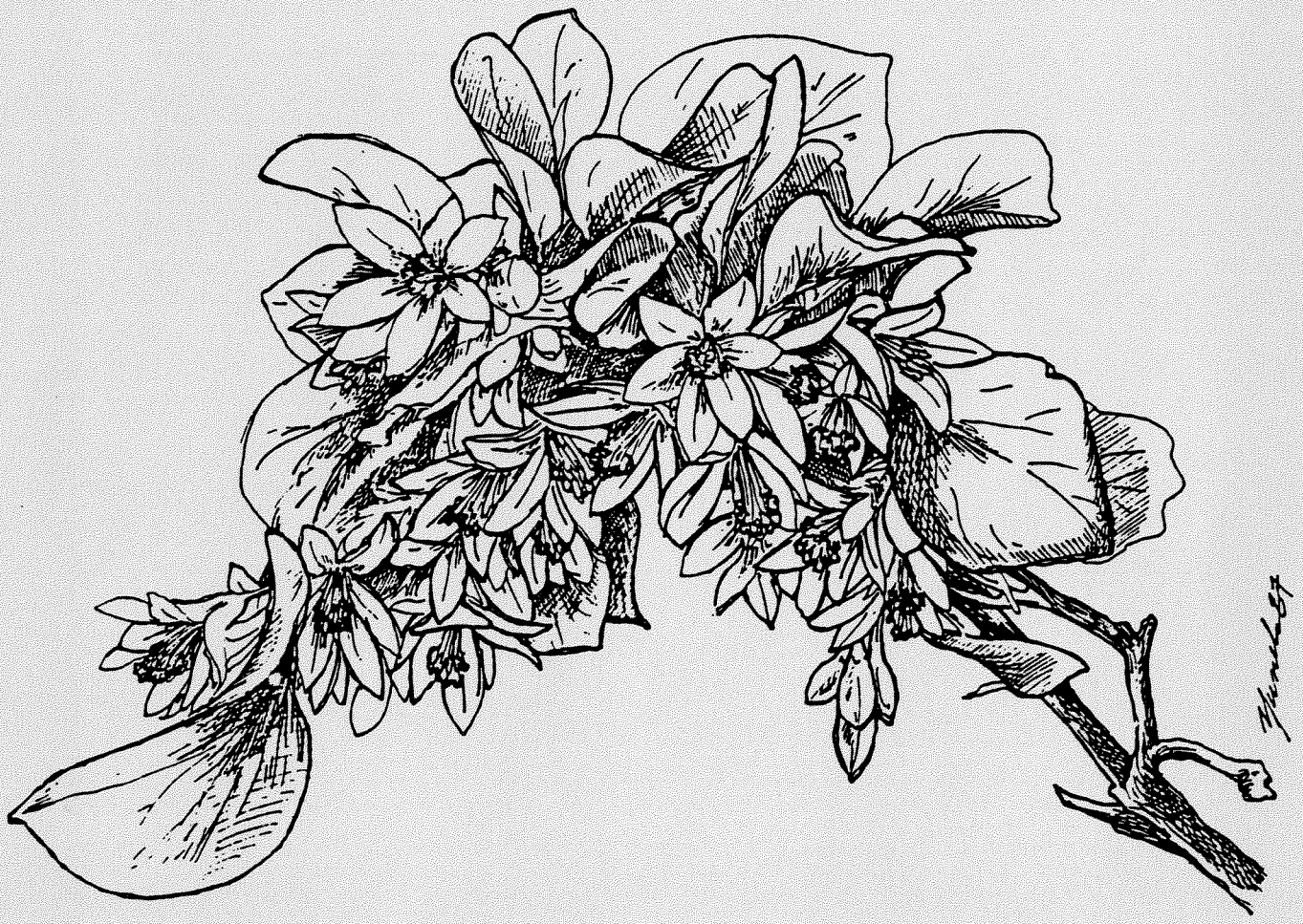
TEXAS SNOWBELLS

(*Styrax texana*)

RECOVERY PLAN



U.S. Fish and Wildlife Service

Albuquerque, New Mexico

1987

TEXAS SNOWBELLS

(*Styrax texana*)

RECOVERY PLAN

1987

Prepared by:

Toney Keeney

Herbarium

Southwest Texas Junior College

Uvalde, Texas 78801

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

Reviewed and edited by:
Charles McDonald

Approved: _____
Regional Director, Region 2

Date: 7/31/87

DISCLAIMER

This is the completed Texas Snowbells Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all individuals who played a role in preparing this plan. This plan is subject to modification as directed by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other constraints.

Literature Citations should read as follows:

U.S. Fish and Wildlife Service. 1987. Texas Snowbells (Styrax texana) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 53 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
6011 Executive Blvd.
Rockville, Maryland 20852
301/770-3000
or
1-800-582-3421

ACKNOWLEDGEMENTS

Information and assistance in preparation of this plan were provided by Texas Plant Recovery Team members: Mr. Harold Beaty, Dr. William Mahler, Mr. David Riskind, Mr. Gerard Hoddenbach, Dr. Richard Worthington, Ms. Jackie Poole, Dr. Allan Zimmerman, and Dr. Elray Nixon.

SUMMARY

Goal:	To remove Texas snowbells from the Federal list of endangered and threatened species by managing the species and its habitat in a way that will assure the continued existence of self-sustaining wild populations.
Recovery Criteria:	Quantified criteria for downlisting and/or delisting Texas snowbells have not yet been determined. The implementation of studies in this recovery plan will provide the necessary data from which quantified downlisting and/or delisting criteria can be established.
Actions Needed:	Major steps needed to recover Texas snowbells include: maintaining present populations through landowner cooperation and habitat management; establishing new populations in suitable natural habitats; establishing botanical garden populations for research and education; obtaining biological information needed for effective management; and, developing public support for preservation of Texas snowbells.

TABLE OF CONTENTS

PART I

INTRODUCTION

Brief Overview

Styrax texana Cory (Texas snowbells) was listed as endangered under the Endangered Species Act on October 11, 1984 (USFWS, 1984). The species is also on the Texas state endangered plant list. No other species in this genus are federally listed but *Styrax youngae* is under review for possible listing (USFWS, 1985).

Styrax texana is a shrub or small tree that grows in limestone crevices of creek and river bluffs in Edwards and Real Counties, Texas. There are 39 known plants. The immediate threats to the species are browsing by deer, goats, cattle, sheep, and exotic ungulates; natural flooding and erosion; disease; and alteration of groundwater and springs. These threats have combined to almost eliminate new plant establishment. The known populations consist of mature and some very old plants with no seedlings or saplings. If this trend is not reversed, *Styrax texana* will become extinct in the wild.

This plan provides measures to recover Texas snowbells by managing and protecting existing populations and by establishing

new protected populations within the species' historic range. These actions should stabilize existing populations and ultimately increase Texas snowbells to the point where the species can be removed from the endangered species list.

Taxonomy

Texas snowbells is a member of the storax family (Styracaceae). The species was discovered by Victor Louis Cory along Pulliam and Polecat Creeks in Edwards County, Texas on July 4, 1940. Cory wrote this account of his discovery and subsequent visits to the type locality (Cory, 1943):

> The single shrub seen was so unlike the variety of S. platanifolia which I had seen in Sabinal Canyon that I became strongly interested in it. In the following year in the same region in Polecat Canyon, additional shrubs of this plant were found higher up on the cliffs. Later, a single shrub of the plant was found along Cedar Creek. In 1942, special efforts were made to see this plant in bloom. On April 5, the sixty-five mile trip to the Cedar Creek site was made; it was found that the foliage of the plant was immature and the inflorescence was only in bud. On April 18, a visit was made to the discovery plant in Polecat Canyon where our efforts were fully rewarded. In our opinion S. texana should prove to be a highly desirable ornamental plant for growth in the limestone areas of Texas.

