

Texas Snowbells
(Styrax platanifolius ssp. texanus)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, Texas

5-YEAR REVIEW
Texas Snowbells (*Styrax platanifolius* ssp. *texanus*)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office: Southwest (Region 2), Wendy Brown, Endangered Species Recovery Coordinator, (505) 248-6641.

Lead Field Office: Austin Ecological Services Field Office (AESFO), Christina Williams, (512) 490-0057, extension 235.

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (Act) (16 U.S.C. 1531 et seq.). The Service provided notice of this status review via the Federal Register (72 FR 20134) and requested new information from various parties. This review was conducted by Christina Williams, Austin Ecological Services Field Office, and relied heavily on a draft recovery plan prepared under contract by Jackie Poole, botanist for Texas Parks and Wildlife Department (TPWD). TPWD's 2005 and 2007 Wildlife Research Highlights publications provided general status information used in this review. Jackie Poole also provided population status information which was based on observations while monitoring this subspecies.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 72 FR 20134, April 23, 2007.

1.3.2 Listing history

Original Listing

FR notice: 49 FR 40036

Date listed: October 12, 1984

Entity listed: *Styrax texana*

Classification: Endangered

1.3.3 Associated rulemakings: Not applicable.

1.3.4 Review History: Prior to listing, in 1981 Mahler (1981) completed a status review of Texas snowbells, *Styrax texana*, which described the species, its known distribution (Edwards, Real, and Val Verde Counties), and threats to

its existence (erosion, small population, and herbivory). Mahler (1981) concluded with recommending that Texas snowbells be listed as a threatened species with one location designated with critical habitat (reasons not given).

Also, a 5-year review was initiated on November 6, 1991 (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 2

1.3.6 Recovery Plan or Outline

Name of plan or outline: Texas Snowbells (*Styrax texana*) Recovery Plan

Date issued: July 31, 1987

Dates of previous revisions, if applicable: Not applicable.

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

No, so the DPS policy does not apply.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan?

Yes.

2.2.1.1 Does the recovery plan contain objective, measurable criteria?

No. While the recovery plan is final, there are no recovery criteria.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Texas snowbells (*Styrax platanifolius* ssp. *texanus*) are a member of the storax family (*Styracaceae*), a family of trees and shrubs distributed throughout Asia, North and South America, and the Mediterranean (Fritsch 1997, Gonsoulin 1974). Texas snowbells are deciduous (sheds leaves annually), multiple-stemmed, woody shrubs that average about three meters (9.8 feet) in height (Cory 1943, Gonsoulin 1974, Fritsch 1997, Vines 1984).

In late March to late April, one to six flowers 2-5 centimeters (0.8-2 inches) long are produced in pendulous (hanging) racemes (clusters) (Cory 1943, Fritsch 1997). The capsular fruits are dry, hairy, and rounded (Cory 1943, Fritsch 1997), turn from a frosty, light green to brown as they mature, and split open in late August to late November producing one (two or rarely three in very wet years) glossy, dark brown, rounded seed (Fritsch 1997, Rare Plant Study Center 1976, Vines 1984, Gonsoulin 1974).

Most Texas snowbell seeds fall directly beneath the parent plant (Poole 1993). Those seeds may stay where they fall on the ground, be moved by water if growing over a stream or creek, or be carried off by small mammals such as rock squirrels (*Spermophilus variegates*) or wood rats (*Neotoma* sp.) (TPWD 1990, Poole 1993). Occasionally a seed will germinate, leading to the establishment of a plant (Poole 1993).

The reproductive biology of Texas snowbells is not well known. Although it is presumed to be outbreeding and insect-pollinated (Gonsoulin 1974), these assumptions have not been verified. In 2007 the first “true” recruitment (seedling establishment to flowering/fruited adult) was observed for three, 14 year old plants in the wild (Bamberger and Fulton 2007). The pollinators of Texas snowbells are still unknown. However, a recently funded study is attempting to gather this information (Fulton 2006).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

There are currently 22 known natural populations with one to several hundred individuals per population. The estimated total number of individuals is less than 1,000 (Bamberger and Fulton 2007). Two reintroduction projects have occurred, see 2.3.1.5 for further information.

