## FINAL REPORT

As Required by

## THE ENDANGERED SPECIES ACT, SECTION 6

TEXAS
Project No: E-1-4

ENDANGERED AND THREATENED SPECIES CONSERVATION

## <u>Job No. 3-1</u>: Reproductive Biology of Texas Snowbells (Styrax texana)

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January 31, 1993

#### ABSTRACT

It was hypothesized that Texas snowbell seedlings were not establishing in the wild due to seedling browsing by deer and other exotic game species introduced into the habitat. An exclosure experiment was designed using exclosure cages constructed of PVC pipe and one-inch mesh chicken wire. These cages were placed under the existing parent plants, which were situated on a cliff face, to protect falling seeds in an effort to increase the survival rate of the seedlings. Three exclosures and six non-exclosure sites were included within the study. The presence of the cages did increase the survival rate of seedlings and juvenile plants. The first year of germination, FY 1990, 86 seedlings were counted, 44 of which were within the exclosures. Twenty-six of the 44 exclosed seedlings had survived by the fiscal year's end, whereas only 22 of the unexclosed seedlings remained. During FY 1991, 36 second year seedlings remained (27 within the exclosures and 9 within the nonexclosed sites). At the end of FY 1992, only 30 juvenile plants remained (25 within the exclosures and 5 within the unexclosed sites).

There is successful reproduction of Texas snowbells in the wild; however, seedlings which establish outside of the enclosures suffer high rates of mortality. There is severe browsing pressure on Texas snowbells, but browsing is not the exclusive threat impacting the species. It appears that browsing, soil rooting, and insect herbivory, each play a role in preventing the successful establishment of seedlings.

Also, fruit and seed predation by insects, and seed predation and collection by small mammals, proved to be significant factors influencing the life cycle of the species. It was also evident during this study that some small mammal was also collecting the seeds, as seed cashes were frequently discovered within the crevasses of the cliff face.

#### FINAL REPORT

STATE: Texas PROJECT NO.: E-1-

PROJECT TITLE: Endangered and Threatened Species Conservation.

PERIOD COVERED: September 1, 1991 - August 31, 1992

JOB NUMBER: 3-

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IOB TITLE: Reproductive Biology of Texas Snowbells (Styrax texana)

JOB OBJECTIVE: Determine the cause of the lack of dispersed seeds, seedlings, or

juvenile plants in natural populations of Texas snowbells.

SEGMENT OBJECTIVE: Determine by exclosure experimentation the effect of small to

large-sized mammal herbivory on the establishment and viability of seedlings and juvenile plants of Texas snowbells in the natural habitat. Determine the number of flowers and fruits and/or seeds produced per plant for all plants in the population.

Evaluate the amount of flower and fruit/seed herbivory.

#### ACCOMPLISHMENTS

Fiscal Year 1989 (September 1988 - Ausgust 1989)

This was the initial year of the study. It was hypothesized that Texas snowbell seedlings were not establishing in the wild due to seedling browsing by deer and other exotic game species introduced into the habitat. Some adult Texas snowbell individuals were growing, protected from herbivory, in the crevasses of a cliff face along the east prong of the Nueces River. It was theorized that these adult individuals had been relegated to this cliff face as a result of severe browsing pressures in the area. These plants would produce fruit capsules and dehisce seeds below, but establishment was not successful. An exclosure experiment was designed using exclosure cages constructed of PVC pipe and one-inch mesh chicken wire. These cages were placed under the existing parent plants, which were situated on a cliff face, to protect falling seeds in an effort to increase the survival rate of the seedlings.

Three cages (designated Cage 1, Cage 2 and Cage 3) were placed beneath Texas snowbells to capture the seed rain and protect the seed from mid- to large-sized mammal herbivory. Six uncaged sites were selected and marked as controls (designated Control 1, Control 2, Control 2a, Control 3, Control 4, and Control 5). Numbers of flowers and fruits on plants in both caged and uncaged sites were approximated. The site was visited approximately once a week from mid-May to the end of August. Only two capsules had split open by the end of August.