Cory published Styrax texana as a new species in the journal Madrono in 1943, designating the type specimen as: Cory 34940, July 4, 1941, west side of Polecat Creek about one-half mile above its junction with Pulliam Creek, Edwards County, Texas.

In 1974, Gonsoulin published a revision of Styrax in North American, Central American, and the Caribbean. His work cites the holotype for Styrax texana as: U.S.A., TEXAS, Edwards County, Cory S.N., 19 April 1942 (GH, isotypes GH and NY). Gonsoulin made no changes in the classification of Styrax texana but did, through his keys and descriptions, note the species' close relationship to S. plantanifolia and S. youngae, the other two species of western Texas Styrax.

Morphology

Styrax texana is a shrub or small tree 1.5-4 m (4.9-13.1 ft) tall. The leaves are alternate, suborbicular, 4-8 cm (1.6-3.1 in.) long, and about as broad. The leaf margins are entire and the leave bases are cuneate to truncate or rounded. The upper leaf surface is glabrous, bright green and smooth and the lower leaf surface is conspicuously white with a very fine and dense silky tomentum. Flowers are axillary, solitary or in 2-5 flowered racemes with puberulent pedicels 10-12 mm (.39-.47 in.) long. Peduncles are about as long as the pedicels, often recurved, and subglabrous to puberulent. The calyx is 4-6 mm (.16-.24 in.) long, pale, densely puberulent, apex glandular, and 5-7 toothed. The corolla lobes are white and 14-18 mm (.55-.71 in.) long. There are 10 stamens with bright orange-yellow anthers. Fruits are dry, globose to subglobose, 7-8 mm (.28-.31 in.) in diameter; seeds are 1-2, globose, and smooth (Gonsoulin, 1974).

The best characters for field identification of Texas snowbells are the dense, fine, and silky covering of white to silvery hairs on the lower leaf surface and the orbicular to ovate leaf shape. During its flowering period, the abundant white flowers are an excellent field character for locating plants.

Two other Styrax species also occur in the region. These are Styrax youngae known from the Davis Mountains and from Coahuila and Nuevo Leon, Mexico, and Styrax platanifolia (sycamore leaf snowbells) known from most counties of the Eastern Edwards Plateau. These distributions are generally southwest and northeast of Styrax texana, respectively, but either species could overlap with Styrax texana to some extent. The differences between the species are summarized as follows (Cory in Gonsoulin, 1974):

S. platanifolia	S. texana	S. youngae
Upper leaf surface dull green, glabrous to bearing scattered stellate trichomes; reticulate veiny.	Upper leaf surface bright green, glabrous, not reticulate veiny.	Upper surface dull green, densely and coarsely stellate pubescent, not reticulate veiny.
Lower and upper leaf surfaces similar.	Lower surfaces markedly dissimilar to upper, lower bright silvery with a fine and dense indumentum only.	Lower dissimilar to upper but not markedly so; grayish tomentose with a fine and dense indumentum beset with course stellate hairs.

Pedicel glabrous or nearly so.	Pedicel pubescent.	Pedicel densely coarsely stellate pubescent.
Calyx dark brown, glabrous to finely puberulent; apex glandular and prominently toothed.	Calyx pale, densely puberulent; apex glandular and prominently toothed.	Calyx dark brown, densely stellate pubescent; apex non-glandular, the teeth inconspicuous.
Style pubescent half-way to apex.	Style pubescent only at base.	Style pubescent nearly to apex.

Distribution

Styrax texana is endemic to cliffs along rivers, streams, and dry creek beds in the Edwards Plateau of Texas (Fig. 1). The species was historically known from Edwards, Real, and Val Verde Counties, but presently is known only from six confirmed localities in Edwards and Real Counties. Until recently, access to search the area in Val Verde County where Wolfe collected specimens in 1941 and 1942, had been denied by the landowners. The property has recently changed ownership and the new landowners have granted permission to search the area. Hopefully, the Val Verde County plants will be rediscovered. A report of Styrax texana from Kimble County (USFWS, 1984) is apparently in error. After searching the reported sites in Kimble County during the flowering period in 1981, 1983, 1984, and 1985, and flying over the area in 1985, none of the eight reported plants were located. Cory's specimen # 42678 from Bexar County should probably read Real County.

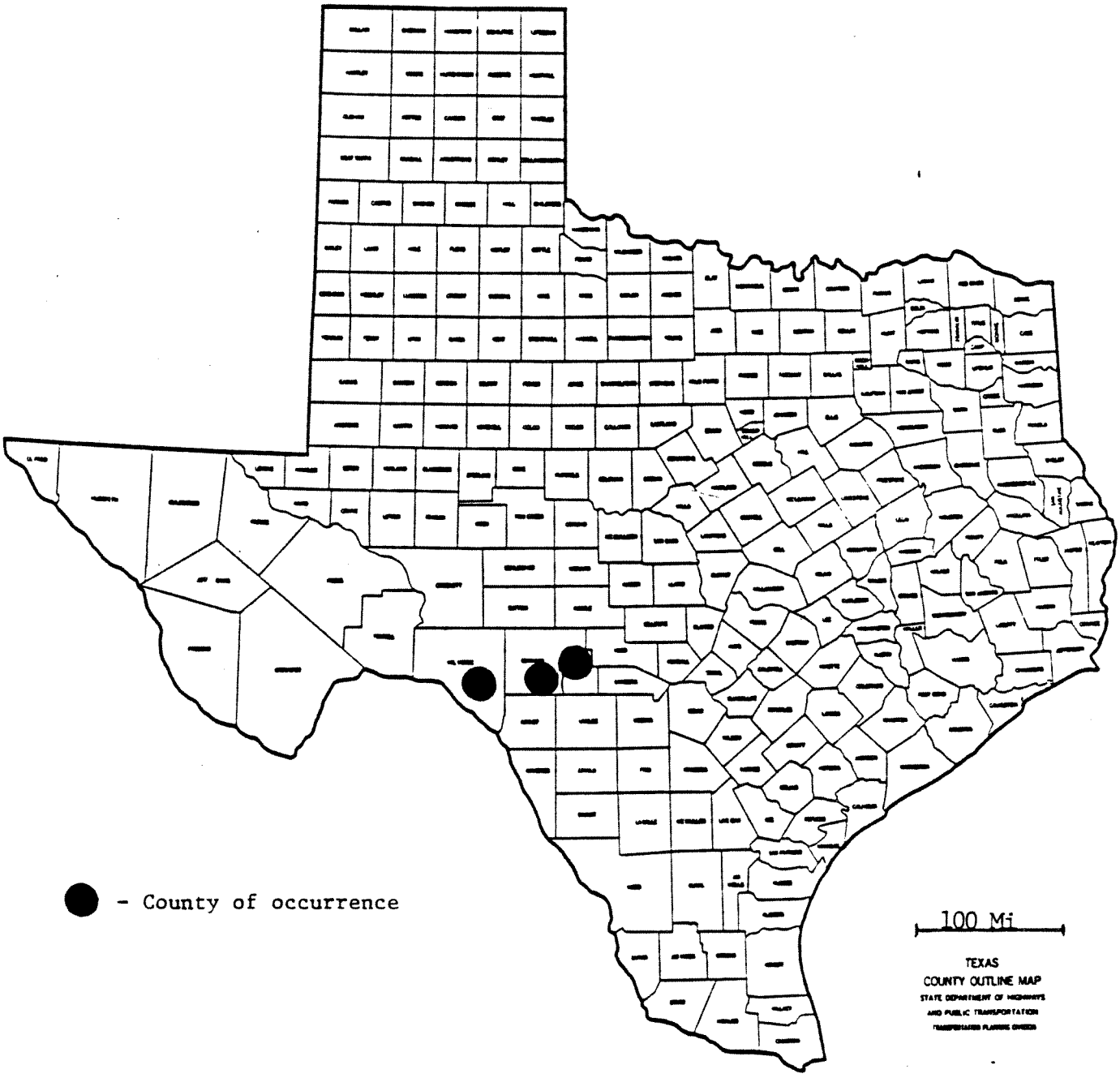


Figure 1. Historic distribution of Styrax texana.

