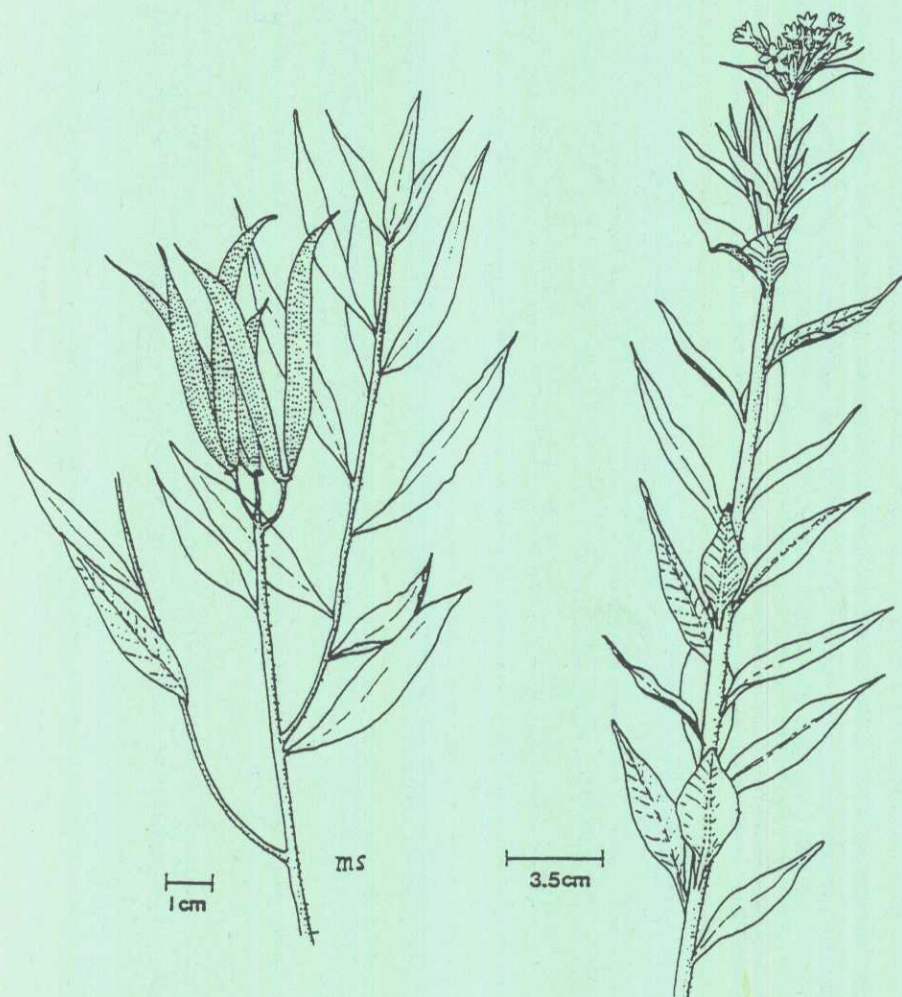


# KEARNEY'S BLUE STAR

*(Amsonia kearneyana)*

## RECOVERY PLAN



**KEARNEY'S BLUE STAR**  
**(Amsonia kearneyana)**  
**RECOVERY PLAN**

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Date:

May 24, 1993

## DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, state agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

### Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1993. Kearney's Blue Star (*Amsonia kearneyana*)  
Recovery Plan. USDI Fish and Wildlife Service, Albuquerque, New Mexico.  
25 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service  
5430 Grosvenor Lane, Suite 110  
Bethesda, Maryland 20814  
301/492-6403 or 1-800-582-3421

The fee for the Plan varies depending on the number of pages in the Plan.

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## EXECUTIVE SUMMARY

**Current Status:** Kearney's blue star is listed as endangered. It is known from two extant populations, one natural and one ex situ, located in the Baboquivari Mountains in Pima County, Arizona. The natural population supported about 25 plants in 1981 but has since decreased to 8 plants. The ex situ population planted in 1988 and 1989 consisted of 181 plants but has since been reduced to 33 plants by catastrophic flooding. The latter population was augmented in 1992 with an additional 69 plants.

**Habitat Requirements and Limiting Factors:** Kearney's blue star grows in arid and semi-arid alluvial soils in seasonally flooded dry rocky washes. Low population numbers, insect predation on seeds, catastrophic flooding, and soil erosion accelerated by losses in plant cover and vigor due to livestock grazing are believed to be important threats to Kearney's blue star.

**Recovery Objective:** Downlisting

**Recovery criteria:** Maintain 10 self-sustaining natural populations of Kearney's blue star and establish procedures to insure continued protection of these populations from human and natural threats.

**Actions Needed:**

1. Protect and manage populations and habitat.
2. Gather biological information needed to describe habitat requirements and determine management decisions.
3. Survey for new populations.
4. Reintroduce populations as needed to meet downlisting criteria.
5. Establish an ex situ conservation program in botanical gardens and natural settings.

**Costs (\$000's):**

| <u>Year</u>                 | <u>Need 1</u> | <u>Need 2</u> | <u>Need 3</u> | <u>Need 4</u> | <u>Need 5</u> | <u>Total</u> |
|-----------------------------|---------------|---------------|---------------|---------------|---------------|--------------|
| 1993                        | 47.5          | 59.0          | 10.0          | 0.0           | 15.0          | 131.5        |
| 1994                        | 45.5          | 44.0          | 10.0          | 0.0           | 15.0          | 114.5        |
| 1995                        | 39.5          | 49.0          | 0.0           | 10.0          | 5.0           | 103.5        |
| 1996                        | 39.5          | 10.0          | 0.0           | 10.0          | 5.0           | 64.5         |
| 1997                        | 39.5          | 10.0          | 0.0           | 10.0          | 5.0           | 64.5         |
| 1998                        | 39.5          | 10.0          | 0.0           | 10.0          | 5.0           | 64.5         |
| 1999                        | 39.5          | 10.0          | 0.0           | 10.0          | 5.0           | 64.5         |
| 2000                        | 39.5          | 10.0          | 0.0           | 0.0           | 5.0           | 54.5         |
| 2001                        | 39.5          | 10.0          | 0.0           | 0.0           | 5.0           | 54.5         |
| 2002                        | <u>39.5</u>   | <u>10.0</u>   | <u>0.0</u>    | <u>0.0</u>    | <u>5.0</u>    | <u>54.5</u>  |
| <b><u>Recovery Cost</u></b> | 409.0         | 220.0         | 20.0          | 50.0          | 70.0          | 771.0        |