The following phenological observations were recorded in the field in 1989: Aprilflowering; May-initiation of fruit development; June-fruit green and filling calyx; July-fruit showing faint suture lines; August-suture lines apparent on most fruits and a some were beginning to dehisce.

### Fiscal Year 1990 (September 1989 - August 1990)

During FY 1990, 564 seeds were observed and counted within the study area. One hundred and eighty-six (186) seeds fell into the three cages placed beneath Texas snowbells. Germination began in mid-February and was more or less over by May. Forty-five (45) seeds germinated within the cages, and at the end of FY 1990, 29 seedlings remained within the cages. Three hundred and seventy-eight (378) seeds were counted outside the cages and in the six control (uncaged) areas. Of the 42 seeds which germinated, 21 seedlings survived at the end of FY 1990. In total, by August 1990, 48 seedlings remained (26 within the cages and 22 outside the cages or in the control areas). Primary causes for seedling mortality were thought to be drought or insect predation.

It was noted during this study year that the fruit capsules and the seeds were being eaten, and some of this herbivory was occurring inside the cages. Seed predation took the form of either seeds split in half with only the shells left, or bites taken out of the shell which left an empty shell. It appeared as though small rodents such as mice, rats or rock squirrels could be the responsible culprits. Rock squirrels were observed on the limestone ledges near the adult Texas snowbells several times.

Flower and fruit counts of the Texas snowbell adult individuals were made to establish reproductive potential.

The two foot high, 1/2 inch mesh hardware cloth was not added to the bottom of the cages, as was planned for 1990.

## Fiscal Year 1991 (September 1990 - August 1991)

During FY 1991, approximately 950 seeds were produced by 14 Styrax texana individuals in the fall of 1990. Approximately 260 seeds fell within the cages. A large number of seed fragments (almost 600) were found. Only 43 fragments were within cages. In the spring about 3300 flowers were produced, and in the fall approximately 1200 fruits were formed. No seeds had dehisced as of August 30, 1991. A single germination was observed in spring 1991, and this seedling lived only a few weeks. The two highest mortality events occurred in the late summer when seedlings died due to drought and in winter when seedlings were uprooted (probably by armadillos). Two seedlings counted as dead in FY 1990 releafed during FY 1991. Three seedlings at least one or more years old were discovered although one died later in the year. Of the 48 seedlings which survived until August 31, 1990, 16 died during FY 1991. Only one of the mortalities occurred within a cage.

It might seem at first glance that the number of remaining plants should be 30 (48-18). However two of the mortalities were plants only observed in FY 1991. Thus the number of mortalities of FY 1990 seedlings in FY 1991 was 16, leaving a total of 32 second-year seedlings. An additional four plants were found or revived in FY 1991. A second-year and an after second-year juvenile, were first observed in FY 1991. Two other seedlings which had been counted as dead in FY 1990 releafed in September 1990 and April 1991. Thus 36 juveniles, 27 within a Cage and 9 in control areas and outside cages, were still alive as of August 31, 1991.

Traps were not baited with Texas snowbell seeds and set for small mammals, as was planned for 1991, due to a lack of available personnel.

## Fiscal Year 1992 (September 1991 - August 1992)

During FY 1992, field data was collected in four separate months. Data collected for October 1991, November 1991 and January 1992, recorded seedling and juvenile numbers within the study area and also the number of seeds observed in the study area. As of January 1992, only 30 juveniles remained in the study area (25 within Cage 2, 3 in Control 3, 1 outside of Cage 1, and 1 outside of Cage 2). No new seedlings were noted. One lone seed was observed. Herbivory and rooting appeared to be the two primary factors contributing to juvenile loss. Refer to *Appendix I* for cumulative seedling to juvenile survival data for the four year study.