There are two major populations of Styrax texana. One major population is on Greenwood Valley Ranch on the East Prong of the Nueces River in Real County; it contains 25 plants. The other major population is on the Puerta Grande Ranch at the junction of Polecat and Pulliam Creeks in Edwards County. This population contains 8 plants and is the site of the original collection by Cory (#34937, July 4, 1940). Other small populations or individual plants occur on Little Hackberry and Cedar Creeks in Edwards County and on the East Prong of the Nueces River in Real County.

Land Ownership

All known plants of Styrax texana are on private land. Complete landowner information is available from the U.S. Fish and Wildlife Service, Office of Endangered Species, Albuquerque, New Mexico.

Habitat and Associated Species

Styrax texana occurs in the Edwards Plateau Vegetation Area of Texas (Gould, 1975). The area is dissected by many canyons and arroyos formed by the regions creeks and major rivers. The Balcones Escarpment on the east and south forms a distinct boundary to the plateau. Elevations range from slightly less

than 100 feet (30 m) to more than 3000 feet (914 m). Average annual rainfall varies from less than 15 inches (38 cm) in the west of the plateau to more the 33 inches (84 cm) in the east. The seasonal rainfall pattern shows typical highs in May and June and again in September. Soils are usually shallow with a wide range of textures.

Areas supporting Styrax texana are lightly wooded vertical limestone and dolomite cliffs. These are mapped as the Segovia and Fort Terrett members of the Edwards Limestone, the Devils River Limestone, and the Glen Rose formation (Bureau of Economic Geology, 1976). Anchoring sites for plants are provided by large cracks that have formed in most cliffs.

The following species have been found associated with Styrax texana. The list is produced from Mahler's 1981 status report and from five years of population monitoring.

TREES

Diospyros texana
Fraxinus texensis
Garrya lindheimeri
Juglans microcarpa
Juniperus ashei
Platanus occidentalis
Quercus glaucoides
Quercus texana
Quercus fusiformis
Ungnadia speciosa

SHRUBS

Baccharis texana

Berberis trifoliolata

Brickellia dentata

Cephalanthus occidentalis

Eysenhardtia texana

Forestiera reticulata

Rhus aromatica

Rhus virens

Sophora secundiflora

HERBS

Acalypha lindheimeri

Adiantum capillus-veneris

Anemia mexicana

Asclepias viridis

Bouteloua curtipendula

Calylophus drummondianus
ssp. *drummondianus*

Centaurium calycosum

Chaetopappa effusa

Chaetopappa bellidifolia

Gaillardia pulchella

Gaillardia suavis

Gilia incisa

Gilia rigidula

Hedeoma drummondii

Hedyotis nigricans

Hilaria berlangeri

Hymenoxys scaposa

Chasmanthium latifolium

Chrysactinia mexicana

Desmanthus velutinus

Dichromena nivea

Dryopteris filix-mas

Elymus canadensis

Euphorbia angusta

Euphorbia cyathophora

Euphorbia marginata

Polanisia dodecandra

Polygala tweedyi

Rhus toxicodendron

Salvia farinacea

Salvia roemeriana

Schizachyrium scoparium

Schrankia roemeriana

Scutellaria wrightii

Smilax bona-nox

var. scaposa
Leptochloa dubia
Lespedeza texana
Liatris mucronata
Lithospermum incisum
Matelea edwardsensis
Melampodium leucanthum
Mentzelia oligosperma
Muhlenbergia schreberi
Nolina lindheimeriana
Paronychia jamesii
Phyllanthus polygonoides
Plantago helleri
Sporobolus vaginaeflorus
Stillingia texana
Teucrium canadense
Thelesperma curvicarpum
Thryallis angustifolia
Tragia nigricans
Tridens muticus
Tripsacum dactyloides
Verbesina microptera
Vernonia lindheimeri
Yucca rupicola
Zexmenia hispida

Demography and Phenology

Texas snowbells occurs at six localities. The population sizes are 25, 8, 2, 2, 1 and 1 for a total of 39 known plants. The populations consist of all mature trees that produce fruit every year. Tree ages have not been determined but there is evidence that some are very old. The two trees on Cedar Creek are clearly visible in a photograph taken in the 1920's (P. Leslie, San Antonio Botanical Gardens, pers. comm., 1986).

Seed viability is good and seedlings are easily grown in greenhouses (P. Cox, San Antonio Botanical Gardens, pers. comm., 1986). Although seedlings have been observed in the wild, no seedlings have been found in habitats suitable for survival to maturity. Most seedlings grow in river gravel or streambed cracks and are destroyed by periodic severe floods. Seedlings are also destroyed by the browsing of goats, cattle, and deer. The only seedlings with a chance of long-term survival are ones that develop above the flood zone and beyond the reach of browsing animals. The likelihood that seeds will be dispersed to these localities must be very low because there has been no seedling establishment in recent years.

Texas snowbells is a deciduous tree. Flower buds develop in March at the apex of old wood and at the base of the initial growth of the current year's apical meristem. Buds open during the third and fourth weeks of April with maximum flowering during the fourth week of April. Fruits form during the months of June, July, and August.

Impacts and Threats

Styrax texana is threatened by the following factors: (1) browsing by deer, goats, cattle, sheep, and exotic ungulates, (2) flooding and erosion, (3) diseases of fungal or bacterial origin, and (4) alteration of groundwater.

Browsing

The Edwards Plateau has been heavily grazed and browsed for many years. Cattle were the first livestock brought to the region, but as rangelands deteriorated more sheep and goats were introduced to take advantage of shrubby vegetation. The region also supports large populations of deer. In many areas, the absence of palatable herbaceous vegetation and the conspicuous browseline are evidence of the present severe grazing and browsing pressures. Exotic game ranching is also increasing in the region and it is possible some of these animals will be able to reach plants presently inaccessible to traditional livestock.

When Styrax texana is planted and protected, it will grow in soils much different from those of the cliffsides presently supporting plants. It is quite possible that cliffsides are not preferred habitat for Styrax texana, but simply represent refuges free from browsing pressure.

Flooding and Erosion

The combination of thin rocky soils, steep topography, and heavy rains produce frequent floods in the Edwards Plateau. Streambanks and streambeds are scoured clean by high velocity flood waters that rise quickly and usually return to normal flows in a few days. Presently, most Styrax texana seeds drop onto

streamsides or into dry streambeds. Some seeds germinate but floods wash away the seedlings before they can become established.

