FINAL REPORT

As Required by

ENDANGERED SPECIES ACT, SECTION 6

TEXAS

Project No: E-1-3

ENDANGERED AND THREATENED SPECIES CONSERVATION

Job No. 13: Habitat Factors and Reproductive Biology of the Ashy Dogweed

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January 28, 1992

ABSTRACT

Seeds of ashy dogweed remained viable after two years of cold storage. An increased germination rate was observed in heat-stratified seeds. Germination rate for non-stratified seeds was 23.8% while the rate for heat-stratified seeds was 48.9%. In tetrazolium tests 69.5% of the seeds were concluded to be viable. Thus the seeds do have a period of dormancy.

Soils at the ashy dogweed site were identified as belonging to the Hebbronville series. This series occurs in Jim Hogg and Webb Counties, and searches were conducted there along public roads. Using soil series as the ex situ indicator, 59 sites were surveyed. Plant community and commonly associated species of the ashy dogweed were not found at any of these localities. Thus there are still no ex situ indicators for the ashy dogweed.

PERFORMANCE REPORT

STATE: Texas **PROJECT NO.:** E-1-3

PROJECT TITLE: Endangered and Threatened Species Conservation.

PERIOD COVERED: September 1, 1990 - August 31, 1991

JOB NUMBER: 13

JOB TITLE: Habitat factors and reproductive biology of the ashy dogweed (Thymophylla tephroleuca)

JOB OBJECTIVE: Develop a habitat profile and search potential habitat for the ashy dogweed, including potential introduction sites. Determine the limiting factors of seedling biology.

SEGMENT OBJECTIVES: Continue seed biology studies (seed viability and longevity, dormancy, and germination requirements). Delineate and survey potential habitat for the ashy dogweed.

ACCOMPLISHMENTS

See Attachments 1 and 2.

SIGNIFICANT DEVIATIONS

See Attachments 1 and 2.

PREPARED BY: Jackie M. Poole — January 29, 1992 (Date)

Botanist (Title)

APPROVED BY: _____ _____ (Date)

Larry D. McKinney, Ph.D.
Director, Resource Protection Division

ATTACHMENT I

SEED BIOLOGY STUDIES

Progress Report on *Thymophylla tephroleuca* by National Wildflower Research Center

Reported by Elinor Crank, Research Horticulturist
Date: August 1991

Summary of Work

The objectives of this project are to examine seed viability over time, assess percent germination, determine if there are any pretreatment requirements for germination, and examine seedling mortality.

The first year of work, 1989 -1990, involved studying percent germination without pretreatment and viability over time. Three sites were examined individually from two collection dates throughout the year. TZ tests and procedures were developed. See report — **September 1990** for results.

The year, September 1990 - August 1991, has focused on pretreatment requirements or dormancy. Seeds were put through a variety of comparative treatments examining germination rates with and without pretreatments. Tetrazolium tests were refined and repeated. Sites and collection dates were kept separately.

A third collection was made according to guidelines from the Center for Plant Conservation on May 5, 1991. Observation of the three sites revealed a distinct difference between the three sites. The plants in site 1 were small and desiccated. There were few flower heads, although each plant had some. The plants in site 2 and 3, on the contrary, looked very healthy and full. They had obviously bloomed prolifically for each plant was covered in seed-heads and many were still blooming.

Methods

Pretreatment Comparative Test 1

One hundred seeds per site and collection date were put in petri dishes with moistened blotter paper. Seeds were either put in the refrigerator at 40 degrees F., in the growth chamber at 100 degrees F., or had no pretreatment. After pretreatment all seeds were put in the growth chamber at the same temperature to compare germination rates.

One hundred seeds were used instead of 50, as designated by the contract, in order to have a higher level of confidence. Standard seed testing, according to the Association of Official Seed Analysts (AOSA), requires four replicates of 100 seeds. Due to the limited availability of seeds from an endangered species this number was not possible for each site and collection date. However, it is possible to combine sites and collection dates per treatment and increase the sample size to 600 seeds per treatment for Test 1.

Germination was counted at radicle emergence so the number of days for initial counts varied based on when germination began.