Jackie Poole, botanist for Texas Parks and Wildlife Department, has been monitoring and collecting data on Texas snowbells for over 20 years. According to the draft recovery plan, Poole (1999) states that:

“Numbers of individuals at some sites have increased over the years as have the number of populations. While this may appear to be expansion, increasing observations have resulted in the detection of additional mature adult plants at known sites, and the discovery of populations new to humans, but composed of obviously well-established mature plants. No new populations have been found which are comprised exclusively of juveniles and seedlings. Such populations would suggest a true increase in the number of populations.”

Based on Jackie Poole's observations during data collection and monitoring since the draft recovery plan was submitted to the Service in 1999, Texas snowbells appear to be stable; however, these data have yet to be analyzed (Poole, TPWD, pers comm. 2008). Once these data are analyzed, we will have a better understanding of the status of the populations being monitored.

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

The only genetics work completed on Texas snowbells was conducted by Fritsch (1996) to determine relatedness of Texas snowbells to other *Styrax* species. This study is discussed further under 2.3.1.4.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Until 1997, there were three recognized species of *Styrax* occurring on the Edwards Plateau: *texana*, *platanifolius*, and *stellatus* (Fritsch 1997). *S. texana* grows in the southwestern part of the Edwards Plateau, *S. platanifolius* mostly on the eastern and northern half, and *S. stellatus* primarily on the southern part (Fritsch 1997).

While Texas snowbells was first collected by V. L. Cory (1943) in 1940 and described by him in 1943, the first taxonomic study to include *S. texana* was that of G. J. Gonsoulin (1974). Gonsoulin (1974) recognized *S. texana* as a distinct species with close relations to *S. platanifolius* and *S. youngae*, which occurs in west Texas (Fritsch 1997).

J. A. Mears (1971), using material from cultivated *Styrax* at the Academy of Natural Sciences in Philadelphia, thought he had "nearly all, if not all, the known *Styrax* spp. of Texas," and so undertook a phylogenetic (evolutionary history) study. After examining the morphology (form and structure) and the phenolic (chemical) compounds, Mears (1971) concluded the species of *Styrax* from central and west Texas (*platanifolia*, *stellata*, *texana*, and *youngae*) formed a natural group. That is, they were all closely related. However, he did not make any taxonomic changes.

Fritsch (1996, 1997) completed isozyme analysis and DNA sequencing on Texas snowbells. These two studies in addition to others completed on *Styrax* morphology by Fritsch led to the designation of *S. texana* as a subspecies of *S. platanifolius*, along with four other subspecies: *platanifolius*, *stellatus*, *youngiae*, and *mollis* (Fritsch 1997). Fritsch (1997) considered the morphological variation recognized by Cory (1943) and Gonsoulin (1974) to be taxonomically unreliable or inconsequential. Fritsch (1997) confirmed the ranges of three of the subspecies (*platanifolia*, *stellata*, and *texana*) did overlap, but genetically they are different enough to be subspecies.

As part of this status review, we are accepting Fritsch's (1997) designation of *S. texana* as a subspecies and are in the process of changing the name on the List to *S. platanifolius* ssp. *texanus*.

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

At the time of listing, 25 Texas snowbell plants were known from Edwards, Real, and Kimble Counties, Texas (Figure 1). Other plants thought to be Texas snowbells were reported in 1942 from Val Verde County, Texas, but have not been reconfirmed (49 FR 40036-40037, TPWD circa 1995). In 1987 when the recovery plan was published, more than 33 plants were known from 6 sites in Edwards and Real counties; the Kimble County location was thought to be an error, since several years of surveys found no plants; and the Val Verde County population had not been reconfirmed (Service 1987). To date 22 natural populations with one to several hundred individuals of Texas snowbells per population are confirmed from Edwards, Real, and Val Verde (reconfirmed in 1992) Counties in the watersheds of the Devils and upper Nueces Rivers, Texas (Bamberger and Fulton 2007, TPWD circa 1995).