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

## TABLE OF CONTENTS

|  | Page |
|--|------|
| DISCLAIMER .....                         | i    |
| ACKNOWLEDGEMENTS .....                   | ii   |
| EXECUTIVE SUMMARY .....                  | iii  |
| TABLE OF CONTENTS .....                  | iv   |
| PART I - INTRODUCTION .....              | 1    |
| Brief Overview .....                     | 1    |
| Taxon History .....                      | 1    |
| Description .....                        | 2    |
| Distribution .....                       | 2    |
| Habitat and Ecology .....                | 5    |
| Management Issues and Concerns .....     | 6    |
| Conservation Measures .....              | 8    |
| PART II - RECOVERY .....                 | 10   |
| Objective and Criteria .....             | 10   |
| Outline of Recovery Actions .....        | 11   |
| Literature Cited .....                   | 19   |
| PART III - IMPLEMENTATION SCHEDULE ..... | 21   |
| APPENDIX A .....                         | 24   |

## PART I - INTRODUCTION

### Brief Overview

Kearney's blue star (*Amsonia kearneyana* Woodson) was listed as an endangered species under the Endangered Species Act of 1973, as amended, on January 19, 1989 (U.S. Fish and Wildlife Service 1989). Critical habitat was not designated. Kearney's blue star has a recovery priority of 2. Recovery priorities for listed species range from 1 to 18, with species ranking 1 having the highest recovery priority.

Kearney's blue star occurs in the Baboquivari Mountains, Pima County, Arizona. There are two known populations, one natural and one introduced. The natural population contains 8 plants, the introduced population contains 102. Threats to the species include low numbers, few populations, catastrophic flooding, soil erosion accelerated by losses in plant cover and vigor due to livestock grazing, apparently insufficient reproduction, and seed predation by insects.

### Taxon History

Kearney's blue star was first collected by F. Thackery on May 24, 1926. Robert H. Peebles, G.H. Harrison, and Thomas H. Kearney collected it on March 29, 1927, and Thackery recollected it on April 9, 1928. Robert E. Woodson, Jr., described the new species in 1928, naming it in honor of Kearney who brought it to Woodson's attention (Woodson 1928, Phillips and Brian 1982). The original collection locality was rediscovered in the late 1970's by Dr. Steven P. McLaughlin of the University of Arizona.

Woodson believed *Amsonia kearneyana* was a hybrid between *A. standleyi* or *A. palmeri* and *A. brevifolia* or *A. tomentosa* because of its geographic location and because seeds from the specimens provided him were sterile. He thought this indicated some form of reproductive incompatibility between the putative parent species. Woodson later reduced *A. kearneyana* to synonymy under *A. palmeri* (Woodson 1938). Because the authors considered its fruits to be distinct

from other species, Kearney et al. (1960) included the species under the original name.

Woodson's conclusion that Kearney's blue star is a recent sterile hybrid was disproved when McLaughlin (1982) observed 66 percent germination of Kearney's blue star seeds collected from the type locality. McLaughlin believes that the seeds available to Woodson had been destroyed by stink bugs (*Chlorochroa ligulata*), which attack and destroy the seed embryos. Presently, Kearney's blue star is considered a distinct species.

### Description

Kearney's blue star is a perennial herb in the dogbane family (Apocynaceae). The root crown produces many erect, rarely branching, pubescent stems. Leaves are alternate, lance-shaped, 0.4 - 0.7 inch (11 - 17 mm) long, 0.1-0.3 inch (3 - 8 mm) wide, soft, and bright green with short petioles. Mature plants are about 2.3 feet (0.7 m) high and 3.0 feet (0.9 m) across. The pale blue flowers are 1.2 - 3.9 inches (12 - 15 mm) long and form in terminal flower clusters in April (Figure 1) (Phillips and Brian 1982). The fruits are follicles 1.2 - 3.9 inches (3 - 10 cm) long and are usually paired, a characteristic of the dogbane family. The follicles are terminal and extend above the foliage, making the plant easy to recognize when fruiting from June to July. Seeds are corky cylinders 0.1 - 0.2 inch (3 - 4 mm) wide and 0.3 - 0.4 inch (8 - 11 mm) long with tapered ends. The nature of the seeds and the riparian habitat suggest that floodwater associated with storms that occur mostly from July to September disperse the seeds.

### Distribution

Kearney's blue star is known from one extant natural population in South Canyon of the Baboquivari Mountains on the Tohono O'odham Nation (TON), Pima County, Arizona (Figure 2). This site is believed to be the type locality. The population consisted of 24 adult plants and 1 sub-adult plant in 1982 (Phillips and Brian 1982). A cursory check of the population in 1986 located only 8 plants (U.S. Fish and Wildlife Service 1989).