Flooding may have been less severe in the past. Before the soil's water holding capacity was reduced by overgrazing and erosion, floods probably lasted longer but had much lower peak flows. This may have allowed some species, like Styrax texana, to occupy riparian habitats that no longer exist under present flooding regimes.

Erosion of cliffsides may be threatening some plants. At one population, a portion of the cliffside recently collapsed. A plant at another population could be destroyed in the future because floodwaters are undercutting the limestone ledge supporting the plant.

Disease

One plant has begun to show signs of disease. Its stems appear to have died back for a distance of 12-18 centimeters. This dieback was observed in May 1985, but the symptoms had declined when the tree was checked in September. During the September check, the older stems had several areas where the bark had erupted from the wood. No evidence of insect infestation was found. These particular disease symptoms were not observed in any other populations.

Alteration of Groundwater

All Texas snowbells plants, except one, grow in areas with continuous water. Water appears to be a definite community factor necessary for either dispersal or plant maintenance. In the Edwards Plateau some major springs have either declined or ceased flowing during droughts due to either pumping or drainage modifications that prevent water from entering recharge zones. Continuing development in the Edwards Plateau will both increase water demands and the problems of lost spring flow. The consequences for Texas snowbells are unknown.

PART II

RECOVERY

Objectives

The primary objectives of recovery are to protect Texas snowbells and its habitat from destruction due to human activities and to maintain, through management, healthy populations at levels where the species can be downlisted to threatened and eventually delisted. However, present limited data makes it impossible to establish quantified downlisting and delisting criteria at this time. Additional information is particularly needed on seedling requirements, population establishment, population growth, and dispersal. Once this information is obtained and existing threats are alleviated, this plan will be reevaluated to: (1) determine if Texas snowbells can be downlisted to threatened, and (2) establish quantified delisting criteria. The implementation of measures in the following step-down outline and narrative should protect Texas snowbells and provide the information needed to establish quantified downlisting and delisting criteria.

Step-down Outline

1. Maintain the habitat at all present localities of the species.
   11. Protect all land presently supporting plants.
      111. Protect land in Edwards County.
      112. Protect land in Real County.
   12. Ensure that populations are secure from present and possible threats.
      121. Construct fences and support landowners in fence maintenance and repair.
      122. Monitor populations to determine changes after fences have been constructed.
   13. Develop a management plan for each population.
2. Maintain and expand present populations and establish new populations in suitable habitat within the range of the species.
   21. Collect and manually plant seeds.
   22. Transplant seedlings into suitable habitat.
      221. Augment present populations.
      222. Establish new populations within the historic range.
         2221. Search for introduction sites.
         2222. Insure that introduction sites are secure from possible threats.

2223. Use life history and ecological information in project design and execution.

2224. Monitor plantings.

23. Maintain populations at botanical gardens.

3. Develop information on the specific life history and ecological requirements of the species.

31. Study life history components.

311. Study pollination.

312. Study seed viability, seed germination, and seedling establishment.

313. Study dispersal.

314. Monitor demographic trends.

32. Determine pathogenic relationships.

321. Determine pathogens.

322. Monitor populations for symptoms of disease.

33. Determine community composition and structure.

34. Determine the relationship between Texas snowbells and other organisms.

341. Determine relationships with the native fauna.

342. Determine relationships with livestock.

343. Determine possible relationships with exotic game.

344. Determine relationships with the rest of the flora.

35. Determine the abiotic dynamics of the habitat.

351. Determine microclimate of the limestone ledges.

352. Determine physiographic and topographic aspects of the habitat.

353. Determine soil pH and other soil characteristics.

354. Determine patterns of both internal and surface drainage.

355. Determine affects of flooding on cliff structure.

36. Establish downlisting and delisting criteria.

4. Search for historical information.

41. Research newspaper files.

42. Contact local landowners.

5. Develop public information and support.

51. Develop and distribute identification material.

52. Enlist the aid and support of local landowners.

53. Establish a technical and public interest group to assist with local recovery efforts.

Narrative

1. Maintain the habitat at all present localities of the species.

Because of the low number of plants, all present localities must be protected from impacts and threats.

11. Protect all land presently supporting plants.

Because all populations are on private land, land protection will require cooperation between landowners and FWS, State agencies, or private conservation organizations.

111. Protect land in Edwards County.

Each of the three localities in Edwards County has a different owner. The locality with the most plants (8) should have the highest protection priority but each locality is historically and biologically important. For instance, the solitary tree on Little Hackberry Creek has a very large basal crown and appears to be very old. This tree is also the most accessible for ecological and other studies.

112. Protect land in Real County.

Each of the three localities in Real County has a different owner. The largest population (25 plants) is in this county and it should have the highest protection priority.

12. Ensure that populations are secure from present and possible threats.

Land-clearing or road-building could make some populations accessible to damage from livestock. Even without these changes, the introduction of some types of exotic game could put new browsing pressures on plants. Measures should be taken to prevent damage from these threats.

121. Construct fences around populations and support landowners in fence maintenance and repair.

Fence construction would reduce possible browsing pressure on plants and allow seedling development in areas presently accessible to livestock. Because of flooding and other factors, fences will be difficult to maintain. Landowners who construct fences for protection of Texas snowbells should be reimbursed for costs of construction and maintenance.

122. Monitor populations to determine changes after fences have been constructed.

After fences have been constructed, the populations should be checked to determine if the fences are excluding grazing animals and if this is promoting the survival of seedlings. Seedlings within exclusion areas should be monitored for success. Some of the seedlings in exclusion areas

might also be used for transplanting but this should be done only as part of a controlled experiment.

13. Develop a management plan for each population.

Once the populations are secure, management plans should be developed that describe long range goals for the populations and habitat. Implementation of the plans could be a key factor in determining the future of the species.

2. Maintain and expand the present populations and establish new populations in suitable habitat within the range of the species.

Four of the six known populations contain only one or two plants. These small populations should be protected and efforts made to establish additional plants. For various reasons though, it may be impossible to substantially increase the populations at these four localities. The other two populations contain 8 and 25 plants, respectively, and appear to have enough suitable habitat to successfully establish additional plants. Augmenting these populations would produce better population age class structure and increase the likelihood that the populations will persist. There is considerable available habitat for Texas snowbells

but the present low number of plants and the ineffective seed dispersal make it unlikely that these sites will be naturally colonized. In order to reduce the risk of extinction, at least two new populations of 25 or more plants each should be established at secure sites within the historic range of the species.

21. Collect and manually plant seeds.

Planting seeds directly into the habitat should be one experimental method used to augment present populations or establish new populations. If successful, this technique would likely be much simpler and cheaper than transplanting seedlings. The seeds should come from existing wild populations but care should be taken not to overly deplete the supply of seeds available for natural dispersal. Seeds planted to augment present populations should come from the same population and those planted to establish new populations should come from the nearest present population. Thorough records should be maintained and plantings should be monitored to determine success.

22. Transplant seedlings into suitable habitat.

Growing seedlings under nursery conditions and then transplanting them or transplanting seedlings from one field locality to another may be the most successful way

to establish new plants.

221. Augment present populations.

When a population is augmented with nursery-grown plants, the seeds should, when possible, originate from the population being augmented. When seedlings in an exclosure are vulnerable to flooding, it may be advisable to transplant some seedlings to secure sites higher on the cliff.

