, pers. comm., 1992) observed a high density of fresh deer sign on the limestone hills, but she believes the density of fresh deer sign seems to have declined in recent years. On a visit to the area in 1989, Bureau of Land Management (BLM) officials stated they believed the impacts to *Vauquelinia* were caused by cattle. Hilsenbeck (pers. comm. 1991) observed large quantities of deer and either horse or wild burro droppings at the population sites in 1991, and noted that the habitat appeared to be somewhat degraded by the numbers of mammals recently present and perhaps the effects of below average rainfall.

Near the three monitoring plots in 1988 and 1989, fresh mule deer droppings far outnumbered cattle droppings. In 1990, the balance began to shift, and by 1992, fresh deer droppings were rare, and recent cattle droppings were common. The explanation for this shift may be the result of a new livestock management system implemented by the ranch owners. New fences were built in 1990, and livestock use patterns changed.

Livestock caused the death of one plant in a monitoring plot about one-half mile (0.8 km) from a water source. The plot was established in 1989, and the next year cattle started trailing directly through the plot. A plant not protected by the bedrock from hooves was killed due to trampling, and others were damaged. Cattle no longer use the trail. No other mortality directly related to livestock trampling has ever been documented in the other two plots. The bedrock or coarse rock substrate seems to protect most plants from damage.

We do not know if the current distribution of Cochise pincushion cactus is natural. Currently, populations reach their highest density on bedrock or coarse, rocky substrate. This distribution pattern could reflect the preference of this species for particular microsites found only on or close to bedrock. Another

explanation could be that plants occur on or close to bedrock because they find a refugium from trampling there. Other explanations are possible.

Illegal Collecting

Cochise pincushion cactus was not discovered until 1975. Initial demand for newly discovered species, particularly rare species, can be quite high in the cactus trade, leading to over-collecting of natural populations. Although the locations of the Cochise pincushion cactus populations in the U.S. have not become general knowledge, the location of Mexican populations is available. Illegal collecting has occurred in the United States, although no collectors have been apprehended. Their effect on native populations is unknown. If a collector were to discover a high-density population, he/she could quickly eliminate almost all reproductive plants within that population. If plants were collected from low density areas, inter-plant distances would increase, thereby decreasing the likelihood of pollination success and gene flow between individuals or populations.

Cochise pincushion cactus is in the commercial trade and plants or seeds are available from several nursery sources. Plants are easily propagated from seeds using standard techniques and soil mixtures (Zimmerman 1985).

Inadequate Regulatory Mechanisms

All of the Cochise pincushion cactus populations occur on private or State land. The ESA offers little protection to threatened plants on non-Federal lands. On private or State lands, it is illegal to remove, cut, dig up, or damage or destroy listed species in knowing violation of any State law or regulation, including State trespass laws [ESA, Section 9(a)(2)(B)].

Access restrictions can help protect Cochise pincushion cactus on State trust land. Access to State trust land is allowed only under a right-of-way or recreation permit issued by the State Land Department, or a hunting/fishing permit issued by the Arizona Game and Fish Department if the user is hunting. If someone collects, damages, or destroys listed plants while knowingly violating this permit requirement, or any other State law or regulation, they will have violated the ESA. This provision of the ESA is intended to assist landowners, including the State, who want to protect listed plants on State or private lands.

The Arizona Native Plant Law (A.R.S. Chapter 7, Article 1) protects *Coryphantha robbinsorum* as a highly safeguarded species. To legally collect this cactus on public or private lands in Arizona, a collector must obtain a permit from the Arizona Department of Agriculture (ADA). Permits may be issued for scientific and educational purposes only. However, private landowners and Federal and State public agencies may clear land and destroy habitat after giving the ADA sufficient notice, to allow plant salvage to occur. Despite the protections of the Arizona Native Plant Law, illegal collecting continues to occur. Due to the remote nature of some of its habitat, and the relatively few law enforcement agents available to cover this area, enforcement is difficult.

Beneficial Insects and Pesticides

As previously mentioned, Zimmerman (1985) has noticed several native species of insects pollinating *Coryphantha robbinsorum* flowers. Nothing is known about the life history and habitat requirements of these native insects. Also, nothing is known about other beneficial insects that may tend *Coryphantha robbinsorum*, disseminate seeds, or perform other services. Application of pesticides, particularly aerial applications of general rangeland pesticides, could adversely affect the ecosystem on which *Coryphantha robbinsorum* depends. No

aerial applications of pesticides should be allowed within a three-mile radius of occupied or potential habitat.