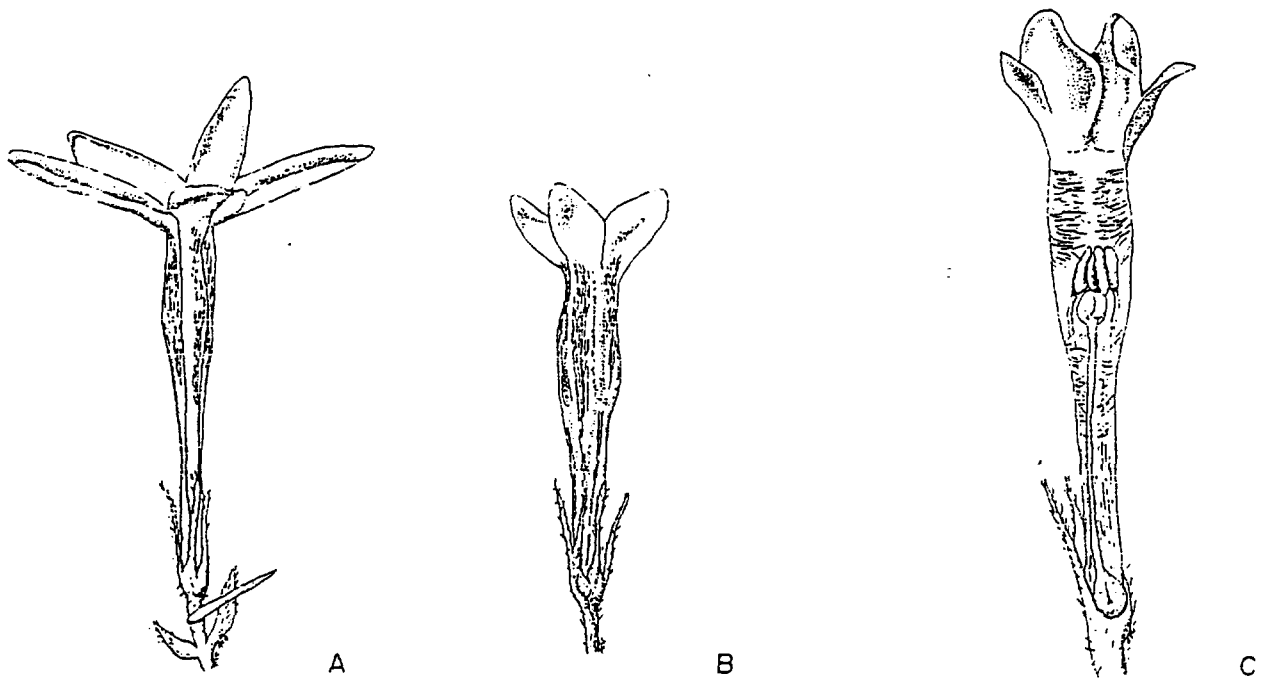


Figure 1. Kearney's blue star flowers, (A) length 0.9 inch (23 mm), width 0.7 inch (17 mm), (B) length 0.8 inch (20 mm), width 0.3 inch (7 mm). The pair of flowers are from different plants and show significant morphological differences. (C) Cut-away view of flower. Illustrations by A.E. Gondor.

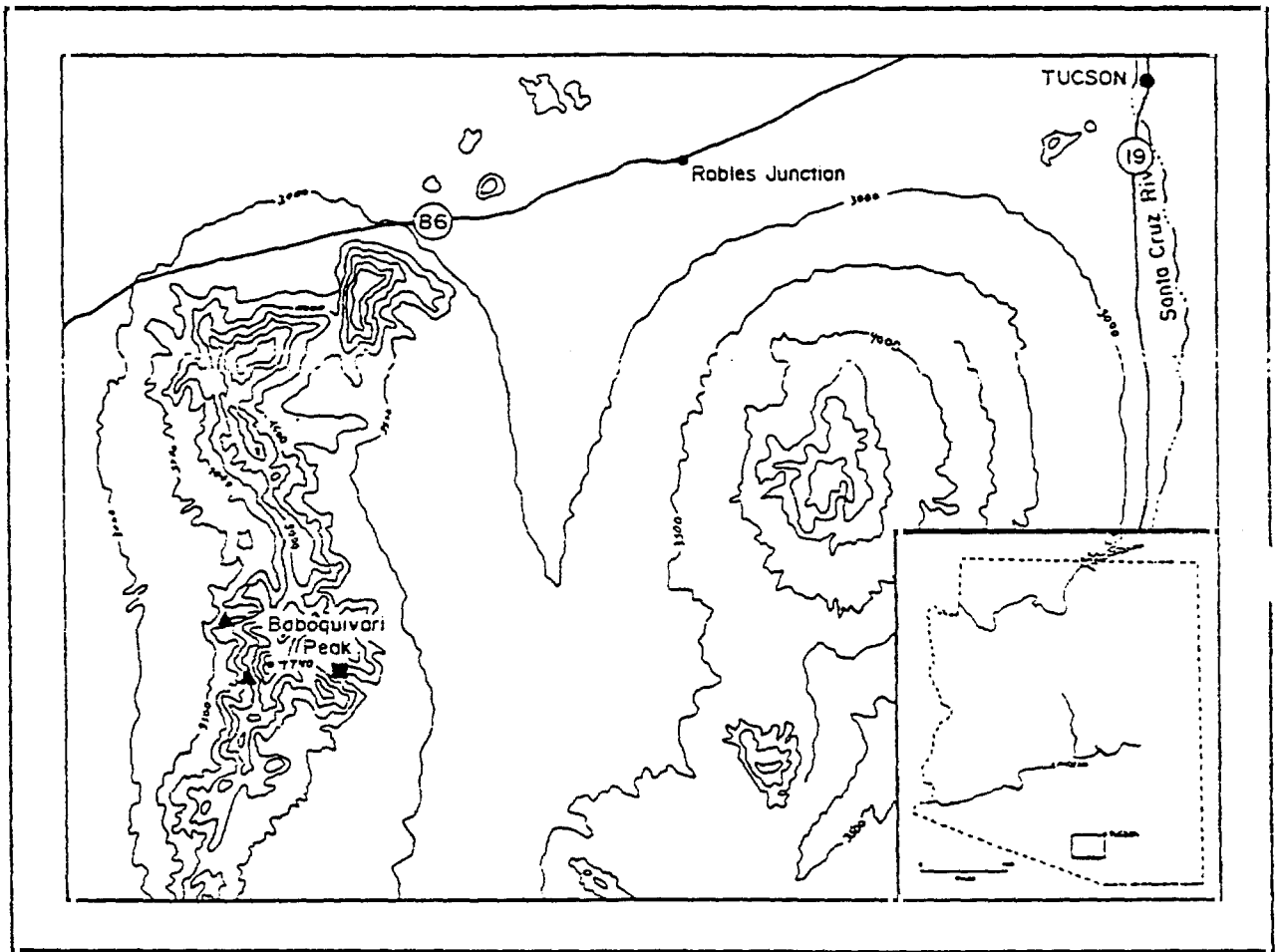


Figure 2. South-central Arizona showing the location of Kearney's blue star populations. Triangles = natural populations, one of which is believed to be extirpated. Square = introduced population.

Another natural population of Kearney's blue star was known from Sycamore Canyon of the Baboquivari Mountains and is documented with a herbarium specimen collected by Goodding on May 14, 1941 (Arizona State University Herbarium, Tempe, Arizona). Sycamore Canyon was searched for Kearney's blue star in 1982, but no plants were found (Phillips and Brian 1982).