Table 1

Moist-cold-stratified for two weeks at 40 degrees F. followed by the growth chamber at 70 degrees F.,12/12 day-night

week 1 — % germination

collection #	11-'89	6-'90	mean	total mean
site 1	5%	0%	2.5	
site 2	0%	0%	0	**0.8%**
site 3	0%	0%	0	
mean	2.5	0		

week 2 — % germination total

collection #	11-'89	6-'90	mean	total mean
site 1	24%	1%	12.5	
site 2	1%	1%	1.0	**6.5%**
site 3	8%	1%	4.5	
mean	11.0	1.0		

Moist-heat-stratified for one week at 100 degrees F. followed by the growth chamber 76 degrees F., 12/12 day-night.

week 1— % germination

collection #	11-'89	6-'90	mean	total mean
site 1	17%	6%	11.5	
site 2	24%	8%	16.0	**13.2%**
site 3	16%	8%	12.0	
mean	19.0	7.3		

week 2— % germination total

collection #	11-'89	6-'90	mean	total mean
site 1	25%	15%	20.0	
site 2	42%	11%	26.5	**22.0%**
site 3	30%	9%	19.5	
mean	32.3	11.7		

No pretreatment put directly in growth chamber at 70 degrees F., 12/12 day-night

week 2— % germination

collection #	11-'89	6-'90	mean	total mean
site 1	5%	4%	4.5	
site 2	5%	5%	5.0	**7.6%**
site 3	23%	4%	13.5	
mean	11.0	4.3		

week 3 — % germination total

collection #	11-'89	6-'90	mean	total mean
site 1	11%	4%	7.5	
site 2	5%	5%	5.0	**9.6%**
site 3	29%	4%	16.5	
mean	15.0	4.3		

Table 2 — Preteatment Comparative Test 1

X_1: no treatment

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
9.667	9.832	4.014	96.667	101.71	6
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
4	29	25	58	1044	0

X_2: cold-strat

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
6.5	10.075	4.113	101.5	154.998	6
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1	26	25	39	761	0

X_3: heat-strat

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
22	12.744	5.203	162.4	57.926	6
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
9	42	33	132	3716	0

Mean = % germination of all sites and collection dates at final count

Pretreatment Comparative Test 2

Test 1 results revealed that heat-stratified seed might have a higher germination rate than seeds not pretreated. Tests were refined and repeated to examine this more closely, including a third collection date, 5 -'91.

Fifty seeds from each site and each collection date were heat-stratified for seven days at 100 degrees F. day/ 85 degrees F. night — 8 hour days.

Fifty non-stratified seeds from each site and each collection date were put in the growth chamber with pretreated heat-stratified seeds at a constant 70 degrees F. with 8 hours of light per day. Fifty seeds were used for each site and collection date with the assumption of combining all sites and collection dates for a total of 450 seeds per treatment.

Table 3

week 1 — % germination — heat-stratified

	site 1	site 2	site 3	mean	total mean
11-'89	18%	34%	68%	40.0	
6 -'90	44%	42%	50%	45.3	**34.0%**
5 -'91	14%	16%	20%	16.6	
mean	25.3	30.6	46.0		

non-stratified

	site 1	site 2	site 3	mean	total mean
11 -'89	4%	8%	14%	8.6	
6 -'90	6%	16%	16%	12.6	**14.6%**
5 -'91	10%	6%	8%	8.0	
mean	10.0	10.0	12.7		

week 2 — % germination total — heat-stratified

	site 1	site 2	site 3	mean	total mean
11 '89	38%	56%	78%	57.3	
6 -'90	58%	50%	58%	55.3	**48.9%**
5-'91	28%	34%	40%	34.0	
mean	41.3	46.6	58.7		

non-stratified

	site 1	site 2	site 3	mean	total mean
11 '89	14%	32%	28%	24.7	
6 -'90	20%	22%	50%	30.7	**23.8%**
5 -'91	22%	8%	18%	16.0	
mean	18.7	20.7	32.0		

Table 4 — Preteatment Comparative Test 2

X_1: no treatment

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
23.778	12.101	4.034	146.444	50.894	9
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
8	50	42	214	6260	0

X_2: heat-stratified

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
48.889	15.496	5.165	240.111	31.695	9
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
28	78	50	440	23432	0

Mean = % germination of all sites and collection dates at final count

Conclusions

Results from Tables 1 and 3 show that seeds from the earliest collection dates, 11 -'89 and 6 -'90, have remained viable through the final testing date of July 1991. Seeds have been stored in cold-storage prior to testing.

The increased germination rates of Test 2 over Test 1 may be due to a more thorough screening and elimination of empty seed coats before testing. The 6 -'90 seed lot especially had a high percentage of insect damaged and empty seeds which resulted in a very low germination rate in the earlier tests (Table 1).

Results indicate an increase in the germination rates between seeds pretreated with heat and those that received no pretreatment. A pretreatment of cold-stratification had no effect on germination. As Table 3 and 4 indicate, seeds pretreated with heat-stratification had a mean germination rate of 48.9% and seeds non-stratified had a mean germination rate of 23.8%.

The higher germination rate after a pretreatment of heat-stratification indicates the seeds have some dormancy that must be broken for germination to take place. Plants growing in such hot environments, as *Thymophylla*, would be better protected if the seeds did not germinate before the summer. Therefore, the seeds germinate better after they experience the high temperatures of summer. Although seeds will germinate without the heat treatment, the rate was higher after pretreatment.