Mining

Exploration for oil and limestone mining are potential threats. At least one deep oil well was drilled around 1976, and the access road passed through a Cochise pincushion cactus population. We do not know if the limestone is of a commercially valuable grade. Because the limestone habitat is so distant from any urbanized area, its extraction would probably be economically unfavorable. The Federal government owns the mineral rights, which are administered by the BLM, for some of the occupied habitat. The present private landowners do not own the subsurface rights to the area, and we do not know if anyone has claimed the mineral rights for the southern part of the species' range.

Research and Conservation Efforts

Dr. A.D. Zimmerman has studied the populations of Cochise pincushion cactus since 1976 and has acquired considerable information on many aspects of the biology of the species. Some of this information is included in the Endangered Species Information System (ESIS) Workbook on *Coryphantha robbinsorum* (Zimmerman 1985).

The owners of the ranch on which the species occurs are aware of the populations on their private land and on State land and have proven to be conscientious and responsible stewards. They keep a watchful eye on the habitat and have reported suspicious activities to law enforcement authorities. One of the current private landowners has a Federal law enforcement commission.

PART II - RECOVERY

Objective and Criteria

The main objective of this recovery plan is to outline the steps necessary to facilitate the recovery of Cochise pincushion cactus and manage its essential habitat so that healthy populations can be sustained in their natural habitat. To meet these objectives and remove the Cochise pincushion cactus from the Federal list of endangered and threatened species, the following actions are required:

1. Develop landowner or public land management agency agreements that will ensure permanent protection and management.
2. Implement management measures that research studies indicate are needed to maintain habitat condition suitable for sustaining 50 high density, viable populations with 300 plants in each population that are linked with habitat maintaining low-density populations.
3. Map and quantify the number of high density populations of *Coryphantha robbinsorum* in the United States.
5. Eliminate or minimize the threat of surface-disturbing activities, particularly oil and gas drilling and mineral entry.
6. Commercial trade protection provided by the Arizona Native Plant Law and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) must remain in place

following removal from the Federal list of endangered and threatened species.

The Cochise pincushion cactus is a localized edaphic endemic and will always be rare, even when fully recovered. Delisting this species, will, therefore, be unrealistic unless protections and management essentially equal to those presently available under the ESA are provided permanently for this species. The delisting criteria for Cochise pincushion cactus will be evaluated for adequacy upon attainment and prior to initiating a delisting proposal.

Outline of Recovery Actions

1. Develop and implement a habitat management plan (HMP) in cooperation with the private landowners and Arizona State Land Department. Cochise pincushion cactus occurs on private land and land held in trust for the State of Arizona and managed by the Arizona State Land Department. Landowner and State cooperation will be critical to the full recovery and long-term existence of the species. Preparing and signing a HMP would bring together the State Land Department, private landowners, and the FWS. Under such an agreement, all parties would agree to a mutually acceptable management scheme that would benefit Cochise pincushion cactus and would allow private landowners to continue a profitable ranching operation. The current private landowners have expressed a commitment to conserving Cochise pincushion cactus; the HMP would formalize this commitment and develop a partnership between the private landowners, State Land Department, and FWS. The primary focus of the HMP would be livestock management. Specifically, it would address the timing and duration of use of each pasture,

limits of utilization for key forage species, carrying capacity, and placement of range management facilities such as roads, water sources, and fences.

2. Study the population biology of Cochise pincushion cactus to determine the effects of management. The number of plants or populations may fluctuate naturally due to biotic and abiotic environmental factors. To separate the effects of human caused threats from natural fluctuations, several monitoring plots should be established. Suitable sites for monitoring populations should include areas of concentrated livestock use, areas that might be susceptible to illegal collecting pressure, and controls. The existing FWS monitoring effort will fulfill some of this recovery goal, but other plots may need to be added. Data collected over a 10-15 year period should provide the information necessary to assess the status and trend of naturally occurring populations and direct management efforts. Monitoring efforts should include collecting information about seed production, seed ecology, seedling establishment, survivorship, growth rates, and flower and fruit production. The demographic data should be used to conduct a population viability analysis.
3. Protect Cochise pincushion cactus from loss of individuals and habitat. Protecting Cochise pincushion cactus from loss of individuals and habitat will depend on effective enforcement of existing laws and regulations, encouraging the involvement of the landowners in protection, performing section 7 consultation as required, and protecting against oil and gas drilling, mineral extraction, and other surface-disturbing activities.
 - 3.a. Enforce existing laws and regulations to eliminate illegal collecting and commercial trade. Cochise pincushion cactus is currently protected