An *ex situ* population of Kearney's blue star was planted in the fall of 1988 and spring of 1989 on private land in Brown Canyon of the Baboquivari Mountains outside of the known range of the species. This population had 33 plants in late 1991 (Reichenbacher et al. 1991) and was supplemented with an additional 69 plants in the spring of 1992 (Reichenbacher, Southwest Field Biologists, Tucson, Arizona, pers. comm. 1992).

### Habitat and Ecology

The only natural population of Kearney's blue star occurs at about 3,700 feet elevation and inhabits a dry rocky wash that drains the southwest slope of Baboquivari Peak. The thermic arid and semi-arid soils are granitic in origin (Soil Conservation Service 1974). Annual precipitation approaches 16 inches (6.3 cm) and there are 225 to 275 frost-free days a year (Sellers and Hill 1974). The area supports Mexican Blue Oak associations along sheltered reaches of the canyons. The ridges and slopes support Sonoran Desertscrub, Semidesert Grassland plant communities, or a transition zone between the two (plant community names follow Brown and Lowe 1980). Common and dominant perennial plants associated with Kearney's blue star in South Canyon include: Mexican blue oak (*Quercus oblongifolia*), desert honeysuckle (*Lonicera arizonica*), catclaw acacia (*Acacia greggii*), desert hackberry (*Celtis pallida*), desert cotton (*Gossypium thurberi*), narrowleaf hoptree (*Ptelia angustifolia*), Arizona walnut (*Juglans major*), and velvet mesquite (*Prosopis velutina*).

Phillips and Brian (1982) reported 25 plants in South Canyon with 24 of them flowering and fruiting. None appeared to be browsed although the site and surrounding habitat were severely impacted by cattle grazing. One of the plants was believed to be a seedling or juvenile. The plants averaged 11.9 inches (30.2 cm) high and 32.1 inches (81.5 cm) across. The largest plants in South Canyon had more than 50 flowering branches.

Valuable knowledge on the phenology and pollination biology of Kearney's blue star was gained during studies of the introduced population in Brown Canyon, although these plants were not as large as fully developed Kearney's blue star (Reichenbacher et al. 1991) and the habitat is different than that of the native population. The root crown of the plant begins to produce stem and leaf buds by middle to late February and plants essentially stop growing by August to October. Leaves begin to wilt by October and the plant is completely dormant by middle to late December. In June 1990, the 2 year old plants in Brown Canyon averaged 19.1 inches (48.6 cm) tall, 12.3 inches (31.2 cm) across, and had an average of 10.2 stems each. Stems of these young plants were somewhat weak and sprawling, in contrast with the erect stems of older plants.

In 1990, the Brown Canyon plants began flowering on March 23, reached a peak on April 9, and finished flowering on April 22. No flowers were observed in summer or fall. The same plants produced an average of 9.9 follicles each, almost all of which had dropped by June 23. Growth and flowering periods in Brown Canyon may be later in the year than in South Canyon, which is a warmer, drier, less shady site.

Reichenbacher observed three species of butterflies and many beetles of the family Mordelidae feeding on Kearney's blue star flowers in April 1990 in Brown Canyon (Reichenbacher et al. 1991). He also observed an unidentified hummingbird feeding sporadically on Kearney's blue star flowers.

#### Management Issues and Concerns

The limited distribution, apparently declining numbers, declining habitat, and poor reproduction of Kearney's blue star were reasons to list the species as endangered (U.S. Fish and Wildlife Service 1989). The number of plants observed in South Canyon was 25 in 1981 and 8 in 1986. The 1986 count was not thorough; more plants may be documented in the future. No plants were found during the last recorded visit to Sycamore Canyon in 1981 (Phillips and Brian 1982). The 33 *ex situ* plants that persisted in Brown Canyon in 1991 were augmented in 1992 with 69 plants. Only 110 individuals are currently known in the wild, and 102 these are in an *ex situ* population with uncertain viability or survivorship.

Nothing is known about the condition of the Kearney's blue star populations found by the original discoverers. Woodson (1928), in his description of the species mentioned, "...several colonies have been found in the same general vicinity...", and Kearney et al. (1960) describes the range of the species as, "Plains and mouths of canyons along the western front of the Baboquivari Mountains...." Woodson probably never visited the site, but Kearney and Peebles both collected specimens. The latter authors may be describing a species that had more populations or plants than presently exist, or they may have seen it in only one place but assumed it should occupy adjacent similar habitats.

Woodson's comment that the species is sterile (Woodson 1928) may have originated because of inviable seeds in specimens he received from Peebles. McLaughlin (1982) believes that the seeds had been destroyed by insect larvae, possibly the stinkbug *Chlorochroa ligata*, and he conducted germination viability studies to prove that the species is not sterile. Due to predation by some insect on the plants at Brown Canyon, Reichenbacher et al. (1991) noted that all of the follicles produced by 31 Kearney's blue star plants had to be collected prematurely. The predator, in this case, was never identified. Thus, it appears Kearney's blue star may be subject to intense periodic predation by several insects.

Kearney's blue star habitat on the TON is overgrazed and erosion, flooding, and general habitat degradation have been the result. Trampling, loss of shade plants, change in soil characteristics, or other causes may be preventing seedling establishment. Seeds washed downstream enter a harsh habitat that is apparently unsuitable for seed germination and seedling establishment. Despite the degraded condition of the habitat, Kearney's blue star plants do not appear to be eaten. Like other members of the dogbane family, Kearney's blue star has a toxic milky alkaloid sap and is not grazed, even during periods of drought when other food sources are limited.

Kearney's blue star is susceptible to damage from catastrophic floods (Phillips and Brian 1982). The natural population of the species occurs among boulders and coarse alluvium along one drainage. One flood could remove the entire population. Torrential rains during the summer of 1990 destroyed 76 percent of the plants at the Brown Canyon *ex situ* population.