See Appendix II for illustrated data records on seedling location and mortality for the four year study. Cage 3, Control 4, and Control 5 are not illustrated because seedlings were not observed in these areas during FY 1990, 1991 and 1992. Illustrations were produced by Bill Bergquist.

The final month of data collection, July 1992, recorded stem number and stem diameter of all parent Texas snowbell plants as a measure of vigor. It was hoped that any continuing studies of S. texana would incorporate this data, in addition to flower and fruit development per plant, to determine whether a correlation existed between hardiness and reproductive potential. The average number of stems per Texas snowbells parent plant was 13.05±6.83. The largest parent plant is situated over Cage 2 and has 26 stems. The smallest parent plant is situated over Control 1 and has 2 stems. The average stem diameter for the Texas snowbells adult plants averaged 15.6±9.71 millimeters, with the largest diameter of 48 mm and the smallest of 3 mm. Refer to Appendix III for the recorded data.

#### Conclusions

Initially, it was hypothesized that severe browsing pressure by deer and other exotic game species was preventing any reproduction in the wild of the Texas snowbells. It was also theorized that these browsing pressures had relegated the only surviving adult individuals to the protected crevasses of the cliff face in the study area. The conclusion of this four year

study has indicated these hypotheses to be only partially correct, and additional questions have been raised.

Firstly, this study proved that there is successful reproduction of Texas snowbells in the wild; however, seedlings which establish outside of the exclosures suffer high rates of mortality. Secondly, this study proved that there is severe browsing pressure on Texas snowbells, but browsing is not the exclusive threat impacting the species. Although the exact cause of seedling mortality cannot be pinpointed, it appears that browsing, soil rooting, and insect herbivory each play a role in preventing the successful establishment of seedlings.

The presence of the cages did increase the survival rate of seedlings and juvenile plants. Seedlings and juveniles protected by the exclosures were not impacted by browsing and rooting as were the unexclosed individuals. Even the cages, however, could not prevent insect herbivory which proved to be a significant factor within the study area.

Additional observations during this study revealed that fruit and seed predation by insects, and seed predation and collection by small mammals, proved to be significant factors influencing the life cycle of the species. Fruits and seeds with pinhole-sized wounds as an insect would make were observed within the study area. Seeds on the ground, in and outside of the cages, were observed with small bites taken out of them. These bites would usually engulf 1/3 to 1/2 of the seed. It was also evident during this study that some small mammal was collecting the seeds, as seed cashes were frequently discovered within the crevasses of the cliff face. It may be possible that the surviving adult Texas snowbell plants initially germinated from within a seed cash, and this could be their preferred niche within such a competitive environment. However, this is speculation.

Further studies should be conducted on this species, for only the surface has been scratched. New studies should focus on determining the difference in mortality rates caused by browsing, rooting and insects. Also studies should be initiated to determine the actual role small mammals play in seed mortality and in the life cycle of the species. Possibly new establishment experiments could be devised considering the "crevice as the preferred niche" theory.