At this point it is not possible to statistically compare collection dates without a second collection date sometime around October through November. This would give two years data at two collecting times.

A comparison between the three sites seems to indicate that site 3 has the highest germination rate.

We are in the process of consulting with a statistician at the University of Texas to analyze all data to determine if there are significant differences between sites as well as between treatments.

Tetrazolium Tests

Methods

Two hundred seeds had their seed coats sliced longitudinally and the embryos excised from the seed coat. Embryos were then put in petri dishes with .01% TZ solution for five hours at 100 degrees F. TZ testing requires only 200 seeds per test instead of the 400 required for a germination test because of the less dependency on moisture, light and other environmental factors.

Results

completely stained — 20.5%
partially stained — 49.0%
empty seed coats — 30.5%

Conclusions

Examination of the embryos revealed that 20.5% were completely stained and determined viable. The 49.0% that were partially stained went from varying degrees of stain from barely any color to only select parts being stained to all stained only lighter in color. In order to determine if partially stained embryos can be classified as germinable it is important to know facts about the species and the seed parts. According to the Tetrazolium Testing Handbook published by the AOSA, it is important to know the growth habit of the plant in order to determine if significant parts of the embryo that are not stained indicate it is non-germinable. For example, if the entire embryo stains except the radicle in a tap-rooted plant, such as *Thymophylla*, this would indicate non-germinable. However, if the plant has a fibrous root system the unstained radicle would not be significant.

Comparisons of TZ tests with actual germination rates also help determine the percent of partially stained seeds classified as viable. TZ tests often reveal a higher percent of viable seeds than a germination test because the TZ test includes both germinable and dormant seeds. While a germination test shows only germinable seeds. If we compare the final percent germination rate as seen in Table 3 for non-stratified seeds the rate is 23.8% compared with the TZ test of a possible 69.5%. However, if we compare the germination rate for heat-stratified seeds with the TZ test they are much closer, 48.9% compared with 69.5%. The germination test of pretreated heat-stratified seeds gives the percent germination after dormancy has been broken, which is more like a TZ test including germinable and dormant seeds. With the comparison of the two tests, TZ and germination, we can conclude that some of the partially stained seeds are viable and that there is a large number of dormant seed in any given sample.

Seedling Mortality/Survival

Seedling mortality studies are currently being conducted. Seedlings are being grown in native soil in the growth chamber where the temperature can go to 110 degrees F. Seedlings will be given a consistent amount of water throughout the tests as the temperature is gradually raised until seedling mortality reaches 50%. This will determine the LD50.

Extended Studies

Although the contract did not call for further studies beyond seed biology, we have also successfully grown and established *Thymophylla* plants on the grounds at the Wildflower Center and are examining the potential for reseeding. Root samples have also been taken from the native site and have been cleared and stained to reveal mycorrhizal fungi.

ATTACHMENT II

HABITAT DELINEATION

Habitat Delineation for the ashy dogweed (Thymophylla tephroleuca)

Introduction

The ashy dogweed (Thymophylla tephroleuca) is known historically from two sites. The type locality for the species is from Starr County and was collected by Dr. E. U. Clover 8 miles north of Rio Grande City in 1932. This site has never been relocated possibly due to the large number of roads which lead north from Rio Grande City. The other location is 2.3 miles south of the Webb-Zapata County line on Highway 83 in Zapata County. Several thousand plants are found on the highway right-of-way and adjacent ranches. Although the ashy dogweed is easily recognizable particularly when the whitish-gray rounded mounds are covered with bright yellow daisy-like flowers and because the plants tend to occur in groups, sometimes of hundreds of individuals, rather than scattered, single individuals, no new sites have been verified by botanists. When searching for rare plants it is most efficient to develop a habitat profile and then survey identified sites. This study was an attempt to develop such a habitat profile for the ashy dogweed in order to discover more localities and potential introduction sites.

Methodology

Using the known site in Zapata County for the ashy dogweed soils, geology, topography, plant community, and associated species were identified. Potential habitat was then delineated using soil surveys, geologic maps, and topographic maps. It was hoped that color infrared aerial photographs could be used to pinpoint plant community. However the Texas Natural Resource Information System which maintains most of the aerial photography for the state had only one color infrared photograph of the ashy dogweed site. Unfortunately the precise location was covered by clouds. Other photographs could be ordered for a fee, but it was felt that the cost of obtaining photographs which might or might not be helpful was beyond the means of the project.

Sites identified as potential habitat were selected for ground-truthing based on public access. In other words those sites which could be viewed from a public road were chosen as a first cut in case the habitat profile did not seem correct. Also this saves much time contacting landowners and perhaps needlessly worrying them about endangered species. Field work was conducted June 17, 19-21, 1991.