### Conservation Measures

For a number of years, volunteers and paid researchers have been studying and trying to conserve Kearney's blue star. McLaughlin (1982) began studying Kearney's blue star during investigations that led to the revision of the *Amsonia* genus in Arizona. He gave some of the seeds he collected from the wild population between 1979 and 1982 to the Arizona-Sonora Desert Museum's Curator of Plants in 1987. These seeds were used to test seed viability and verify that the species is not sterile and to provide a source of artificially propagated plants for introduction into natural habitats. Seeds sown at the Arizona-Sonoran Desert Museum in 1987 totalled 306 with 49 percent germination (Mark A. Dimmitt, Arizona-Sonoran Desert Museum, pers. comm. 1987). Six lots of seeds had germination rates ranging from 25 to 80 percent. Results indicated that the best germination was obtained from 4-year old seeds. Other seed lots collected in 1979 (7-year old seeds) had lower germination rates, suggesting the seeds were losing viability. Reserve seed lots are being kept frozen to prevent loss of viability. Dimmitt noted that Kearney's blue star is easy to propagate.

While the Desert Museum was propagating plants, surveys indicated the population in South Canyon had decreased from 25 to 8 plants. The U.S. Fish and Wildlife Service (FWS) believed it prudent to find a suitable site to introduce a new population of Kearney's blue star. This was to serve as an *ex situ* conservation pool and research opportunity.

Dr. Donna J. Howell was contracted by the FWS to survey the Baboquivari Mountains for possible introduction sites. She concluded that three areas were suitable (Howell 1987). She recommended the Brown Canyon site to be the most desirable, as vegetation and soils were somewhat similar to those of South Canyon. Additionally, Brown Canyon was lightly grazed and the private landowners were interested in an introduction program. Shortly thereafter, an agreement with the Brown Canyon landowners was signed to permit the planting of propagated Kearney's blue star seedlings to establish an *ex situ* population.

In February 1988, the FWS contracted with Southwestern Field Biologists to plant propagated Kearney's blue star seedlings into suitable sites in Brown

Canyon and to monitor this effort. The project initially involved planting 76 one-year old Kearney's blue star plants at designated sites in Brown Canyon on March 29 - 30, 1988. On January 28, 1989, an additional 105 two-year old plants were transplanted a few hundred yards down canyon from the 1988 plantings. In June 1990, 34 plants (45 percent) were alive at the upper site and 102 (97 percent) were alive in the lower site, for a total of 136 live plants. The earlier planting was of fully leafed plants in bloom while the second planting was with plants just beginning to emerge from winter dormancy. The greater maturity of the 1989 group probably accounts for most of the difference in success between the two plantings (Reichenbacher et al. 1991).

Because of drought conditions in the spring of 1988 and 1989, all plants were hand watered every one to two weeks. This watering was critical to the survival of both groups during the first growing season. Pesticides were applied once to control cutworms and caterpillar damage observed in the spring of 1989.

The 1990 summer rainy season brought torrential rains that flooded and scoured Brown Canyon and the Kearney's blue star sites. A January, 1991, resurvey of the sites recorded a total of 33 live plants (Reichenbacher et al. 1991).

In 1991, Southwestern Field Biologists were contracted by FWS to supplement the earlier plantings in Brown Canyon and continue monitoring the old and new plantings. On February 3, 1992, an additional 69 five-year old plants were planted at the upper site.

The Arizona Native Plant Law (A.R.S. Chapter 7, Article 1) provides for the protection of Kearney's blue star. Kearney's blue star is protected as a Highly Safeguarded Species by the Native Plant Law. Species in the Highly Safeguarded category can not be removed from their habitat, except for scientific and educational purposes with a permit from the Arizona Department of Agriculture and with the landowner's permission. Although the Arizona Native Plant Law does not apply on Indian Reservations, it does apply to native populations found off the Reservation in the United States and to wild-collected plants that are transported off the Reservation.

## **PART II - RECOVERY**

### Objective and Criteria

The primary objective of this recovery plan is to maintain viable Kearney's blue star populations in natural habitat to insure that the species is safe from extinction. Kearney's blue star will be considered for reclassification from endangered to threatened when 10 geographically distinct, self-sustaining, natural populations are protected in Arizona. These 10 populations must represent the geographic range of the species.

Due to the present precarious existence of the species and the unknown nature of its life history and habitat requirements, it is impossible at this time to predict what measures will be sufficient to permit delisting the species. Tasks necessary to accomplish downlisting should provide the information necessary to determine if delisting will be possible and what the delisting objectives and criteria should be. After downlisting is accomplished, this plan will be revised to establish specific delisting objectives. The criteria to meet the downlisting objective are:

1. Establish or maintain 10 self-sustaining native populations of Kearney's blue star within the known or inferred historic range of the species. Each population must contain at least 200 reproducing individuals and show recruitment that equals or exceeds mortality. The populations should be geographically distinct and represent the geographic range and genetic variability of the species. Of the ten natural populations needed to ensure the long-term survival of the species, at least seven must be natural populations and up to three may be reintroduced populations. The downlisting criteria will not be met if fewer than seven natural populations are found.
2. Insure long-term protection of the populations from human threats on Indian, private, and public lands. Because most of the potential habitat for Kearney's blue star occurs on the Tohono O'odham Nation (TON), the Tribe will need to take the lead in implementing the recovery plan and any additional protective measures on the Reservation. The FWS must provide the Tribe the technical



advice needed to carry out recovery actions and seek the funding necessary to support the Tribe in their recovery efforts.

For the purposes of interagency section 7 consultation, each distinct natural population of Kearney's blue star will be considered essential for the survival and recovery of the species.

### Outline of Recovery Actions

1. **Identify and protect natural and introduced populations.** Management planning and the long-term commitment of interested parties will be required to insure the survival of natural Kearney's blue star populations. The known population of Kearney's blue star is threatened by habitat degradation due to livestock grazing, flooding, and insect predation. Recovery of the species will depend on protecting this population and any that may be discovered or reintroduced in the future.
  - 1.a. **Develop a conservation strategy for Kearney's blue star and the associated ecosystem on the Tohono O'odham Reservation.** The future survival of Kearney's blue star depends on how the Tohono O'odham Tribe manages the ecosystem. An essential part of this conservation strategy will be the Tribe's appointment of a recovery coordinator to facilitate and guide recovery activities on the TON. Ideally, the coordinator will be a Native American who has the technical expertise to coordinate recovery, understands the concerns and sensitivities of the local Indian people, understands the workings of the Tribal and District councils, and is accepted by the Tribe. The TON recovery coordinator will be the liaison between the FWS and individual Tribal members and leaders.
    - 1.a.1. **Develop and implement a habitat management plan (HMP) for the TON.** With the assistance of the recovery coordinator and FWS, the Tribal government should produce a HMP for Kearney's blue star on the Reservation. The plan should address the need for ecosystem management, not just the needs of the limited areas occupied by Kearney's blue star. The HMP should

identify the threats to the species and make management recommendations that will eliminate or reduce those threats. Effective control of livestock grazing will likely be the principal management need. The HMP should also include guidelines for establishing reintroduced populations and augmenting existing native populations.