In 1987, Texas snowbell seeds were collected in the wild, grown in containers. From these, 49 plants were established at two sites, one in Uvalde County and another in Real County (McDonald 1996). At the time of the reintroductions, the Frio River watershed in Uvalde County was thought to be within the historic range of Texas snowbells (McDonald 1996). The reintroduced populations were caged and occasionally watered in the first five years of monitoring (McDonald 1996). The last report of their status was received in 1991 and stated the majority of plants from both locations had survived and appeared to be established (Keeney 1991). Jackie Poole (pers. comm. 2008) and Paul Cox, San Antonio Botanical Gardens, visited the two sites in the late 1990's and found 39 total plants between the two sites. Most plants were still restricted to their cages, due to obvious signs of browsing (Poole pers. comm. 2008). We are unaware of any other monitoring occurring with these plants.

Bamberger Ranch Preserve (BRP) (2004), a privately owned ranch, began another reintroduction project in 1994. The goal of this project was to establish 32 distinct populations supporting a total of at least 500 reproducing plants (BRP 2004). In the process of seeking out participating landowners within the historic range, at least five new locations with plants were discovered (BRP 2004). Seeds were collected in the wild, grown in containers, and replanted in the same watershed they were collected from

(BRP 2004). As of 2004, 11 private ranches have had plants established on them and they are monitored twice a year (BRP 2004; Bamberger and Fulton 2007).

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

Texas snowbells occur in moist habitats such as river drainages, canyons, and draws, which are abundant in the Edwards Plateau (Correll and Johnston 1970, Vines 1984, Poole and Birnbaum 2005, Riskind and Diamond 1988). Although surface water may not necessarily be present, these sites have sub-surface water or collect run-off (Keeney 1988, Keeney 1989). Most plants occur in areas where they receive at least partial shade from surrounding vegetation during the day (Poole and Cook 1996). While Texas snowbells are most often described on vertical cliffs (possibly because of threats from herbivory in more accessible terrain), many plants occur on level terrain (Cory 1943, McDonald 1996, Poole and Cook 1996). Fulton (2006) is currently collecting data on microhabitat characteristics. Once these data are analyzed we may then be able to determine the amount and distribution of Texas snowbell habitat which will improve search methods for finding existing populations and for determining where potential reintroductions could occur.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

Texas snowbells were listed as a federally-endangered species based on the following threats: (1) only 25 plants were known to exist, 24 of those were privately owned and 1 was owned by the State of Texas; (2) stream bank erosion; (3) the possibility that cattle and/or deer browsing were reducing seedlings and young plants; and (4) lack of reproduction due to small population sizes (49 FR 40037). By the time the recovery plan was published, threats to the species were: (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 (Service 1987).

Following is a summary of new information, since the 1987 recovery plan, regarding threats to this species:

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

Activities, such as the introduction of domestic livestock, the suppression of fire, brush clearing, and cultivation have led to vegetation alteration across the Edwards Plateau (Riskind and Diamond 1988, Fonteyn et al. 1988).

Such changes have caused a shift from mid-grasses to short grasses (Riskind and Diamond 1988, Smeins and Merrill 1988). Sites dominated by short grasses have higher sedimentation loss (erosion) and lower infiltration rates (higher runoff) than sites with mid-grasses (Smeins and Merrill 1988). Increased erosion and runoff destroys the fragile cliffs on which Texas snowbells occur (Keeney 1991). Because many of the activities that lead to increased erosion are still prevalent on the Edwards Plateau (Lockwood 2008, Wilkens et al. 2006), we still consider habitat alteration from overgrazing, fire suppression, brush clearing, and cultivation to be a threat to the species.

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

Historically, there was concern that Texas snowbells would enter the horticultural trade (49 FR 40037). Various individuals and botanical gardens have collected seeds for conservation purposes (BRP 2004, Texas Discovery Gardens 2001). However, no plants could be found for sale on the internet as of May 19, 2008, and we are unaware of any nurseries selling this species. Therefore, we do not consider collection a threat to the continued existence of the species.

2.3.2.3 Disease or predation:

Disease

The Texas Snowbells Recovery Plan (Service 1987) discusses one plant showing signs of disease with stem dieback and bark breaking off of the wood. However, this type of disease has not been noted since. During Poole and Cook's (1996) Texas snowbell monitoring study, six percent of plants at one monitoring site were noted as having spots on their leaves. However, these spots did not seem to affect the vigor of the plant (Poole and Cook 1996). We are not aware of any other diseases affecting Texas snowbells; therefore, we do not consider disease to be a threat to this species.