Results

In August 1990 a soil scientist tested the soil at four ashy dogweed sites. At three of these sites the soil was identified as Hebbronville sandy loam. At the fourth site the soil was a variant of the Aguilares series. As only one site was identified as

Aguilares, the soil series is widespread in the western and central Rio Grande Plain, and the soil at the ashy dogweed site was a variant of the regular series, the Aguilares series was not used in the habitat profile. The Hebbronville series is found in the southwestern part of the Rio Grande Plain and is of moderate extent. The series is mapped in the Jim Hogg and Webb County soil surveys. It is not mapped in the soil surveys of Starr, Dimmit, and Zavala Counties. Unfortunately there are many counties in this area of Texas without soil surveys, including Zapata, Duval, Brooks, La Salle, and Frio where Hebbronville soils might occur. The underlying geologic formation at the ashy dogweed site is the Laredo Formation which is composed of Eocene sandstone and clay. This formation runs in a north-south block from beside the Rio Grande in Starr County north through Zapata, Webb, La Salle, Dimmit, Zavala, and Frio Counties where it is bounded by the Frio River.

The ashy dogweed sites are flat to very gently sloping with no particular aspect. The sites are between two minor intermittent drainages, one which runs into the Rio Grande and the other which runs into Dolores Creek, a tributary of the Rio Grande. There are two small hills (actually rock piles) in the midst of the ashy dogweed sites, and scattered boulders or large rocks are found in the immediate area. All sites are within a mile of the Rio Grande.

The plant community at the sites is a relatively open grassland with scattered shrubs. Dominant grass species are Aristida and Bouteloua while ashy dogweed and Heliotropium confertifolium are common herbaceous perennials. Perhaps the most important associate of the ashy dogweed is Yucca constricta. This species is more common on deep sandy soils in Jim Hogg and Brooks Counties, but seems to tolerate sandy loam soils with open grasslands like the ashy dogweed in Zapata County.

Because no highly unusual topographic features were found at the ashy dogweed sites, topography was not relied upon as a precise indicator. As long as the sites were flat or had gentle slopes they were thought to fit the profile. The Laredo Formation covers a large area and seems to support several different plant communities. This and the fact that the historical ashy dogweed location from Starr County does not occur anywhere close to the Laredo Formation led to not using geology as an specific indicator. Geology and historical localities were generally used to define the study area (Starr, Zapata, Jim Hogg, Webb, La Salle, Dimmit, Zavala, and Frio Counties). Soils were then used to further refine the potential habitat. Only Webb and Jim Hogg Counties had published soil surveys with Hebbronville soils (see figures 1 and 2). Sites were selected in these counties by accessibility (i.e., those which could be viewed from public roads). Finally surveyed sites were accepted or rejected by community type and associates. The appendix lists those sites surveyed and the results site by site.