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January 29, 1993

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Date

## APPENDIX I

Styrax texana Seedling Survival for 1990, 1991, 1992

Recorded on the East Prong of the Nueces River

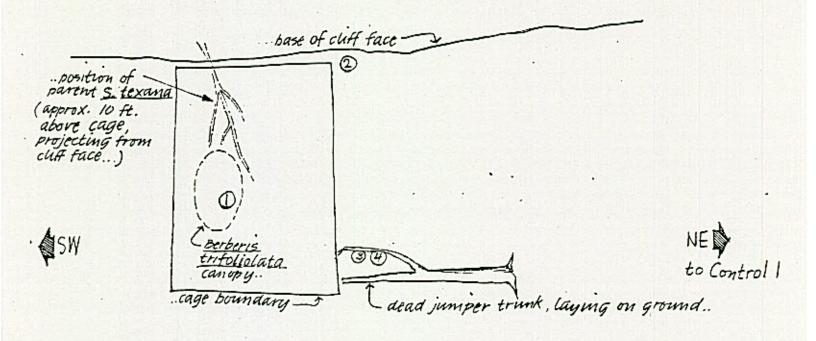
		Seedling	200	Second Year		Juvenile
Treatment	Germinations	Survival	Germinations	Survival	Germinations	Survivial
Treatment	1990			1991	1992	1992
Cage 1	1	0	0	0	0	0
Cage 2	43	26	0	* 27	0	25
Cage 3	0	0	0	0	0	0
Outside Cage	3	2	0	1	0	
Outside Cage		4	D 12 1	3	0	
Outside Cage		0	<b>0</b>	0	0	0
Control 1	1	SE SENTERS	0			0
Control 2	3	0	0			
Control 2a	2	2	0			
Control 3	27	13	0 0			
Control 4	1	0	9 6 0			
Control 5	0	0	0	0	0	
TOTAL	86	48	1	36		3 (
			2 2			
* One addition	nal seedling was	found which w	as over-looked	the previous ye	ar	

#### APPENDIX II

Styrax texana Locations and Mortality Data for The East Prong of the Nueces River 1990, 1991, 1992

Seedlings observed during the four year study

BY 1992: Seedling 4 is the sole survivor. Seedlings 1, 2 and 3 are dead.