222. Establish new populations within the historic range.

Suitable unoccupied habitat exists within the historic range of the species. A program should be developed to establish new populations in at least two suitable areas. New populations will reduce the overall vulnerability of the species and improve the likelihood of further colonization through natural dispersal.

2221. Search for introduction sites.

Surveys should be conducted to locate sites that are similar in vegetation and physical aspects to those sites presently supporting plants. The sites should be thoroughly

searched to be sure Styrax platinifolia or Styrax youngae are not present. The potential for hybridization between Styrax texana and these species is not known and until this aspect of species biology is better understood it would be best to keep the three species separate.

2222. Insure that introduction sites are secure from possible threats.

If possible, sites should be selected on public lands that can be managed for the species. If sites on private land are selected, permanent protection for the plants should be obtained through land-owner cooperation.

2223. Use life history and ecological information in project design and execution.

All available biological data should be used to plan projects that will have the greatest likelihood of success.

2224. Monitor plantings.

Data on survival, vigor, growth, insect or

browsing damage, and other factors should be maintained on all plants for at least five years.

23. Maintain populations at botanical gardens.

Much biological information can be obtained most easily from a botanical garden collection. In addition, a permanent, well documented, and accessible botanical garden collection, together with appropriate seed banking, would provide an important source of material for non-destructive research, maintenance of wild populations if no other sources are available, and public awareness.

3. Develop information on the specific life history and ecological requirements of the species.

Little is known about the life history and ecology of Texas snowbells. Some of this information may be critical to future management of the species.

31. Study life history components.

A better understanding of the life history of Texas snowbells may identify factors contributing to its present lack of success.

311. Study pollination.

Pollinators and pollination mechanisms should be studied in detail.

312. Study seed viability, seed germination, and seedling establishment.

Raising seedlings under nursery conditions will require an understanding of such factors as seed storage techniques, germination pretreatment requirements, and soil requirements.

313. Study dispersal.

Texas snowbells does not appear to have any specialized dispersal mechanisms. Such factors as rodent or bird transport and seed flotation should be studied.

314. Monitor demographic trends.

Since seedlings and young plants are presently absent, it is important to follow the demography of populations. Annual growth should be recorded and used to estimate plant ages. Tree deaths and reasons, if determinable, should be noted. The frequency of seedling establishment and the number of years required to reach fruiting are also important statistics for determining if

populations are stable, expanding or declining.

32. Determine pathogenic relationships.

One plant has shown disease symptoms. The cause of disease and its possible affect on other trees needs to be determined.

321. Determine pathogens.

Stem and leaf samples of diseased trees should be sent to a plant pathology lab to determine causes and possible treatment.

322. Monitor populations for symptoms of disease.

The populations should be watched for signs and spread of disease. Treatment of diseased trees or preventative treatment of healthy trees should be initiated only after possible ecological consequences are considered.

33. Determine community composition and structure.

The composition and structure of Texas snowbells communities should be determined. This should include a floristic analysis and an analysis of each vegetation layer. Traditional non-destructive quadrat or transect sampling techniques should be used to the extent

possible but the steep topography may make some of these methods impractical. It may be possible to substitute various photo interpretation techniques when other sampling methods cannot be used. Complete community information will be helpful in selecting new introduction sites.

34. Determine the relationship between Texas snowbells and other organisms.

The competitive, commensal, and symbiotic relationships between Texas snowbells and other community members should be determined.

341. Determine relationships with the native fauna.

Such factors as deer browsing, insect damage, and rodent seed predation should be investigated. The possible dispersal role of rodents should be determined.

342. Determine relationships with livestock.

Browsing of seedlings by livestock, mainly goats, has been identified as a threat to the species. This and the effect of livestock browsing on mature plants should be studied.

343. Determine possible relationships with exotic

game.

The food preferences and browsing habits of some exotic game species may be much different from the preferences and habits of present livestock and wildlife. A thorough understanding of the interactions between exotic game and the flora, particularly endangered species like Texas snowbells, is needed.

344. Determine relationships with the rest of the flora.

Only limited plant habitat is provided by the limestone cliffs on which Texas snowbells grows. Any tree or shrub is restricted to large cracks where roots can reach adequate water. The ability of Texas snowbells to compete under these conditions needs to be assessed. This could be done through carefully monitored permanent plots.

35. Determine the abiotic dynamics of the habitat.

A better understanding of the physical habitat may improve the selection of reintroduction sites or the selection of specific planting sites for seeds or seedlings.

351. Determine microclimate of the limestone ledges.

Such factors as soil temperature, temperature near the ground, precipitation, soil moisture, wind speed and direction, humidity fluctuations, and light intensity should be studied to better understand the habitat needs of plants.

352. Determine physiographic and topographic aspects of the habitat.

All populations should be studied to determine relief, elevation range, slope, and aspect of the habitat.

353. Determine soil pH and other soil characteristics.

A complete soils analysis should be conducted.

354. Determine patterns of both internal and surface drainage.

The water source for both seedlings and mature plants needs to be determined. It is possible that seedlings rely on water from surface runoff while older plants use a more permanent source deeper in the rocks. The relationship of plants to springs should be investigated to determine if plants benefit from these water sources.

355. Determine the affects of flooding on cliff structure.

Some habitat has been affected by erosion. Study is needed to determine if this type of habitat change could or should be prevented.

36. Establish downlisting and delisting criteria.

Once more biological information is obtained and management success can be determined, this plan will be reevaluated to establish quantified downlisting and delisting criteria.

4. Search for historical information.

Newspaper or other historical records should be searched for any information on early botanists such as Cory. This could provide new data on plant localities or provide information that might be useful in ecological or life history studies.

41. Research newspaper files.

Newspapers in small towns publish information of local interest. Stories containing locality or other useful information could have been written about some of the early botanists.

42. Contact local landowners.

Some landowners may remember early botanists and have information about what and where they collected.

5. Develop public information and support.

Public education is a vital part of the recovery process. Support should be developed through groups like the Nature Conservancy, Rotary clubs, and local garden clubs. Useful materials for developing public support might include talks, slide presentations, posters, circulars, and newspaper or magazine articles.

51. Develop and distribute identification material.

A packet containing illustrations and a non-technical description of the species and its habitat should be developed for distribution to the public. The packet should tell who to contact if plants are found.

52. Enlist aid and support of local landowners.

Landowners near the present populations should be asked to be alert for plants on their land. Landowner cooperation should be sought to allow seeds or young plants to be planted in suitable habitat on their land.

53. Establish a technical and public interest group to assist with local recovery efforts.

A group that includes botanists, landowners, and local

community leaders should be established to assist recovery efforts. This group could participate in public information programs, some types of monitoring, and some population establishment projects.

Literature Cited

Bureau of Economic Geology. 1976. Geologic atlas of Texas: San Antonio and Del Rio sheets. University of Texas at Austin.

Cory, V.L. 1943. The genus Styrax in central and western Texas. Madrono 7(4): 110-115.

Gonsoulin, G.J. 1974. A revision of Styrax (Styracaceae) in North America, Central America, and the Caribbean. Sida 5(4): 191-258.

Gould, F.W. 1975. Texas plants - A checklist and ecological summary. Texas A&M University, College Station.

Mahler, W.F. 1981. Status report on Styrax texana. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1984. Final rule to determine Styrax texana (Texas snowbells) to be an endangered species. Federal Register 49:40036-40038.

U.S. Fish and Wildlife Service. 1985. Review of plant taxa for listing as endangered or threatened species. Federal Register 50:39526-39527.