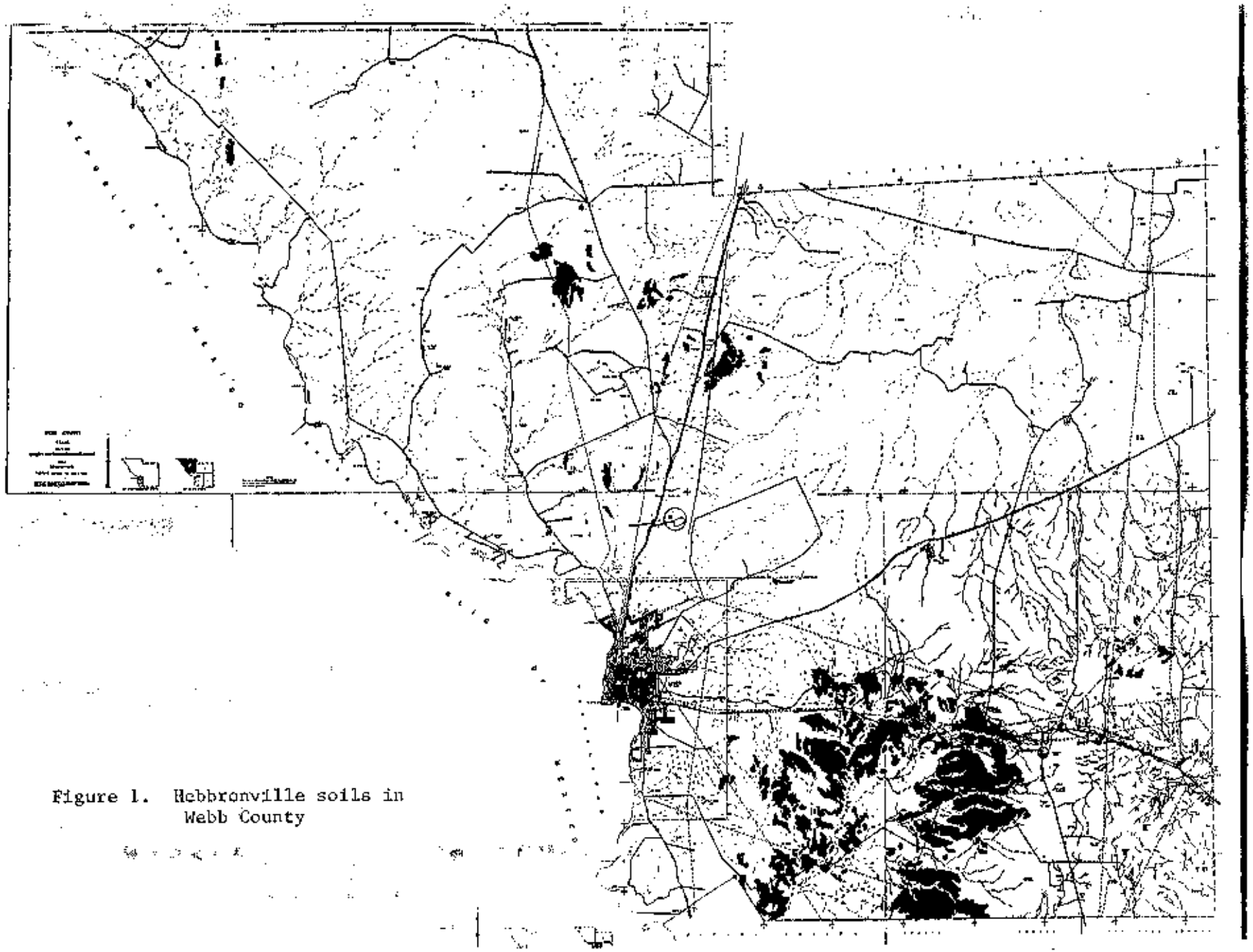

Figure 1. Hebbronville soils in Webb County

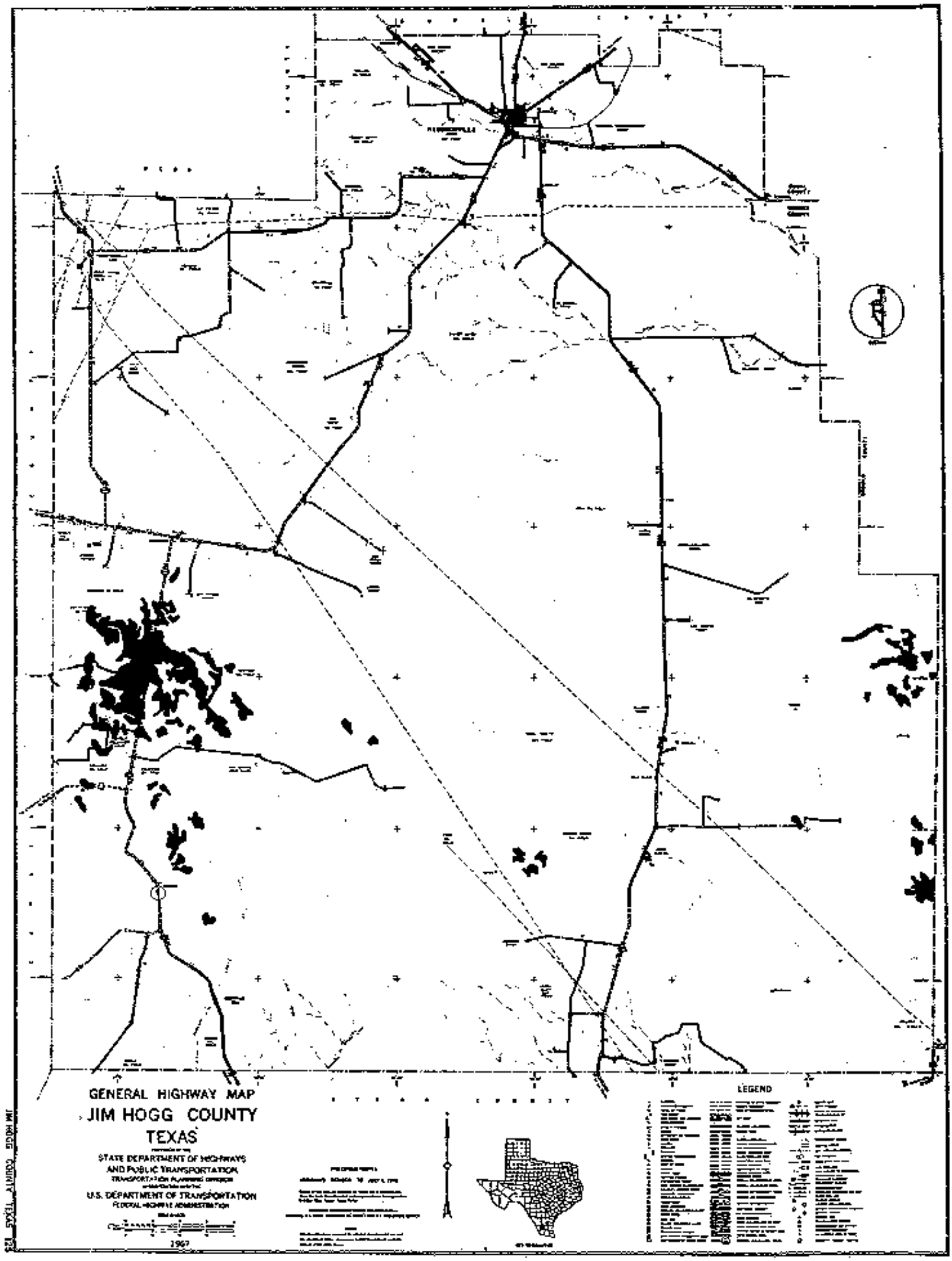

Figure 2. Hebbronville soils in Jim Hogg County

Discussion

The habitat profile developed for the ashy dogweed identified sites as being open grasslands with scattered shrubs on Hebbronville soils (sandy loam) with little to no slope. Common associates were Aristida sp., Bouteloua sp., Heliotropium confertifolium, and Yucca constricta. However using this profile no new sites for ashy dogweed were discovered. All sites were chosen on the basis of presence of Hebbronville soils. In Webb and Jim Hogg Counties, these soils supported mesquite-grasslands or mesquite woodlands which occasionally had been converted into improved pastures or cropland rather than the open grasslands with scattered shrubs like those at the ashy dogweed sites in Zapata County. Also Yucca constricta was not found at any of the sites in Webb and Jim Hogg Counties, and Heliotropium confertifolium was found only at one site in Webb County. Thus soils do not appear to be indicative of ashy dogweed sites. Plant community and associated species seem to be the only indicators of potential ashy dogweed habitat, but specific studies have not been conducted to test this correlation.

Conclusion

So far it is not possible to identify ashy dogweed habitat ex situ, and conclusive studies have not been done on the fidelity of the ashy dogweed and its associated species and plant community. Possibly the plant community (open grassland with scattered shrubs) could be distinguished on color infrared photographs, and the resulting sites field-checked. However there is no certainty that plant community type and associated species would be any better indicators than soil type, geology, or topography. Thus the only way to find ashy dogweed sites is to return to the field and look for the plants themselves.

ACKNOWLEDGEMENTS

The author would like to thank Bill Bergquist for locating and transcribing the Hebbronville soils from the county soil surveys to county maps and for selecting the appropriate topographic maps for these areas.

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APPENDIX

SURVEYED POTENTIAL HABITAT FOR THE ASHY DOGWEED