by the ESA, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Lacey Act, the Arizona Native Plant Law, and other State laws, including trespass law. The provisions of these laws can protect the species from collecting and limited types of habitat destruction. Violators of Federal environmental laws should be prosecuted vigorously and this should be made known through the public media as a warning and deterrent to others.

Regulation of trade is the most practical means of controlling field collecting of commercially valuable endangered plants, particularly for plants on private land where ESA protections are limited. The Cochise pincushion cactus is commercially available from nurseries. The nursery facilities of individuals requesting permits for interstate or international commerce are investigated to insure that stock being offered for sale is artificially propagated. Legal commercial trade in this species should be encouraged and facilitated to reduce pressure to collect wild specimens.

3.a.1. Educate law enforcement officers and border patrol agents

State and Federal law enforcement officers should be educated so that they know where the species occurs and how to identify the species. This education could occur in the field and/or in classes along with written materials. Education will help border agents identify this species when inspecting shipments and ensure proper documentation.

3.a.2. Encourage private landowners to continue reporting trespassers

Private or State land must be crossed to access Cochise

pincushion cactus populations. The current landowners/users have been very cooperative in notifying law enforcement authorities when they notice suspicious activity in the area. If land ownership changes, the new owners should be contacted and encouraged to do the same.

A formalized system needs to be developed so that the neighboring private landowners know who to contact and what information to collect if they see suspicious activities. Responding law enforcement officials should be made aware of this system and know the laws and regulations protecting this species.

3.b. Conduct required consultations under section 7 of the ESA.

Federal agencies must formally consult with the FWS when an action authorized, funded, or carried out by an agency may affect a threatened or endangered species. Even though the plants are on private and State lands, such actions as oil and gas leasing, minerals exploration, pipeline construction, highway construction, pesticide registration, biological pest control programs, and cooperative range management programs may involve Federal permits or funding. Awareness and timely consultation by Federal agencies can avoid or minimize impacts to the species.

Aerial applications of pesticides funded wholly or in part by a Federal agency should undergo section 7 consultation. Specifically, aerial applications of general pesticides should not occur within at least a three mile buffer zone of known habitat for Cochise pincushion cactus. This three mile buffer zone should be maintained until scientific

information can be collected that indicates the buffer zone should be decreased or increased.

- 3.c. Protect against surface-disturbing activities. Road building, exploration and drilling for oil and gas, mineral exploration and extraction, utility corridors, and other surface-disturbing activities should be prohibited within potential habitat for Cochise pincushion cactus. The BLM should withdraw mineral entry for the habitat and surrounding area.
- 3.d. Acquire habitat. The Federal government should use opportunities to acquire habitat through voluntary Federal-State-private land exchanges or other methods. Federal ownership will enhance protections for Cochise pincushion cactus because Federal laws and regulations will apply more frequently.
- 3.e. Protect against application of general pesticides or biological pest controls that have the potential to degrade the ecosystem. General pesticides have the capability of destroying beneficial, native insect populations. Large-scale, aerial applications of general pesticides should be prohibited within a three mile radius of occupied or potential habitat. Biological controls that have been tested and are specific to the pest target should be considered. To control insect pests, Integrated Pest Management should be applied and all other methods of control used before biological controls are considered.
- 4. Establish an *ex situ* conservation and research program. Currently, the need to establish a living *ex situ* population of Cochise pincushion cactus in a botanical garden is a low priority. Extinction in the wild does not seem

imminent, and populations appear to be currently stable and need no artificial supplementation. These two situations and others would support *ex situ* conservation efforts, but neither situation occurs at this time. If populations are lost or the species nears extinction in the future, a reintroduction program should be considered.

4.a. Reintroductions. Establishing a living collection in arboreta, botanical gardens, or other qualified institution would ensure a genetically diverse pool of plants in the event of a reintroduction is necessary. Reintroduction would be considered only if an extirpation or extinction occurred. *Ex situ* populations should contain an adequate sample of the natural population to insure retention of a large portion of the genetic diversity. Institutions must maintain careful records of their cultivated material so the original source will be known in the event a reintroduction is required.