PART III

IMPLEMENTATION SCHEDULE

The following Implementation Schedule outlines actions and costs for the Texas snowbells recovery program. It is a guide to meeting the objectives elaborated in Part II of this plan. This schedule indicates the general category for implementation, recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks ("on-going" denotes a task that once begun should continue on an annual basis), which agencies are responsible to perform these tasks, and lastly, estimated costs for Fish and Wildlife Service tasks. These actions, when accomplished, should bring about the recovery of the Texas snowbells and protect its habitat. It should be noted that monetary needs for agencies other than the Fish and Wildlife Service are not identified and therefore, the Implementation Schedule may not reflect the total financial requirements for recovery for this species.

General Categories for Implementation Schedule

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contamination
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Mgmt. Agrt
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Recovery Action Priorities

1 = an action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the forseeable future.

2 = an action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

3 = all other actions necessary to provide for full recovery of the species.

Abbreviations Used

FWS - USDI Fish and Wildlife Service
SE - Office of Endangered Species
RE - Realty

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY		FISCAL YEAR COSTS (EST.)*			COMMENTS
					FWS REGION	OTHER PROGRAM	FY 1	FY 2	FY 3	
A3	Protect land in Edwards County	111	1	3 years	2	SE RE	2,000	2,000	2,000	
A3	Protect land in Real County	112	1	3 years	2	SE RE	2,000	2,000	2,000	
M4	Protect plants by constructing and maintaining fences	121	1	ongoing	2	SE	6,000	500	500	
M3	Monitor fenced populations	122	2	ongoing	2	SE	500	500	500	
M3	Develop management plans	13	2	2 years	2	SE	4,000	4,000		
M1	Maintain and expand populations by planting seeds	21	1	5 years	2	SE	5,000	5,000	5,000	
M1	Augment present populations with planted seedlings	221	1	5 years	2	SE	3,000	3,000	3,000	

*Costs refer to USFWS expenditures only.

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY		FISCAL YEAR COSTS (EST.)*			COMMENTS
					FWS	OTHER				
					REGION	PROGRAM	FY 1	FY 2	FY3	
M2	Establish new populations within the historic range	2221-2224	1	5 years	2	SE	10,000	10,000	10,000	
M1	Maintain botanical garden populations	23	2	3 years	2	SE	7,500	7,500	7,500	
I14	Study pollination	311	2	3 years	2	SE	3,000	3,000	3,000	
I14	Study seed and seedling characteristics	312	2	3 years	2	SE	2,000	2,000	2,000	
I8	Study dispersal	313	2	3 years	2	SE	4,000	4,000	4,000	
I6	Monitor demographic trends	314	2	5 years	2	SE	5,000	5,000	5,000	
I11	Determine plant pathogens	321	2	1 year	2	SE	500			
M6	Monitor for disease	322	2	ongoing	2	SE	250	250	250	
I3	Determine community composition and structure	33	2	2 years	2	SE	5,000	5,000		

*Costs refer to USFWS expenditures only.

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY		FISCAL YEAR COSTS (EST.)*			COMMENTS
					FWS	OTHER				
					REGION	PROGRAM	FY 1	FY2	FY3	
I3	Determine relationships with native fauna	341	2	5 years	2	SE	4,000	4,000	4,000	
I3	Determine relationships with livestock	342	2	5 years	2	SE	3,000	3,000	3,000	
I3	Determine relationships with exotic game	343	2	5 years	2	SE	6,000	6,000	6,000	
I3	Determine community vegetational relationships	344	2	5 years	2	SE	5,000	5,000	5,000	
I3	Determine microclimate	351	2	3 years	2	SE	7,000	2,000	2,000	
I3	Determine physiography	352	2	2 years	2	SE	1,500	1,500		
I3	Determine soil characteristics	353	2	1 year	2	SE	500			
I3	Determine drainage patterns	354	3	3 years	2	SE	2,500	2,500	2,500	

*Costs refer to USFWS expenditures only.

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY		FISCAL YEAR COSTS (EST.)*			COMMENTS
					FWS	OTHER				
					REGION	PROGRAM	FY 1	FY 2	FY 3	
I2	Determine effects of flooding on cliff structure	355	3	5 years	2	SE	2,000	2,000	2,000	
03	Establish down-listing and de-listing criteria	36	3	1 year	2	SE	500			
I14	Research newspaper files for historical information	41	3	1 year	2	SE	500			
I14	Contact landowners for historical information	42	3	1 year	2	SE	500			
01	Develop identification material for public distribution	51	2	1 year	2	SE	5,000			
M7	Enlist aid and support of local landowners	52	2	ongoing	2	SE	1,000	1,000	1,000	
M7	Establish a technical and public interest group	53	2	1 year	2	SE	1,000			

*Costs refer to USFWS expenditures only.

APPENDIX

List of Reviewers

A technical/agency review draft of the Texas Snowbells Recovery Plan was sent to the following individuals and agencies on December 10, 1986.

Ms. Jackie Poole, Texas Natural Heritage Program, Austin, TX

Mr. Gerard Hoddenbach, National Park Service, Santa Fe, NM

Dr. William Mahler, Southern Methodist University, Dallas, TX

Mr. David Riskind, Texas Parks and Wildlife Department, Austin, TX

Mr. Gary Valentine, U.S. Soil Conservation Service, Temple, TX

Dr. Richard Worthington, The University of Texas at El Paso, El Paso, TX

Dr. Elray Nixon, Stephen F. Austin State University, Nacogdoches, TX

Mr. Andrew Sansom, The Texas Nature Conservancy, San Antonio, TX

Dr. Allan Zimmerman, Chihuahuan Desert Research Institute, Alpine, TX

Mr. Harold Beaty, Temple, TX

Mr. Paul Cox, San Antonio Botanical Gardens, San Antonio, TX

Dr. Francis Thibodeau, The Center for Plant Conservation, Jamaica Plain, MA

Executive Director, Texas Parks and Wildlife Department, Austin, TX

Regional Supervisor, Realty, USFWS, Region 2

Field Supervisor, Ecological Services, Fort Worth Field Office, USFWS, Region 2

Field Supervisor, Ecological Services, Corpus Christi Field Office, USFWS, Region 2

Director (AFA/OES), Office of Endangered Species, USFWS, Washington, D.C.

Director (WR), Division of Research, USFWS, Washington, D.C.

Comments Received

Comment letters are reproduced in this section followed by the Service's response to each comment. Some reviewers submitted comments marked directly on the draft plan or submitted comments by phone. These comments have not been reproduced.

TEXAS NATURAL HERITAGE PROGRAM
GENERAL LAND OFFICE
STEPHEN F. AUSTIN BUILDING
1700 NORTH CONGRESS AVENUE
ROOM 619
AUSTIN, TEXAS 78701
(512) 463-5299
1-800-252-RARE

January 7, 1987

Dr. Charlie McDonald
U.S. Fish and Wildlife Service
Endangered Species Office
P.O. Box 1306
Albuquerque, New Mexico 87103

Dear Charlie,

Thank you for allowing me the opportunity to comment on the recovery plan for Styrax texana.