Southeast along a dirt road (Vaquillas Road according to Webb County Soil Survey) from its junction with the Texas Mexican railroad in Aguilares

Site 1 (1.3-4.05 miles) - fine sandy loam, crusted on top, with scattered caliche; shrub-invaded improved pasture on west side of road, very heavily grazed mesquite shrubland with a few small erratic openings on east side of road; Mirando City 7.5' topographic map; Webb County Soil Survey sheets 86 and 92

Site 2 (4.55-5.35 miles) - fine sandy loam, crusted on top, with scattered caliche; recent second growth mesquite may be hiding improved pasture; no openings; very heavily grazed; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 92

Site 3 (5.55-6.05 miles) - fine sandy loam, crusted on top, with scattered caliche; mesquite shrubland with improved pasture beyond shrub barrier; no openings; very heavily grazed; Heliotropium confertifolium present; Mirando City and Agua Azul Creek East 7.5' topographic maps; Webb County Soil Survey sheets 92 and 93

Aguilares

Site 4 (San Pedro Cemetery and the intersection of Highway 359 and FM 2895) - fine sandy loam somewhat crusted; mesquite shrubland; few scattered openings filled with buffelgrass; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

North along FM 2895 from the intersection of FM 2895 and Highway 359

Site 5 (0.85-1.9 miles) - fine sandy loam somewhat crusted; mesquite shrubland with erratic patches of grass; very heavily grazed; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 6 (2.15-2.5 miles) - fine sandy loam somewhat crusted; herbicided mesquite shrubland with buffelgrass on east side of road, improved buffelgrass pasture on west side of road; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 7 (2.7-3.8 miles) - fine sandy loam somewhat crusted; improved buffelgrass pasture with varying degrees of shrub invasion; Mirando City and Shipp Ranch 7.5' topographic maps; Webb County Soil Survey sheet 86

East along Highway 359 from the intersection of Highway 359 and FM 2895

Site 8 (0.55-1.55 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 9 (1.75-2.2 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 10 (2.5-3.6 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Mirando City 7.5' topographic map; Webb County Soil Survey sheets 86 and 87