4.b. Seed banking and research. Seed "banking" (maintaining a collection of viable seed) is a comparatively inexpensive method of maintaining a diverse genetic sample of the species. Maintaining seeds in reliable collections would provide insurance against the natural or human-induced catastrophic demise of the species.

Seed germination experiments would help the FWS understand the reproductive potential of the species and model the species' stability. As they are identified, other *ex situ* research projects should be conducted.

5. Define the range and distribution of Cochise pincushion cactus. Inventories are a necessary step in evaluating the status of the species and documenting its range, distribution, and abundance.
 - 5.a. Describe and map the distribution of the species within the known habitat area. Dense clusters of Cochise pincushion cactus are separated by large areas of apparently suitable but unoccupied or sparsely occupied habitat. The vast majority of individuals occur within these high density clusters. With the exception of a few clusters, the number and position of these high density clusters is currently unknown to the FWS. Mapping these clusters would help us understand the abundance of the species and prioritize areas for conservation efforts.
 - 5.b. Search for new populations. A search for additional populations should be conducted in southeastern Cochise County, Arizona, adjacent New Mexico, and Sonora, Mexico. Search efforts should concentrate on areas similar to the known habitat in vegetation, geology, and soils. Other rare plants occurring in the same habitat as Cochise pincushion cactus may be used as indicators to locate new populations. Zimmerman (1985) recommends surveying for new populations in the Chiricahua, Peloncillo, Swisshelm, Whetstone, Dragoon, Mule, and Big Hatchet Mountains, and the Tombstone Hills.
6. Conduct biological studies necessary for effective management of the species. Many aspects of Cochise pincushion cactus biology remain poorly understood, which limits efforts to define management needs. As information

is obtained, it should be incorporated into management plans and practices. As new management strategies are applied, research should occur concurrently to determine its effects on Cochise pincushion cactus.

6.a. Define the habitat. Cochise pincushion cactus is an endemic species limited in distribution by one or more biotic or abiotic factors.

6.a.1. Study the substrate. Cochise pincushion cactus occurs only on Permian limestone substrate and possibly certain layers within this Formation. Some soil analyses to determine texture, nutrients, and minerals have been completed. Compare these with soils from nearby unoccupied habitat to determine if there is a specific limiting soil factor. Conduct further analyses of occupied soils if necessary.

6.a.2. Study the general climate. Desert weather patterns are so erratic that it would be useful to establish a weather station near the populations. Use climatic information in conjunction with demographic monitoring to determine correlations between weather patterns such as temperature and rainfall and biological factors such as mortality, recruitment, flowering, and seed production. The current private landowners are collecting rainfall information and have offered to operate a weather station if provided.

6.a.3. Study microclimate. The authors have observed that many Cochise pincushion cactus plants appear to be located in small pockets of soil at the base of large embedded rocks.

Zimmerman (1985) believes that plants establish under nurse trees. If either opinion is true, these microsites may have specific microclimatic conditions necessary for seedling recruitment and long-term survival of the species. Disagreements about microhabitat requirements should be resolved through scientific research.

- 6.a.4. Determine community structure. No detailed quantitative characterization of the plant community where Cochise pincushion cactus occurs has been done. This information may be useful in refining the search for new populations or understanding the dynamics and management needs of the populations.
- 6.b. Study interactions with other organisms. Some of the positive and negative interactions of Cochise pincushion cactus with other plants and animals will likely be found critical to maintaining healthy populations.
 - 6.b.1. Study reproductive biology and pollinators. The Cochise pincushion cactus may be pollinated principally by native bees that are obligate cactus specialists (Zimmerman 1985). The native pollinators and their life history and habitat requirements should be determined. Once this is done, it can be determined if other species of cacti in the community are critical to maintaining pollinator populations. The effect of non-native, feral honeybees (including Africanized honeybees) on native pollinators and Cochise pincushion cactus should be examined.

6.b.2. Study mammal predators. Rodents, rabbits, and javelina eat plants, dig them up, and bury them under nest building material. The impact of this predation should be determined to see if management measures are needed.