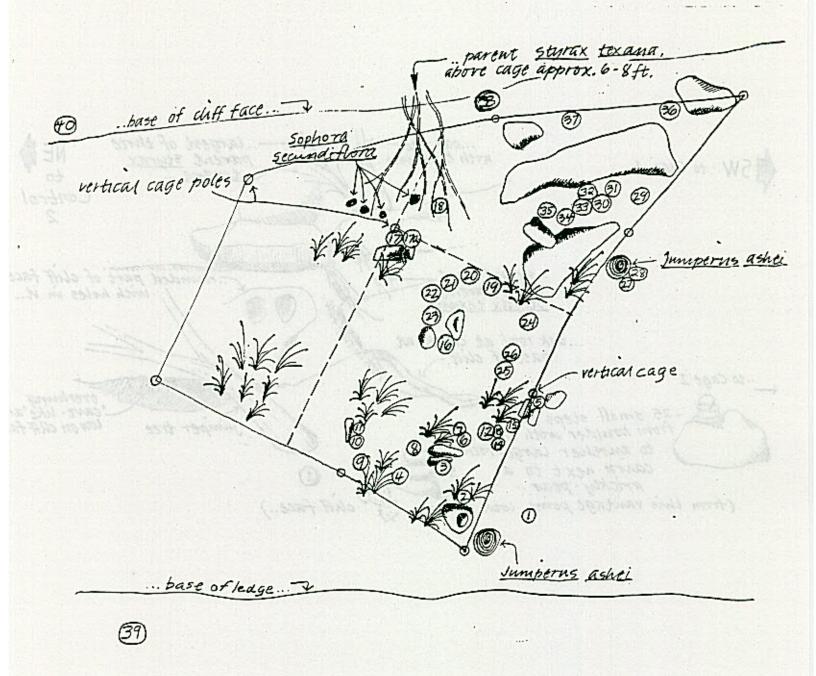


The East Prong of the Nueces River 1990, 1991, 1992

APPENDIX H

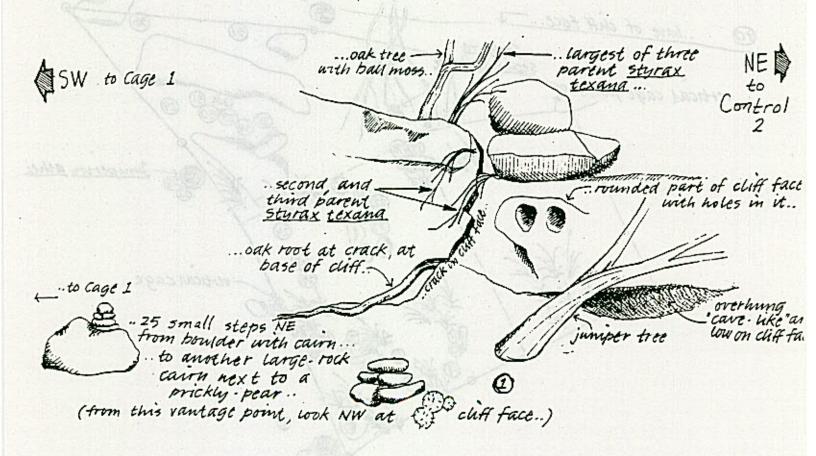
### CAGE 1 Seedlings observed during the four year study

FY 1992: Seedling 4 is the sole survivor. Seedlings 1, 2 and 3 are dead.



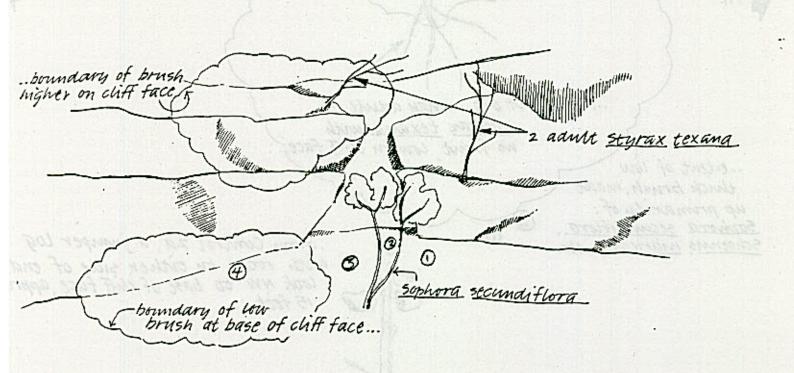
#### CAGE 2 Seedlings observed during the four year study

FY 1992: 26 seedlings remain living in this area. Living seedling numbers are: 2, 3, 4, 5, 6, 8, 12, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 29, 30, 31, 34, 36, 37, and 40.



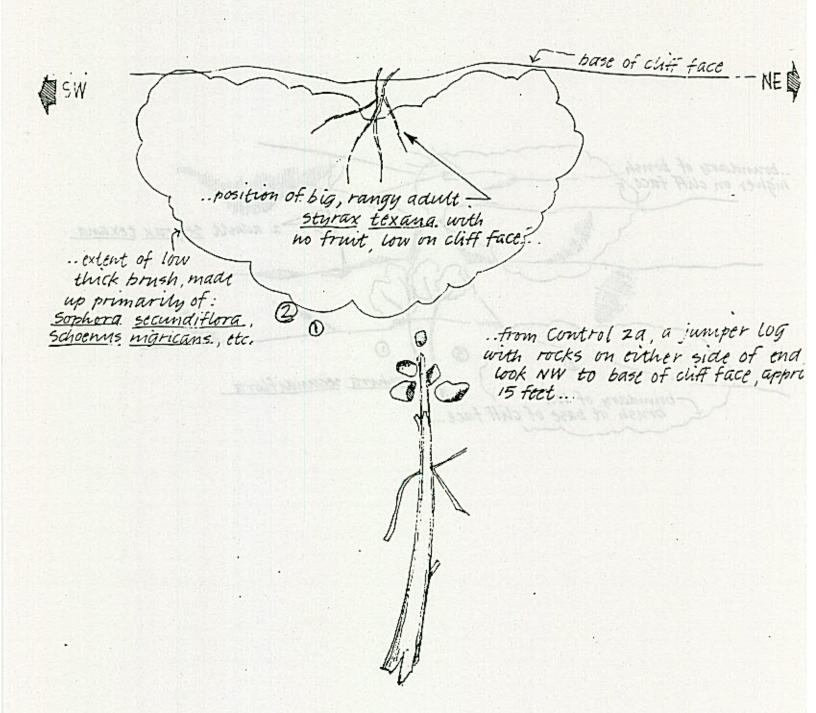
## CONTROL 1 Seedlings observed during the four year study

FY 1992: No seedlings have survived.