Site 11 (3.8-6.5 miles) - fine sandy loam somewhat crusted; either mesquite shrubland invaded by buffelgrass or a shrub-invaded buffelgrass pasture; very heavily grazed; Mirando, City and Oilton 7,5' topographic maps; Webb County Soil Survey sheet 87

Site 12 (6.6-6.8 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Oilton 7.5' topographic map; Webb County Soil Survey sheet 87

Site 13 (10.5-10.9 miles) - farmland and improved pasture; Oilton 7.5' topographic map; Webb County Soil Survey sheet 87

North along the Carolina Road from its junction on Highway 359 between Oilton and Bruni

Site 14 (0.25-0.5 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Oilton 7.5' topographic map; Webb County Soil Survey sheet 87

Site 15 (6.0-6.1 miles) - fine sandy loam somewhat crusted; mesquite shrubland; erratic openings dominated by buffelgrass; very heavily grazed; Mills Bennett Southwest 7.5' topographic map; Webb County Soil Survey sheet 81

Site 16 (6.5-6.7 miles) - light brownish red fine sandy loam; mesquite shrubland; erratic openings; grazed; Mills Bennett Southwest 7.5' topographic map; Webb County Soil Survey sheet 81

East along Highway 359 from its junction with the Carolina Road between Oilton and Bruni

Site 17 (1.65-1.85 miles) - fine sandy loam; mesquite shrubland; erratic openings; heavily grazed; Oilton 7.5' topographic map; Webb County Soil Survey sheet 88

Site 18 (2.05-2.15 miles) - fine sandy loam with heavily grazed mesquite shrubland with erratic openings on north

side of road; very sandy soils dominated by Helianthus petiolaris? on south side of road; Oilton and Bruni 7.5' topographic maps; Webb County Soil Survey sheet 88

North along FM 2050 from its junction with Highway 359 in Bruni

Site 19 (8.7-8.75 and 8.85-8.9 miles) - fine sandy loam; mesquite shrubland with no grass; no openings; very heavily grazed; San Pablo 7.5' topographic map; Webb County Soil Survey sheet 82

East along Highway 359 from its junction with FM 2050 in Bruni

Site 20 (1.3-3.15 miles) - fine sandy loam; mostly improved pasture with various degrees of shrub invasion, very little mesquite shrubland with no grass and few erratic openings; Bruni 7.5' topographic map; Webb County Soil Survey sheet 94

West along Highway 359 from its junction with FM 2895 in Aguilares

Site 21 (0.3-0.4 miles) - fine sandy loam; mesquite shrubland with no openings on south side of road; improved pasture with a few shrubs on north side of road; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 22 (1.7-2.1 miles) - fine sandy loam; improved pasture with scattered shrubs; Mirando City 7.5' topographic map; Webb County Soil Survey sheet 86

Site 23 (2.4-2.5 miles) - fine sandy loam; improved pasture with scattered shrubs; Mirando City and Retama Creek 7.5' topographic maps; Webb County Soil Survey sheet 86

Site 24 (3.2-3.7 miles) - fine sandy loam; improved pasture with scattered shrubs on south side of road; mesquite woodland with scattered openings on north side of road; Retama Creek 7.5' topographic map; Webb County Soil Survey sheet 86

Site 25 (4.5-4.6 miles) - fine sandy loam; closed mesquite shrubland; Retama Creek 7.5' topographic map; Webb County Soil Survey sheets 85 and 86

Site 26 (4.7-6.5 miles) - fine sandy loam; mix of improved pasture with various degrees of shrub invasion, and mesquite shrublands with no to few and scattered openings; Retama Creek 7.5' topographic map; Webb County Soil Survey sheet 85

Site 27 (8.2-8.4 miles) - fine sandy loam; old improved pasture with small mesquites and other shrubs; scattered openings with buffelgrass; Retama Creek 7.5' topographic map; Webb County Soil Survey sheet 85

Site 28 (10.3-10.4 miles) - fine sandy loam; mesquite shrubland; scattered openings; Retama Creek 7.5' topographic map; Webb County Soil Survey sheet 85

Laredo

Site 29 (Casa Blanca Country Club) - golf course, industrial lots, residential development, and extremely disturbed vacant land; Laredo East 7.5' topographic map; Webb County Soil Survey sheet 77

East and south along a dirt road (the Eistetter Road according to Webb County Soil Survey) which is ca. 1.0 miles south of the junction of Highways 20 and 83, and 0.7 miles east on Saltillo Street in Laredo

Site 30 (7.3-7.9 miles) - light-colored sand; mesquite woodland; mostly improved pasture; Laredo South and Blancas Creek North 7.5' topographic maps; Webb County Soil Survey sheet 90