6.b.3. Study insect predators. The larvae of several insect species feed on Cochise pincushion cactus tissue, usually killing the plants. These predators need to be identified and their life history and habitat requirements studied. Since infestation levels often depend on the density of cactus host plants, these insects may explain the spacing and density of Cochise pincushion cactus populations.

6.b.4. Study grazing effects. The effects of cattle, wildlife, and feral animals on the habitat needs to be studied. This includes the effects of vegetation removal, soil compaction, and erosion. The effect of removing vegetation by grazing needs to be studied as it relates to competition between Cochise pincushion cactus and other vegetation, trampling, erosion, nutrient cycling, habitat condition and trend, fuel loading for fires, and the possible effect of fire on the populations.

6.b.5. Compile oral and written histories of grazing use.

Understanding the history of grazing use in Cochise pincushion cactus habitat will help us understand the current condition of the habitat and help us recommend management decisions.

6.b.6. Study interactions with other vegetation. Zimmerman (1985) reports Cochise pincushion cactus plants frequently occur beneath nurse plants that provide shade and concealment long after the cactus has reached maturity. Further study is needed. Grazing is presently reducing competing vegetation. The effect of plant competition under ungrazed conditions should be studied.

Livestock may be disturbing or destroying the soil crusts, with unknown effects on Cochise pincushion cactus. Possible effects could be disruption of short-term nutrient cycles and erosion. The relationship of Cochise pincushion cactus establishment and population stability to soil crust condition should be examined.

7. Information and education. Exchange of information and ideas among private landowners, the scientific community, the public, and Federal, State and local agencies is essential to a successful recovery program. Scientific information, including results of field and greenhouse research, monitoring data, trip reports, agency reports, and scientific literature should be readily available to all parties interested in the management and survival of Cochise pincushion cactus. Ideas should be freely exchanged so that optimal recovery strategies can be outlined and implemented. Meetings of interested parties to discuss new information or management issues or strategies should be encouraged. Preliminary or refined research or monitoring data should be presented at local, regional, and national gatherings of professional scientists so that a broad professional audience may have

opportunities to comment on, and potentially enhance, recovery of Cochise pincushion cactus.

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PART III - IMPLEMENTATION SCHEDULE

The following implementation schedule outlines actions and costs for the Cochise pincushion cactus recovery program. It is a guide for meeting the objectives discussed in Part II of this Plan. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, responsible agencies, and estimated costs. These actions, when accomplished, should bring about the recovery of Cochise pincushion cactus and protect its habitat. It should be noted that estimated monetary needs for all parties involved in recovery are identified for the first three years only, and therefore are not reflective of total recovery costs. Costs are estimated to assist in planning. This recovery plan does not obligate any involved agency to expend the estimated funds. Though work with private landowners is called for in the plan, landowners are not obligated to expend any funds.

Task Priorities

- Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2 -
An action that must be taken to prevent a significant decline in species population/habitat quality, or some other negative impact short of extinction.
- Priority 3 - All other actions necessary to meet recovery objectives.

Agency Abbreviations

FWS - USDI Fish and Wildlife Service

ES - Ecological Services

LE - Law Enforcement

RE - Realty

USDA- Border Inspection Agents

BLM - Bureau of Land Management

AZ - State of Arizona

PVT - Private landowners

VOL - Volunteers

PCO - Private Conservation Organizations

Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates (Thousands)			Comments
				FWS		Other	Year 1	Year 2	Year 3	
				Region	Program					
1	1	Develop HMP	2	2	ES	PVT AZ	4.0 -0- 1.0	4.0 -0- 1.0	-0- -0- -0-	
1	2	Study population biology	10	2	ES	VOL	4.0 -0-	4.0 -0-	4.0 -0-	
1	3.a.1.	Law enforcement education	Ongoing, periodic	2	ES LE	AZ USDA	1.0 1.0 2.0 2.0	-0- -0- -0- -0-	1.0 1.0 2.0 2.0	
1	3.a.2.	Landowners reporting trespass	Ongoing	2	ES LE	PVT AZ	-0- 1.0 -0- -0-	-0- 1.0 -0- -0-	-0- 1.0 -0- -0-	
1	3.b.	Section 7 consultation	Ongoing	2	ES	Federal agencies	1.0 1.0	1.0 1.0	1.0 1.0	
1	3.c.	Protect against surface disturbance	Ongoing	2	ES	BLM PVT AZ	-0- 4.0 -0- -0-	-0- 4.0 -0- -0-	-0- -0- -0- -0-	
1	6.b.1.	Study reproductive biology	2	2	ES		8.0	8.0	-0-	
1	6.b.3.	Study insect predators	3	2	ES		7.0	7.0	7.0	
1	6.b.4.	Study grazing effects	5	2	ES		10.0	6.0	6.0	
2	3.d.	Acquire habitat	Ongoing	2	ES RE	BLM	-0- 2.0 2.0	-0- 2.0 2.0	-0- 2.0 2.0	
2	3.e.	Protect against detrimental insect pest control	Ongoing	2	ES		0.5	0.5	0.5	
2	5.a.	Map species distribution	2	2	ES		4.0	4.0	-0-	

Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates (Thousands)			Comments
				FWS		Other	Year 1	Year 2	Year 3	
				Region	Program					
2	6.a.1.	Study substrate	1	2	ES		1.5	-0-	-0-	
2	6.a.2.	Study general climate	10	2	ES	PVT	0.5 -0-	-0- -0-	-0- -0-	
2	6.a.3.	Study microclimate	5	2	ES		8.0	3.0	-0-	
2	6.a.4.	Determine community structure	1	2	ES		5.0	-0-	-0-	
2	6.b.5.	Compile grazing history	1	2	ES		2.0			
2	6.b.6.	Study plant interactions	3	2	ES		-0-	-0-	-0-	
2	5.b.	Search for new populations	2	2	ES	FS	4.0 4.0	4.0 4.0	-0-	
3	6.b.2.	Study mammal predators	2	2	ES		8.0	8.0	-0-	
3	7	Information and education	Ongoing	2	ES		0.5	0.5	-0-	
3	4.a.	Reintroductions	Unknown	2	ES	PCO	-0- -0-	-0- -0-	-0- -0-	
3	4.b.	Seed banking and <u>ex situ</u> research	Ongoing	2	ES	PCO	1.0 1.0	1.0 1.0	1.0 1.0	

Appendix

Summary of Comments Received on the Cochise Pincushion Cactus Draft Recovery Plan

On June 14, 1993, a Federal Register notice announced that the draft Cochise Pincushion Cactus Recovery Plan was available for public review. The Fish and Wildlife Service (Service) accepted comments on the draft plan between June 14, 1993, and August 14, 1993. The draft recovery plan was distributed to 45 agencies and individuals. Comments were received from private landowners and the U.S. International Boundary Waters Commission.

All comments were considered when revising the draft plan. The Service appreciates the time each of the commentors took to review the draft and to submit their comments.

The comments discussed below represent a composite of those received prior to the close of the public comment period. Comments of a similar nature are grouped together. Substantive comments that question approach, methodology, or financial needs called for in the draft plan, or suggest changes to the plan are discussed here. Comments regarding simple editorial suggestions, such as better wording, measuring unit equivalency, or spelling and punctuation changes, were incorporated as appropriate without discussion here.

All comments received are retained as part of the Administrative Record of recovery plan development in the Arizona Ecological Services Office, Phoenix, Arizona.

Comment 1: Research is the biggest threat to this species. Researchers trample plants, gather seeds, and their site markers contribute to curiosity, mostly by hunters. The effect of research is greater than the effect of livestock.

Service Response 1: The Service has three permanent plots to monitor population stability. Two of these plots are three meters in diameter, the other is 10 meters. The Service believes that the area covered by these plots is minimal when compared with the total amount of habitat. We also believe the benefits of this research outweigh the costs. In addition, the Service has not documented any mortality due to research activities or theft related to site markers. However, we acknowledge that research can have the potential to cause minor adverse effects.

To our knowledge, seed gathering has happened only once since the species was listed. In 1987, the Desert Botanical Garden collected about seeds from 30-35 plants to conduct research and create a permanent bank of stored seeds as part of an *ex situ* conservation program. The seeds were collected under permit from the Service. The Service believes the impacts of this program are outweighed by the benefits. An intra-Service section 7 consultation covers the Regional permitting process.

The Service believes that the effect of livestock on the species is greater than the effect of researchers. Grazing occurs throughout the habitat; monitoring does not. Researchers collect data for several hours once per year and take care not to trample plants or disturb rocks or soil. Cattle move through the habitat and are in the area for longer periods of time than are researchers.