Herbivory

Herbivory is still the primary threat to Texas snowbells (Poole and Birnbaum 2005). Exotics ungulates (such as axis, sika, and fallow deer), white-tailed deer, goats, and cattle threaten this species (Huerta-Patricio et al. 2005, McDonald 1996). Wilkins et al. (2006) summarized the U.S. Department of Agriculture's 2002 Census of Agriculture data for Texas (the next census is due out in 2009) and stated that the Edwards Plateau had the highest density of goats (48.7 goats per 1,000 acres) and is second in number of cattle (74.7 cows per 1,000 acres). Lockwood (2008) determined the Edwards Plateau supports 52 percent (86 deer per 1,000

acres) of Texas' white-tailed deer population; however, it makes up only 20 percent of land in the state.

Poole and Cook's (1996) Texas snowbell monitoring study consistently found evidence of mammal herbivory. During a Texas snowbells reproductive biology study, caged and uncaged plants were monitored to determine impacts from herbivory (Poole 1993). While small mammal herbivory occurred inside the cages, seedlings and juveniles had a higher survival rate inside than those plants outside of cages (Poole 1993). In addition to small mammal herbivory, plants outside of cages were also impacted by rooting, possibly an armadillo, and heavy browsing (Poole 1990, Poole 1993).

In addition to mammal herbivory, insect herbivory is also prevalent in Texas snowbells (Poole and Cook 1996). Poole (1990) found most monitored seedlings were damaged by insects with damage ranging from pinholes in leaves, to bites, or large pieces missing. In captivity, seedlings were predated by loopers (moths), caterpillars, snails, and other insects (Rare Plant Study Center 1976).

During a reproductive biology study, fruit and seed predation by insects was noted where pin-hole sized wounds were made (Poole 1993). Seed shells were also found with shells split or bites taken out of them with no seeds inside (Poole 1993). A cache of partially eaten Texas snowbell seeds was discovered in cliff crevices (Poole 1993). Rock squirrels, mice, or packrats may gather the seeds, stuffing them in their nests in the rock cliffs (Poole 1993).

The combination of mammal and insect herbivory on all life stages of Texas snowbells significantly decreases reproduction in the wild for this species (Poole 1990, Poole 1993, Rare Plant Study Center 1976) and is the primary threat to its survival.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Regarding plants, listing under the Endangered Species Act makes it unlawful for anyone to maliciously damage or destroy plants on Federal lands, and protects plants from jeopardy (when an action is reasonably expected to appreciably reduce a species' likelihood of survival and recovery in the wild) on non-Federal land if the activity is authorized, funded, or carried out by a Federal agency. The State of Texas lists Texas snowbells as endangered and thus the species is prohibited from commerce. Additionally, collection of listed plant species from State land (in this case only two of the 22 known populations) is only authorized with a TPWD permit. Texas snowbells receive no State protections on private lands.

Texas snowbells have not been found on Federal lands and we are unaware of any planned federally funded activities that will impact the species on private lands. Additionally, we do not consider collection to be a threat to the species (section 2.3.2.2). Therefore, we do not consider a lack of regulatory mechanisms to be a threat to this species.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Alteration of Groundwater

We have no information that alteration of groundwater has or will affect Texas snowbells.

Small Population Size

Pavlik (1996) summarized characteristics (annual growth, sensitivity of size, seed production, etc...) necessary for determining a viable population. Poole (1999) applied these characteristics to Texas snowbells and determined that 1,000 reproductive plants per population would be necessary for long-term survival. Additionally, all three life stages (seedlings, juveniles, and mature plants) would need to be adequately represented to carry out basic life-history processes (Pavlik 1996). Currently the total number of known Texas snowbell plants is less than 1,000 (Bamberger and Fulton 2007), and we are unsure of the life stages represented throughout the range. We believe small population sizes can lead to genetic erosion through inbreeding and increase loss from random natural events and therefore threaten long-term survival of the species (Meffe and Carroll 1994).

Flooding

Because Texas snowbells grow along creeks and drainages (Correll and Johnston 1970, Vines 1984, Poole and Birnbaum 2005, Riskind and Diamond 1988), impacts from flooding are still a threat, particularly if the population is small. Impacts can range from plant damage to completely washing away whole plants if they are not well established (Keeney 1988, Keeney 1991).