- 1.a.2. Develop guidelines to determine need and techniques for supplementing natural populations. Guidelines to determine whether or not supplementing natural populations is necessary, and how transplanting and monitoring should be done, should be written by the FWS, with input from the Tribe. Monitoring is particularly important to developing successful methods. Plantings on the TON should follow appropriate guidelines and be done by Tribal members under the guidance of the FWS and the TON recovery coordinator.
- 1.a.3. Establish special land use designations where needed. On the Reservation, the TON recovery coordinator should work with the Tribal and District Councils to identify any lands that may be suitable for special management designation to protect Kearney's blue star and its ecosystem. In other areas, the FWS or other parties should work with the private landowner(s) or appropriate Mexican representative(s).
- 1.b. The FWS will coordinate and provide technical assistance for recovery activities on private and public lands. The cooperation of landowners and land managers will be vital to recovery of this species.
  - 1.b.1. Develop written agreements between the FWS, landowners, and other Federal and State agencies that will assist and direct the management and protection of the ecosystem of Kearney's blue star. These understandings may take the form of memoranda of understanding, cooperative agreements, management plans, conservation easements, etc. They should specify the specific actions and time frames for activities to be undertaken by each involved party.

- 1.b.2. Develop and implement HMPs if appropriate. Written plans should be developed to guide landowners and managers in protecting and conserving the ecosystem of Kearney's blue star on private and public lands. The HMPs should address threats to the species and make recommendations that will lead to minimizing or eliminating these threats. It should also address guidelines for establishing new populations and augmenting existing native populations.
- 1.b.3. Develop guidelines to determine need and techniques for supplementing natural populations. Guidelines to determine whether or not supplementing natural populations is necessary should be written by the FWS. These guidelines should incorporate transplantation and monitoring techniques. Monitoring transplanted plants is essential to develop successful methods.
- 1.c. Enforce existing rules and regulations of the Endangered Species Act, the Arizona Native Plant Law, and any other applicable law or local ordinance. Tribal, State, and Federal law enforcement agents should exercise their full authorities to protect the species. Enforcement should help protect existing populations, help prevent further declines, and assist recovery. The Bureau of Indian Affairs (BIA) and all other Federal agencies are required to carry out formal Endangered Species Act Section 7 consultations when actions they fund, carry out, or permit may affect a listed species. All Federal agencies have an affirmative responsibility under section 7(a)(1) to carry out conservation programs for listed species. The Arizona Native Plant Law requires that persons transporting a Highly Safeguarded Species outside the Reservation boundary have a permit from the Arizona Department of Agriculture. The recovery coordinator should interact with the Tribal Council to encourage the Tribe to adopt and implement ordinances to protect Kearney's blue star and its ecosystem on the Reservation. Researchers may need to obtain Federal, State, or Tribal permits for some types of work with this species.

1.d. Acquire and protect Kearney's blue star populations and ecosystems not already protected. All known natural populations of Kearney's blue star occur on land managed by the TON with assistance from the BIA. If new populations are found on private or Arizona State trust lands, acquisition of the land or management rights by State, Federal, or private entities interested in protecting Kearney's blue star should be considered and protection given if warranted.

2. Assess the status of natural, reintroduced, and ex situ populations.

Because of the small number of known Kearney's blue star populations, all should be visited regularly to determine their status. With only one known natural population in existence, the status of this population is critical.

2.a. Monitor Threats. Each population should be visited during critical life stages, such as flowering and fruiting times. Changes in the amount of damage from insects, trampling or grazing, drought, or flooding should be noted so that steps may be taken to alleviate any serious or recurring problems and recovery success can be determined. Visits could be scheduled at the times needed to collect information for conducting demographic analyses.

2.b. Collect demographic data to determine population status and viability.

Standard demographic monitoring techniques should be used to determine the status of each natural population. Individual plants should be marked and all pertinent data, including phenology, growth, vigor, reproduction, and pollination, should be recorded. Demographic information is used to determine minimum viable population sizes and acceptable levels of natural variation within stable, reproducing populations. The data should be interpreted knowing the current and future condition of the habitat. This information can be used to identify man-caused threats, environmental variables, or other problems that may be interfering with population stability. Once identified, attempts should be made to reduce or eliminate the threats.

**3. Conduct research and observe the populations to describe the species' habitat requirements, and modify management as appropriate.** Sound management of viable populations can only occur with the guidance of biological information. Determining current habitat conditions and whether or not they are currently suitable to support Kearney's blue star is critical to immediate management decisions.

3.a. Define associated plant species. Determine the abundance and distribution of associated plant species to identify the community type. This information may help us understand the ecology of the species, to locate currently unknown natural populations, or select future reintroduction sites.

3.b. Describe the physical environment. This information is needed to determine the natural conditions for seed germination and seedling survival. Field and greenhouse experiments may be required to determine if current natural conditions are suitable for seedling establishment and vigorous growth and reproduction of mature plants.

3.c. Use information obtained in tasks 3.a. and 3.b. to map the inferred historic range of the species. This information will be useful in guiding searches for new populations and selecting sites for reintroductions if this becomes necessary to meet the downlisting criteria.

3.d. Conduct grazing impact studies and determine watershed conditions and trends. Conduct comparative studies using grazed and ungrazed plots to determine if grazing is a limiting factor. Studies such as these take a long time because the ecosystem may take a long time to recover from past management practices. Because ungrazed plots may not fully recover from overgrazing for 50 to 100 years, the data obtained from these plots will show the short-term effects of no grazing and habitat recovery. Ungrazed plots would have to be large and situated to measure ecosystem, and not more limited, localized, changes. If grazing is found to limit the viability of the population, determine the effects and make management recommendations to reduce or eliminate the effects. The BIA may assist the Tribe in making and implementing livestock management recommendations.