Comment 2: Keeping a temperature record along with a rainfall record will help create a picture of temperature/rainfall extremes, which will reflect severe periods of plant stress.

Service Response 2: The Service agrees and has clarified this recommendation in recovery task 6.a.2 in the final plan.

Comment 3: Why wasn't the private landowner named?

Service Response 3: No individuals were named in the recovery plan because the Service was protecting the privacy of the private landowner. We did not intend to avoid acknowledging the management efforts of the landowner.

Comment 4: The Service should have contacted the private landowner for grazing history information. Historical perspective of livestock ranching should be provided in the recovery plan. Oral histories and written records are available but not referenced.

Service Response 4: The Service agrees that understanding grazing history is an important element in interpreting the current status of Cochise pincushion cactus habitat. However, due to our schedule for producing draft recovery plans and lack of adequate staff, the Service did not have time to reconstruct the past grazing history and current grazing use. The task is included in the final recovery plan.

Comment 5: The draft recovery plan is inconsistent in its discussion of the effects of cattle grazing.

Service Response 5: We can not directly address this comment because it does not identify specific inconsistencies. We are not aware of any inconsistencies.

Comment 6: Commentor questions the amount of trampling by cattle.

Service Response 6: The recovery plan identifies trampling by livestock as a potential threat. The recovery plan recommends research to determine whether or not livestock are trampling plants or are otherwise causing adverse effects.

Only one Cochise pincushion cactus death directly attributable to trampling by livestock has been detected in the monitoring plots. However, insufficient recruitment and habitat modification are potential adverse effects of livestock grazing that are more subtle than trampling and will take long-term study to detect.

Comment 7: Most of the habitat has not been surveyed. Better surveys are needed, including information about elevation, aspect and slope.

Service Response 7: The Service agrees with this need and has identified it as recovery task 5.a.

Comment 8: The reference to the Mormon Battalion is inappropriate in the recovery plan because they travelled through Mexico, 10 miles from Cochise pincushion cactus habitat.

Service Response 8: Historical references of the vegetation of the San Bernardino Valley, including that of the Mormon Battalion, may not refer to the exact habitat of the Cochise pincushion cactus. They are included in this plan to describe the

presence of livestock and probable overstocking of the San Bernardino Valley during the mid-1800's.

Comment 9: It is not appropriate to base conclusions on the status of Arizona limestone rosewood from observations made during two hot and droughty years. The commentor believes the plants are now healthy and that various stages of plants are abundant.

Service Response 9: The Service has made observations about the status of Arizona limestone rosewood since 1988, when we first visited the habitat. Some of those years were hot and droughty; others were not. During the past six years, the Service has observed heavy browsing on Arizona limestone rosewood plants. The form of the plants and the short internode distances serve as evidence of this browsing.

The Service's observations about the health and reproduction of Arizona limestone rosewood are different from those of the commentor. Although different sizes of plants are present, small plants appear to be many years old and are very stunted. Many plants have a "bonsai" appearance atypical of the species. Their appearance indicates poor health. The status of this species can only be determined with any certainty through further study.

The Service's purpose in mentioning the status of Arizona limestone rosewood in this recovery plan is to point out the possibility that this species may be useful in gauging the health of the habitat.

Comment 10: Grazing impacts to *Vauquelinia* are likely caused by mule deer, not livestock.

Service Response 10: No studies have been conducted to provide an objective evaluation of the source of browsing on Arizona limestone rosewood. Currently, the Service is relying on our observations and those of the BLM, including the following.

Branches browsed by cattle look different than those browsed by mule deer. The Service is not an expert in recognizing these differences. However, the BLM employee who made the observation that livestock are the primary browsers of Arizona limestone rosewood does have experience in distinguishing the two.

Comment 11: Page 10, paragraph 2 of the draft plan implies that cactus distribution is limited by grazing. This paragraph seems to contradict paragraph 2, page 4, which suggests that microsite requirements are very specific and unrelated to grazing.

Service Response 11: The Service believes these two paragraphs complement one another. Both paragraphs state that the current distribution of Cochise pincushion cactus may be an expression of microsite requirements or other factors.

Comment 12: Local residents are angry that the Service did not enforce laws against illegal collection.