The primary threats to Styrax texana are browsing by over-abundant populations of domestic livestock, native animals , and exotic ungulates, alteration of habitat, natural climatic and geologic processes, and disease. Although the absence of seedlings is a threat, it is more accurately described as the result of the above combined threats. A-1

In the last 100 years the Edwards Plateau has been grazed and browsed severely. Not only were number of domestic livestock (cattle, sheep, and goats) beyond the lands's carrying capacity, the native white-tail deer population was allowed to expand beyond its natural limit due to decreased predator populations, intentional and unintentional feeding, and mismanagement of hunting policies. Added to this harsh pressure on the available native food plants of the area was the introduction of exotic ungulates. According to a 1985 Texas Parks and Wildlife Report there were 4264 and 18,723 exotic animals in Edward and Real counties, respectively. For a species already low in numbers and of restricted distribution probably due to long-term climatic changes, Texas snowbells was pushed to the edge of extinction by such heavy browsing. A-2

Due to overgrazing, much of the grass cover was lost from the land, and along with it, the soil. In attempts to combat the subsequent brush invasion, much remaining native cover was removed from the landscape. This reduced the land's capacity to absorb moisture, causing accelerated erosion, increased run-off and consequent heavier and more frequent flooding. Alteration of perculation and drainage patterns as well as pumping groundwater has caused lowered watertables and the decline or cessation of A-3

several springs. Thus areas which Texas snowbells may have at one time been able to colonize were no longer suitable due to their more disturbed nature.

Certainly natural climatic (floods, droughts, freezes, etc.) and geologic (erosion) processes are a threat to the species. However these are not usually, or should not be, controllable by man. Man's alteration of the habitat and general mismanagement of the animal component of the ecosystem has led to sufficient destruction and resultant mutation of the natural processes. Any further interference by man should be carefully and thoughtfully planned. A-4

Any disease should be thoroughly studied. Any treatments should take into account all ecological ramifications. A-5

It is questionable whether the normal habitat for Texas snowbells is cliffs or whether the species has become relegated to such sites by abnormal browsing pressure. The cliffs may also represent refuges where the snowbells are more sheltered from temperature and moisture extremes. Such climatic conditions have probably been altered less along the cliffs than the streambeds, banks, slopes, or uplands. In these areas, habitat alteration has been more easily accomplished, and the moisture and/or soil/surface temperature regimes have been altered significantly. A-6

The geologic formations on which Texas snowbells occur may be more precisely defined than the cretaceous Comanche series limestone. The San Antonio and Del Rio sheets of the Bureau of Economic Geology's Geologic Atlas of Texas show the species to be found on the Segovia and Fort Terrett members of the Edwards Limestone, the Devils River Limestone, and the Glen Rose formation. All of these formations are composed primarily of limestone and dolomite. A-7

The single taxonomic sentence of the Taxonomy section should be expanded. It should state who first collected the species, who described the species, when and where the description was published, and any taxonomic studies which included the species. The remainder of the paragraph stating the differences between S. texana and the other Styrax species of the western half of Texas should be placed after the description in the Morphology section. A-8

Among the additional references to other Styrax species, it should be noted that S. youngae is not endemic to the Davis Mountains. The species also occurs in Coahuila and Nuevo Leon, Mexico. Also S. youngae is listed by U.S. Fish and Wildlife Service as Category 2 and thus should be added to the first paragraph of the Recovery Plan. S. platanifolia, sycamore leaf snowbells, does not occur only in dense shade, but also in habitats similar to those S. texana. Probably the sentence concerning the sunlight/shade dichotomy between the two species should be deleted. A-9 A-10 A-11

In the Morphology section the height should be adjusted . In Trees, Shrubs, and Woody Vines of the Southwest, Robert Vines gives the height as 15 ft. Gonsoulin in his 1974 monograph of Styrax states the height is 4 m. In the best characters for field identification, "white hairs on the lower leaf surface" should be augmented. S. platanifolia can have sparse scattered stellate hairs, and thus may not be easily distinguished. In Cory's type description, he states the lower leaf surface is "bright silvery with a very dense fine and silky covering." This description is much more explicit than simply "white hairs." A-12 A-13

It should be noted that the plants were not relocated in Val Verde County because access to the property was denied. As it stands now in the Plan, it is implied that the plants were searched for, but not relocated. A-14

Several times in the Plan the "east prong of the Nueces River" is mentioned. East Prong should be capitalized as it appears on the USGS topographic maps. A-15

In the Recovery Narrative, it is suggested that new populations be established. This should not be done until the selected establishment sites are protected. And until "suitable habitat," seedling establishment and dispersal are better defined and understood, it would not be wise to take all seeds which "fall into unsuitable habitat or be washed away." Care should be taken when raising plants outside their natural habitat to avoid possible hybridization. Certainly seed from such plants should not be used for reintroduction material unless the plants are part of an extremely structured breeding program. A-16

Not only should the relationship between native fauna and Texas snowbells be determined, but also the relationship between the plants and the exotic fauna, particularly the introduced ungulates. Also the pollinators and other plant visitors should be identified as some may be carriers or vectors for disease. A-17 A-18

Finally the exact habitat requirements (edaphic, macro- and microclimate, air and water quality; physiographic and topographic, vegetation physiognomy and community structure, associated species, dominance and frequency, successional phenomena, and dependence on natural disturbance) should be delineated to aid in management, search the additional populations, and selection of suitable sites for colonization. A-19

Sincerely,

Jackie

Jackie M. Poole
Botanist, Texas Natural Heritage Program

JMP:mt

RD
DRD
ABA
AEE
ARW
AWE
ALE
APA
AHR
Cole
File SE
Action
CL

3414 Forest Trail
Temple, Texas 76502
15 December 1986

Director, Region 2
U.S. Fish and Wildlife Service, USDI
P.O. Box 1306
Albuquerque, NM 87103

RE: Region 2 SE

Dear sir,

A few days ago I received copies of U.S. Fish and Wildlife Service technical/agency review draft recovery plans (ashy dogweed, Johnston's frankenia, Texas snowbells, and slender rush-pea) for review and comments.

Due to my limited knowledge of these species, I am unable to offer any suggestions at this time. Each of the plans have been excellently prepared, and it is felt that the various aspects of the recovery plans have been adequately addressed. My personal congratulations to each person who worked on these documents. B-1

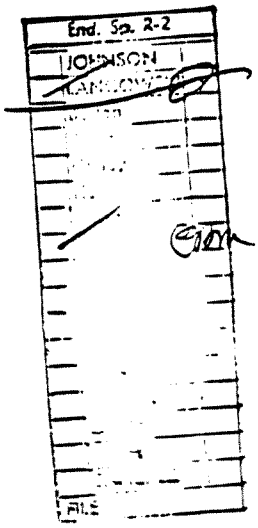
I would like to make a couple of suggestions:

(1) Use the metric system throughout for all distances, areas, and temperatures. (It is noted that the metric system is used for plant parts measurements with English equivalents in parentheses.) B-2

(2) It is noted in the Texas snowbells' recovery plan, pp. 7-10, the specific epithet taken from a name of a person is capitalized, i.e., Hedeoma Drummondii, Polygala Tweedyi, and others. To be consistent with other recovery plans, it is suggested that the lower case letter be used. I believe that the latest preferred writing of the special epithet is the use of the lower case letter. B-3

Sincerely yours,

Harold E. Beaty
Leader, Texas Plant Recovery Team

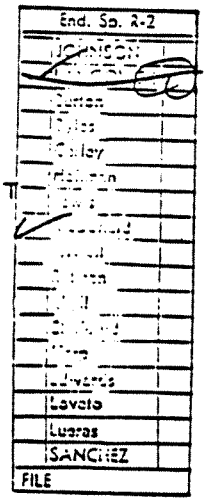


FWS REG 2
RECEIVED
DEC 19 '86
SE

RECD
FWS-Region 2
DEC 18 1986
AEE

48

TEXAS
PARKS AND WILDLIFE DEPARTMENT
4200 South School Road Austin, Texas 78744



RD
DRD
ABA
AFF
ARW
AWE
ALE
APA
AHR
CHARLES D. TRAVIS
Executive Director
File SE
Action
CL

January 21, 1987

Mr. Conrad A. Fjetland
Assistant Regional Director
United States Department of the Interior
Fish and Wildlife Service
Post Office Box 1306
Albuquerque, N. M. 87103

Re: Recovery plans for Johnston's frankenia, Texas snowbells, slender rush-pea, and ashy dogwood.