Drought

According to the Texas State Historical Association (TSHA) (2008a, 2008b, 2008c), annual rainfall across the Texas snowbells range is approximately 0.53 meters (21 inches) annually and temperatures average 33°C (96°F) in July. Texas snowbells have displayed signs of stress during the summer, and some reintroduced plants died due to the heat (Keeney 1988, Keeney 1991). While minor, we do consider drought to be a threat to the species, particularly when the population size is small.

2.4 Synthesis

Texas snowbells were listed as endangered in 1984, meaning the species was in danger of extinction throughout all or a significant portion of its range. One reason for the endangered status was that there were only 25 known Texas snowbell plants at the time of listing. While we had additional species and distribution information at the time we published the recovery plan in 1987, there was not enough information for us to draft recovery criteria. More than two decades of research, monitoring, and searching have increased our knowledge of the species, refined the distribution to the Devils and Nueces Rivers in Edwards, Real, and Val Verde Counties, and located almost 1,000 plants range-wide. We are encouraged by these results and the ongoing conservation, reintroduction, and research efforts. Because of the increased information on Texas snowbells, we are currently able to draft recovery criteria for the species. We plan on publishing a revised recovery plan with objective and measurable recovery criteria that address all of the five listing factors that are relevant to the species in the near future.

Currently, we believe that threats from collection, disease, and groundwater alteration are lacking. However, we understand these threats could increase in the future and should be monitored for impacts.

On the other hand, some threats are still prevalent throughout the Texas snowbells' range. The shift in vegetation from mid-grasses to short grasses throughout the Edwards Plateau continues to cause erosion and increase runoff. We believe threats from drought, flooding, and erosion will be minimal when population levels and representative life stages are sufficient to prevent extinction. However, herbivory is still the primary threat to the continued existence of Texas snowbells throughout its range. Every threat is exacerbated when populations are small and minimal reproduction is occurring. Due to the limited distribution of the species and the amount of private lands in the area, we are relying on private landowners to assist in recovering this species. While there has been an increase in conservation efforts by private landowners for this species, available data indicate population numbers are still not at levels near those recommended in the draft recovery plan for long-term conservation: 10 population centers each containing at least five populations with at least one of those five being a protected, viable, self-perpetuating population comprised of no fewer than 1,000 plants. These recommendations are based on the best available science for population viability of plants. Additionally, there are no protections in place to ensure long-term survival for the species.

Our limited knowledge of the status and location of many of the Texas snowbell populations and impacts on reproduction from herbivory leads us to determine that no change in classification is warranted at this time. Texas snowbells should remain endangered.

3.0 RESULTS

3.1 Recommended Classification:

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

3.2 New Recovery Priority Number: 3

Brief Rationale: We believe the degree of threat to Texas snowbells from herbivory is still high, and the recovery potential is also high. However, because we are accepting the Texas snowbells taxonomic classification as a subspecies (Fritsch 1997), our Recovery Priority System (48 FR 43104) requires a change in priority number. We recommend a new Recovery Priority Number of 3 (rather than a 2).

3.3 Listing and Reclassification Priority Number – Not applicable.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Update the Recovery Plan to include objective and measurable recovery criteria that address all of the five listing factors that are relevant to the species.
- Obtain information on all natural and reintroduced populations to adequately assess the status of the species.
- Map the amount and distribution of potential Texas snowbell habitat across the range.
- Conduct a population viability analysis.
- Draft a reintroduction plan to maximize efficiency and success for meeting recovery criteria.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
Texas Snowbells (*Styrax platanifolius* ssp. *texanus*)**

Current Classification: endangered

Recommendation resulting from the 5-Year Review:

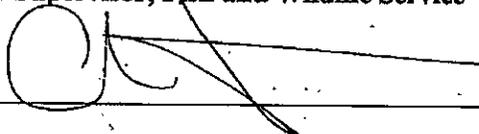
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: n/a

Review Conducted By: Christina Williams, Austin Ecological Services Office, Austin, Texas

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 8/4/08

REGIONAL OFFICE APPROVAL:

Acting

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Region 2

Signature  Date 9-12-08

Figure 1: Distribution Map of Texas Snowbells (*Styrax platanifolius* ssp. *texanus*)