Service Response 12: The commentor is referring to a 1988 report of a theft of Cochise pincushion cactus. The Arizona Department of Agriculture (then the Arizona Commission of Agriculture and Horticulture) requested the assistance of the Service. The Service declined to assist, because the Endangered

Species Act was not violated. At the time the alleged theft occurred, the 1988 amendments to the ESA had not been enacted and removal of threatened plants from private or State land was legal under the Act. However, the alleged removal violated the Arizona Native Plant Law. Federal involvement was not appropriate because the situation was solely a question of whether or not State law had been violated. We regret any misunderstandings this incident may have caused.

Comment 13: Federal ownership would not be appropriate or successful or would change law enforcement.

Service Response 13: The Service believes that Federal ownership would strengthen the protections provided for Cochise pincushion cactus by sections 7 and 9 of the ESA. The Service believes strengthening legal protection for Cochise pincushion cactus is a reason for supporting Federal ownership of the habitat.

Section 9 does not protect threatened plants on private or State lands unless such a plant is removed, cut, dug up, damaged or destroyed in knowing violation of any law or regulation of any state (such as the Arizona Native Plant Law) or in the course of any violation of a state criminal trespass law. Listed plants on Federal lands are given protection against removal and reduction to possession and malicious damage or destruction. The Arizona Native Plant Law also provides protection of listed plants on Federal lands.

Section 7 of the ESA regulates actions that Federal agencies permit, fund, or carry out. If Cochise pincushion cactus habitat was Federally owned, then

activities such as mineral exploration and development and aerial pesticide applications would be regulated.

The Service has no reason to believe that Federal ownership would prove unsuccessful, particularly because we do not anticipate any change in land use.

Comment 14: Local resident has law enforcement capabilities needed to enforce ESA and ANPL.

Service Response 14: The Service appreciates the offer of law enforcement assistance from the local resident. These skills will help strengthen the legal protections given this species.

Comment 15: Pesticides are not a threat because the ranch owner does not intend to use them.

Service Response 15: We appreciate the knowledge that the current private landowner does not intend to use pesticides. However, Cochise pincushion cactus also occurs on State Trust land. If grasshopper densities exceed eight grasshoppers per square yard (6.7 per square meter) on State Trust land, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, at the request of the Arizona Department of Agriculture and Arizona State Land Department, could apply chemical controls to the general area. Such a situation was proposed in 1989, when the Arizona Department of Agriculture proposed treating the area containing occupied Cochise pincushion cactus habitat with ultra-low volume Malathion, a general pesticide. Although the Service believes chemical control of insect pests may be unlikely in this area, we believe the recovery plan should recommend pesticide restrictions.

Comment 16: Africanized honeybees could adversely affect native pollinators.

Service Response 16: The Service agrees and recognizes the need for this research in recovery task 6.b.1.

Comment 17: Rodents, rabbits, javelina are native species and the co-existence between these plants and animals should be realized before the "Terminator" arrives.

Service Response 17: The Service can not respond to this comment because we do not know what is meant by the Terminator. Perhaps the commentor was referring to herbivorous animals. If so, the effects of herbivores on Cochise pincushion cactus will be studied as time and funding permit.

Comment 18: Fire and grazing are naturally occurring events and not a threat to the species.

Service Response 18: The Service agrees that fire is a naturally occurring event. Grazing by wildlife is also a naturally occurring event, but livestock grazing is not. The Service believes that understanding the perturbations that may have been caused by the introduction of domesticated livestock may help us manage this ecosystem. The studies described in the recovery plan would help us achieve this goal.

Comment 19: The statement that "livestock may be disturbing or destroying soil crusts" contradicts a later statement that plants occur in microsites where the soil crust is undisturbed.

Service Response 19: The Service does not believe these two statements contradict one another. If *Coryphantha robbinsorum* plants occur where the soil crust is undisturbed and if livestock disturb or destroy soil crusts, then livestock may interfere with population stability.

Comment 20: Recovery costs for 1997 - 2003 should be included not only in the executive summary but also in the implementation schedule.

Service Response 20: The amount of information contained in other columns of the implementation schedule limits the number of cost columns the Service can provide. The Service believes it is sufficient to provide the ten-year implementation costs in the executive summary.

Comment 21: With whom will the international agreements mentioned in recovery criteria 1 be developed?

Service Response 21: References to international agreements were omitted in the final plan. The Service believes landowner or agency agreements, whether they be in the United States or Mexico, are preferable to and more effective than international-level agreements.