Dear Mr. Fjetland:

The Texas Parks and Wildlife Department has reviewed the four referenced U. S. Fish and Wildlife Service technical/agency draft recovery plans.

All four plants are listed as endangered by the U. S. Fish and Wildlife Service and by the Texas Parks and Wildlife Department. These plant species exist only in very limited numbers and locations. They are also endangered by a variety of problems, such as invading exotic grasses, browsing by wild and domestic animals, and limited reproduction.

C-1

The four recovery plans appear to provide the guidance and priorities needed to protect and/or augment populations of the four species.

Sincerely,

Charles D. Travis
Executive Director

CDT:LER:tj

FWS REG 2
RECEIVED
JAN 30 '87
SE

REC'D
FWS-Region 2
JAN 30 1987
AFF

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Southwest Region
P. O. Box 728
Santa Fe, New Mexico 87504-0728

RD
DRD
ABA
AFE
ARW
AWE
ALE
APA
AHR
Cole
File
Action SE
CL-2-119

In Reply Refer To:

N1621(SWR-ONR)

FEB 10 1987

Memorandum

To: Regional Director, Region 2, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

From: Regional Director, Southwest Region

Subject: Listing of Mancos Saltbush and Recovery Plan Review on Four Other Species

We appreciate being able to comment on the proposal to list Mancos saltbush and on the recovery plans for Johnston's frankenia, slender rush-pea, ashy dogweed, and Texas snowbells.

None of these plants occur in areas administered by the National Park Service and we, therefore, have no specific comments. We are returning the recovery plan drafts should you have other uses for them. D-1

Enclosure

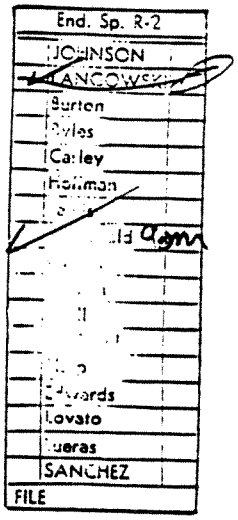
End. Sp. R-2
JOHNSON
Burton
Byles
Carley
Lavers
Lucero
SANCHEZ
FILE

FWS REG 2
RECEIVED
FEB 12 '87
SE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE



In Reply Refer To:
FWS/OES

MAY - 8 1987

Memorandum

To: Regional Director, Region 2

From: Assistant Director - Fish and Wildlife Enhancement

Subject: Review of Six Texas Draft Plant Recovery Plans

We have reviewed the technical/agency drafts of the Texas snowbells, slender rush-pea, ashy dogweed, Johnston's frankenia, Lloyd's Mariposa cactus, and bunched cory cactus recovery plans. Editorial comments for each of the plans are provided as marginalia on the attached plans. In addition, the following comments are provided:

1. Some of these plans give detailed site locations, e.g., ashy dogweed and slender rush-pea. On page 10 of the ashy dogweed, it states that "...publication of its one location could lead to vandalism or imprudent taking." However, on page 8 of the same plan, it gives details on land ownership plus additional information that a gas pipeline crosses the site. With this degree of detail, it would be relatively easy to locate the subject plants. Please consider if you wish to be this specific. E-1

2. The Implementation Schedule of some of the plans have tasks which are assigned Priorities of 1. A Priority 1 task is an action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future (emphasis added). Some of the Priority 1 tasks are questionable. For example, Lloyd's Mariposa cactus is a threatened species found on National Park Service land and on private land. Much of the private land is owned by the Lafitas Museum and Desert Garden. It seems inappropriate to have task 122, "Establish safe sites on private lands" and task 123, "Develop and implement species management plans" as Priority 1 tasks. Also, note that tasks 111-115 are missing from the Implementation Schedule for this plan. E-2

   Similar concerns exist for the Priority 1 tasks listed for the threatened bunched cory cactus. This cactus is also found on National Park land, State land, and private land. It seems inappropriate to have tasks 112 and 113 dealing with protection on private lands assigned a level 1 priority.

3. The recovery objectives for the threatened bunched cory cactus and Lloyd's Mariposa cactus have interim goals of 10,000 individuals and 20,000 individuals, respectively. Why is the interim goal for the Lloyd's cactus double that of the bunched cory cactus?

4. All maps and drawings should include a scale to better depict size and distance. E-3

5. Most of the plans do not quantify the primary objective. This should be done if at all possible. E-4

I hope these comments are useful as you prepare the final draft of these recovery plans for the Regional Director's approval. Upon his approval, notify the Office of Endangered Species, 500 Broyhill Building, and provide them with 30 copies of the printed plan when it is available.

Ronald E. Lambertson

Attachments

Responses to Comments

A-1 The Impacts and Threars section has been revised.

A-2 Comment noted.

A-3 This information have been incorporated into the Impacts and Threats section.

A-4 The recovery plan task that addresses the threat of natural erosion is limited to evaluating whether this threat can or should be controlled. There are no tasks in this plan to attempt any erosion control measures.

A-5 Recovery tasks have been included to study plant diseases and then begin any treatment only after ecological consequences have been considered.

A-6 This information has been incorporated into the Impacts and Threats section.

A-7 This information has been incorporated into the Habitat and Associated Species section.

A-8 The Taxonomy and Morphology sections have been rewritten to incorporate these suggestions.

A-9 Information has been incorporated.

A-10 Suggestion has been incorporated.

A-11 The sentence comparing the habitat preferences of Styrax texana and S. platinifolia has been deleted.

A-12 Gonsoulin's monograph has been followed for all measurements in the morphology section.

A-13 Suggestion has been incorporated.

A-14 This statement has been revised to improve its clarity.

A-15 Corrections have been made.

A-16 The recovery tasks for establishing new populations have been expanded to address these concerns.

A-17 These recovery tasks have been expanded to specifically address the relationships between Styrax texana and native wildlife, domestic livestock, and exotic game.

A-18 A task to study pollinators has been added.

A-19 Tasks to determine the exact ecological requirements of Styrax texana are included in the plan.

B-1 Comment noted.

B-2 Because some non-technical readers may not be familiar with metric measurements, both metric measurements and English equivalents have been used throughout the plan.

B-3 Suggestion has been followed.

C-1 Comment noted.

D-1 Comment noted.

E-1 Collecting is not considered a threat to Texas snowbells and access to plants is controlled by landowners who are aware of the species' endangered status. Under these circumstances, it is not believed that locality information in this plan will cause any additional risk to the species.

E-2 The Implementation Schedule has been reviewed to insure that recovery task priorities are appropriate.

E-3 Suggestion has been incorporated.

E-4 For many endangered plants with restricted distribution and low numbers, to little is known about their reproduction and ecological requirements to establish any realistic numerical goals for downlisting or delisting. This plan contains a task to establish numerical goals once adequate biological information is available.