- 3.e. **Study insect seed predation.** Determine the insect seed predators. Study seed predators in detail to determine if they are a long-term or a more temporary, cyclical problem. If they are a long-term threat, examine methods of alleviating this threat, including natural methods.
- 3.f. **Examine the pollination ecology and reproductive biology.** Little information is known about whether or not flowering plants in the natural population are being successfully pollinated. If pollination and seed set appears to be limited, possible causes should be investigated.
4. **Survey for new populations.** Inventory all lands in Arizona and Mexico believed capable of supporting Kearney's blue star. Searches of varying thoroughness have been made without new discoveries in Baboquivari, Sycamore, Leyvas, Weaver, Jupiter, Thomas, Brown, Sabino, and Nogales Canyons, and in Asolido Wash. Additional surveys are needed on the west slope of the Baboquivari Mountains. Surveys on the Reservation should be conducted by Tribal members under the supervision of the TON recovery coordinator, or by a non-Tribal member(s) with the approval of the Tribe.
5. **Establish a sufficient number of reintroduced populations to meet the downlisting criteria.** Ten self-sustaining populations within the known or inferred historic range of Kearney's blue star are needed before the species can be downlisted to threatened. If searches of potential habitat fail to locate ten natural populations, up to three reintroduced populations could make up part of the difference. The reintroduction of populations should not be used to substitute for effective management of natural populations or habitat. Techniques learned in the *ex situ* conservation program should be employed in establishing populations. Reintroduced populations should be managed and monitored the same as natural populations.
6. **Establish an *ex situ* conservation program.** An *ex situ* conservation program should establish living plants in botanical gardens, a seed bank, plants growing in a natural setting (such as Brown Canyon), and other appropriate programs. These *ex situ* populations will provide some assurance against extinction in the event of catastrophic loss of the populations in natural habitat. However, *ex situ* populations will not count toward the ten

population downlisting goal; they will be treated as a conservation pool and source of research material.

- 6.a. Establish a botanical garden population and a seed bank. The Center for Plant Conservation or other appropriate organization(s) should be contracted to establish and maintain a seed bank and plants in cultivation. The plants would be available for research and as a source of stock for future introduction projects. Appropriate facilities for these *ex situ* programs include, but are not limited to, the Desert Botanical Garden in Phoenix, Arizona, and the Arizona-Sonora Desert Museum in Tucson, Arizona.
  - 6.b. Establish and monitor *ex situ* populations to maintain a conservation pool. Maintaining plants at a garden is limited by funding and space and can result in the slow decrease of genetic diversity. *Ex situ* conservation in a natural setting can alleviate the constraints of the lack of greenhouse space and can reduce the likelihood of the loss of biodiversity. Sites for *ex situ* population establishment in a natural setting should be chosen according to FWS guidelines or using the best available information. Some sites that may be considered for introduction of Kearney's blue star include, but are not limited to, Weaver, Thomas, and Sabino/Nogales Canyons on the east side of the Baboquivari Mountains. Transplantation techniques should follow written guidelines or follow the best information available from previously successful transplants.
7. Information and education. Exchange of information and ideas among individuals representing the Tribe, private landowners, the scientific community, the public, and Federal, State and local agencies is essential to a successful recovery program. Information on the goals, plans, and progress of recovery implementation should be readily available to all interested parties.
    - 7.a. Develop and implement a public awareness program. Public cooperation, particularly on the TON where all known populations are located, is essential for the success of the Kearney's blue star recovery program. An educational program should be developed for presentation to Tohono O'odham Tribal and District councils, private landowners, and

other interested groups or organizations in the United States and Mexico.

- 7.b. Information exchange. 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 Kearney's blue star. 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 Kearney's blue star.



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### **PART III - IMPLEMENTATION SCHEDULE**

The following implementation schedule outlines actions and costs for the Kearney's blue star 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 Kearney's blue star and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified and, therefore, Part III reflects the total estimated financial requirements for the recovery of this species.

#### 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

AZ - State of Arizona  
FWS - USDI Fish and Wildlife Service  
ES - Ecological Services  
LE - Law Enforcement  
RE - Realty  
PVT - Private Landowners  
TON - Tohono O'odham Nation  
BIA - Bureau of Indian Affairs

### Implementation Schedule

| Priority Number | Task Number | Task Description   | Task Duration (Yrs) | Responsible Party |         |            | Cost Estimates     |                    |                    | Comments |
|-----------------|-------------|--|---------------------|-------------------|---------|------------|--------------------|--------------------|--------------------|----------|
|                 |             |  |                     | FWS               |         | Other      | Year 1             | Year 2             | Year 3             |          |
|                 |             |  |                     | Region            | Program |            |                    |                    |                    |          |
| 1               | 1.a.1.      | Develop and implement HMPs on TON  | ongoing             | 2                 | ES      | BIA<br>TON | 10.0<br>0.5<br>0.5 | 10.0<br>0.5<br>0.5 | 10.0<br>0.5<br>0.5 |          |
| 1               | 1.b.2.      | Develop and implement HMPs on private and public lands                               | ongoing             | 2                 | ES      | PVT        | 10.0<br>-0-        | 10.0<br>-0-        | 10.0<br>-0-        |          |
| 1               | 2.a         | Monitor threats  | ongoing             | 2                 | ES      | TON        | 3.0<br>-0-         | 3.0<br>-0-         | 3.0<br>-0-         |          |
| 1               | 3.b.        | Describe physical environment  | 3                   | 2                 | ES      |            | 4.0                | 4.0                |                    |          |
| 1               | 3.d.        | Study grazing impacts  | 3                   | 2                 | ES      | BIA        | 15.0<br>5.0        | 15.0<br>5.0        | 15.0<br>5.0        |          |
| 1               | 3.e.        | Study insect predation   | 3                   | 2                 | ES      |            | 10.0               | 10.0               | 10.0               |          |
| 1               | 4           | Survey for new populations   | 2                   | 2                 | ES      |            | 10.0               | 10.0               |                    |          |
| 1               | 7.a.        | Develop public awareness program   | ongoing             | 2                 | ES      | AZ         | 4.0<br>1.0         | 2.0<br>1.0         | 2.0<br>1.0         |          |
| 2               | 1.a.2.      | Develop guidelines for supplementing natural populations on TON                      | 2                   | 2                 | ES      | TON        | 4.0<br>-0-         | 4.0<br>-0-         |                    |          |
| 2               | 1.a.3.      | Establish special land use designations  | 2                   | 2                 | ES      | TON        | 1.0<br>1.0         | 1.0<br>1.0         |                    |          |
| 2               | 1.b.1.      | Develop agreements with non-TON landowners   | ongoing             | 2                 | ES      | AZ<br>PVT  | 2.0<br>0.5<br>-0-  | 2.0<br>0.5<br>-0-  | 2.0<br>0.5<br>-0-  |          |
| 2               | 1.b.3       | Develop guidelines for supplementing natural populations on private and public lands | 2                   | 2                 | ES      |            | -0-                | -0-                |                    |          |