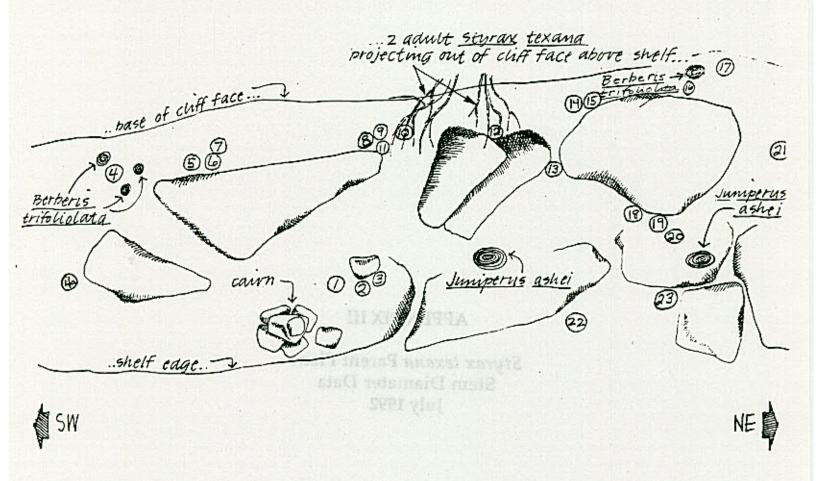
CONTROL 2 Seedlings observed during the four year study

FY 1992: Seedling 4 if the sole survivor.



CONTROL 2a Seedlings observed during the four year study

FY 1992: No seedlings survived in this area.



# CONTROL 3 Seedlings observed during the four year study

FY 1992: Only seedlings number 1, 17 and 22 remain alive in this area.

### APPENDIX III

Styrax texana Parent Plant Stem Diameter Data July 1992

Seedlings observed during the four year study

FY 1992: Only seedlings number 1, 17 and 22 remain alive in this area.

## 1992 Parent Plant Stem Diameter Raw Data

Sample Area	#Parent Plants	#Sten	ns	Diameters (mm)
Junipic Francis				
Cage 1	1		14	6, 9, 14, 13, 11, 30, 28, 26,
cage 1				41, 9, 7, 8, 26, 10
			20	48, 47, 20, 16, 25, 23, 11, 17,
Cage 2	1		26	22, 22, 9, 24, 15, 21, 15, 16,
				33, 7, 5, 3, 11, 9, 5, 11, 8, 11
				33,7,3,3,11,9,3,11,6,11
	1		21	nm*
Cage 3				
Comband 1	2		02	17, 22
Control 1			05	8, 4, 6, 4, 3
				00 05 15 15 5 5 0
Control 2	2		07	33, 25, 15, 15, 5, 5, 8
			11	15, 24, 15, 7, 7, 6, 5, 4, 3,
				3, 6,
			14	6, 9, 11, 22, 14, 12, 15, 15,
Control 2a	1			The state of the s
				14, 14, 13, 17, nm, nm
			05	33, 22, 16, 22, 21
Control 3	2		09	33, 23, 18, 32, 23, 11, 16,
			0,	14, 17
Control 4	6		12	nm
Control 4			23	nm
			05	nm
			15	nm
			10	nm
			18	nm
			25	nm
Control 5	3		25	nm
			13	nm
			13	nm
*nm - not mea	surable			
Average	number of stems:	13.05±6.83	high: 26	low: 2
		45 6010 54	biob. 40	low: 3
Average	stem diameter:	15.60±9.71	high: 48	10W. 3