### Implementation Schedule

| Priority Number    | Task Number | Task Description                                 | Task Duration (Yrs) | Responsible Party |          |           | Cost Estimates           |                          |                          | Comments     |
|--------------------|-------------|--|---------------------|-------------------|----------|-----------|--------------------------|--------------------------|--------------------------|--------------|
|                    |             |  |                     | FWS               |          | Other     | Year 1                   | Year 2                   | Year 3                   |              |
|                    |             |  |                     | Region            | Program  |           |                          |                          |                          |              |
| 2                  | 1.c.        | Enforce laws, regulations, and ordinances        | ongoing             | 2                 | ES<br>LE | AZ<br>TON | 2.5<br>2.5<br>-0-<br>1.0 | 2.5<br>2.5<br>-0-<br>1.0 | 2.5<br>2.5<br>-0-<br>1.0 |              |
| 2                  | 1.d.        | Acquire and protect lands not already protected  | ongoing             | 2                 | RE       |           | 3.0                      | 3.0                      | 3.0                      |              |
| 2                  | 2.b.        | Collect demographic data                         | 10                  | 2                 | ES       |           | 10.0                     | 10.0                     | 10.0                     |              |
| 2                  | 3.a.        | Define associated plant species                  | 1                   | 2                 | ES       |           | 5.0                      |                          |                          |              |
| 2                  | 3.c.        | Map historic range                               | 1                   | 2                 | ES       |           |                          |                          | 5.0                      |              |
| 2                  | 3.f.        | Examine pollination ecology                      | 1                   | 2                 | ES       |           | 10.0                     |                          |                          |              |
| 2                  | 5           | Reintroduce populations                          | 5                   | 2                 | ES       |           |                          |                          | 10.0                     | 10K per pop. |
| 2                  | 6.a         | Establish garden population and seed bank        | 2                   | 2                 | ES       |           | 10.0                     | 10.0                     |                          |              |
| 2                  | 6.b         | Establish and monitor <u>ex situ</u> populations | ongoing             | 2                 | ES       |           | 5.0                      | 5.0                      | 5.0                      | 5K per pop.  |
| 3                  | 7.b         | Information exchange                             | ongoing             | 2                 | ES       |           | 1.0                      | 1.0                      | 1.0                      |              |
| <b>GRAND TOTAL</b> |             |  |                     |                   |          |           | <b>131.5</b>             | <b>114.5</b>             | <b>94.5</b>              |              |

## APPENDIX A

The 60-day public comment period for the draft Kearney's Blue Star Recovery Plan was announced in the Federal Register on July 9, 1992 (57 FR 30504). Legal notices in the August 4, 1992, Tucson Citizen and Arizona Daily Star also announced the comment period. Copies of the draft plan were supplied to following parties:

Dr. Donald Pinkava, Arizona State University, Tempe, Arizona  
Dr. Arthur M. Phillips, III, Flagstaff, Arizona  
Mr. John Anderson, Bureau of Land Management, Phoenix District Office,  
Phoenix, Arizona  
Teresa Prendusi, U.S. Forest Service, Regional Office, Albuquerque, New  
Mexico  
Donna House, The Nature Conservancy, Santa Fe, New Mexico  
Peter Bennett, National Park Service, Western Archeology and Conservation  
Center, Tucson, Arizona  
Peter Warren, The Arizona Nature Conservancy, Tucson, Arizona  
Frank Reichenbacher, Southwest Field Biologists, Tucson, Arizona  
Dr. Barbara Phillips, Coconino National Forest, Flagstaff, Arizona  
Jefferd Francisco, Topawa, Arizona  
Peggy Olwell, Center for Plant Conservation, Missouri Botanical Garden, St.  
Louis, Missouri  
Chairman, Natural Resources Committee, Tohono O'odham Nation, Sells,  
Arizona  
Chairman, Tohono O'odham Nation, Tribal Council, Sells, Arizona  
Amy Heuslein, Bureau of Indian Affairs, Phoenix Area Office, Environmental  
Section, Phoenix, Arizona  
Dr. Steve McLaughlin, University of Arizona, Office of Arid Lands Studies,  
Tucson, Arizona  
Ray Harm, H Rafter Ranch, Tucson, Arizona  
Mark Dimmitt, Arizona-Sonora Desert Museum, Tucson, Arizona  
Julia Fonseca, The Arizona Native Plant Society, Tucson, Arizona  
Robert Dummer, Army Corps of Engineers, Regulatory Branch, Phoenix,  
Arizona  
James Barber, Superintendent, Bureau of Indian Affairs, Papago Agency,  
Sells, Arizona

Arizona State Clearinghouse, Federal Programs, Department of Commerce,  
Phoenix, Arizona

Tara L. Linville, Bio Data, Golden, Colorado

Robert Anderson, Fennemore Craig Law Firm, Phoenix, Arizona

Warren Eastland, USDA-Animal and Plant Health Inspection Service, BBEP-  
TFS, Hyattsville, Maryland

Anita Allen, CH<sup>2</sup>M Hill, Reston, Virginia

Liz Ecker, Desert Botanical Garden, Phoenix, Arizona

Douglas Echlin, US Section, International Boundary & Water Commission, El  
Paso, Texas

Peter D. McKone, Freese and Nichols, Inc., Fort Worth, Texas

Michael Bean, Wildlife Program, Environmental Defense Fund, Washington,  
D.C.

Alan Parolini, FB & D Technologies, Inc., Houston, Texas

Carol Jones, SEC Donahue, Greenville, South Carolina

Fred C. Schmidt, Library - Documents Department, Colorado State University,  
Fort Collins, Colorado

The Service did not receive any comments on the draft plan.