Site 31 (8.1-8.25 miles) - light-colored sand; mesquite woodland; mostly improved pasture; Blancas Creek North 7.5' topographic map; Webb County Soil Survey sheet 90

Site 32 (10.25-11.15 miles) - light-colored fine sand to fine sandy loam; mesquite shrubland with frequent grassy openings; Blancas Creek North 7.5' topographic map; Webb County Soil Survey sheet 90

Site 33 (11.45-11.6 miles at locked gate) - light-colored fine sandy loam; mesquite shrubland; partially improved and heavily grazed; Blancas Creek North 7.5' topographic map; Webb County Soil Survey sheet 90

East and south on a dirt road (Mangana-Hein Road according to Webb County Soil Survey) which is ca. 6.1 miles south of the junction of Highways 20 and 83 in Laredo

Site 34 (10.2-11.0 miles) - sandy loam with some gravel; improved pasture with varying degrees of shrub invasion; Blancas Creek South 7.5' topographic map; Webb County Soil Survey sheet 96

South-southeast along a dirt road (Jennings Road according to Webb County Soil Survey) from its crossing with the Texas-Mexican Railroad in Aguilares

Site 35 (0.25-0.4 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings with patches of grass; grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheet 86

Site 36 (0.6-0.85 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings with patches of grass; grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheet 86

Site 37 (1.1-1.8 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings with patches of grass; grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheets 86 and 92

Site 38 (1.9-2.5 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings with patches of grass; grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheet 92

Site 39 (2.75-3.2 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings with patches of grass; grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheet 92

Site 40 (3.3-4.7 miles) - light beige sand to sandy loam; second growth mesquite shrubland, few erratic openings; heavily grazed; Mirando City East 7.5' topographic map; Webb County Soil Survey sheet 92

Site 41 (5.45-5.75 miles) - beige sandy loam, crusted; probably second growth mesquite shrubland, scattered openings; heavily grazed; Mirando City East and Agua Azul Creek East 7.5' topographic maps; Webb County Soil Survey sheet 92

Site 42 (5.9-7.4 miles) - beige sandy loam, crusted; probably second growth mesquite shrubland, scattered openings; heavily grazed; Agua Azul Creek East 7.5' topographic map; Webb County Soil Survey sheets 92 and 98

Site 43 (9.15-9.7 miles) - beige sandy loam, crusted; second growth mesquite shrubland; formerly improved pasture in various stages of openness; Agua Azul Creek East 7.5' topographic map; Webb County Soil Survey sheet 98

Site 44 (9.8-10.5 miles) - beige sandy loam, crusted; second growth mesquite shrubland with mixed openings invaded by buffelgrass, partially burned; Agua Azul Creek East 7.5' topographic map; Webb County Soil Survey sheet 98

Site 45 (10.85-10.95 miles) - could not find this soil, perhaps it was eroded away; Agua Azul Creek East 7.5' topographic map; Webb County Soil Survey sheets 97 and 98

Site 46 (11.15-13.2 miles) - beige sandy loam, crusted; thick second growth mesquite shrubland hiding improved buffelgrass pasture beyond road; Agua Azul Creek East 7.5' topographic map; Webb County Soil Survey sheets 97 and 102

North-northeast along IH-35 from the junction of IH-35 and Highway 83

Site 47 (5.9-6.15 miles) - beige sandy loam, somewhat crusted; highway right-of-way and improved pasture with shrub invasion; Callaghan Ranch South 7.5' topographic map; Webb County Soil Survey sheet 47

South and east along a dirt road (Callaghan-Lincoln-Nicholson Road according to Webb County Soil Survey) which is 8.4 miles north-northeast of the junction of IH-35 and Highway 83

Site 48 (0.95-1.0 miles) - medium beige sandy loam, hardpacked; highly improved pasture, heavily grazed, but mesquite invasion in one pasture; Callaghan Ranch South 7.5' topographic map; Webb County Soil Survey sheet 39

JIM HOGG COUNTY

South along Highway 649 from the intersection of Highways 16 and 649 near Randado

Site 1 (2.5-2.85 miles) - very soft loose sand; mesquite-buffelgrass shrubland; few openings; Randado 7.5' topographic map; Jim Hogg County Soil Survey sheet 18

Site 2 (2.95-3.2 miles) - very soft loose sand; mesquite-vine mesquite grassland; frequent, scattered openings; Randado 7.5' topographic map; Jim Hogg County Soil Survey sheet 18

Site 3 (3.35-3.5 miles) - very soft loose sand; mesquite woodland; common, scattered openings; Randado 7.5' topographic map; Jim Hogg County Soil Survey sheet 18

Site 4 (3.7-6.2 miles) - very soft loose sand; mesquite woodland; common, scattered openings; improved pasture on east side of road; Randado and Guerra 7.5' topographic maps; Jim Hogg County Soil Survey sheet 18

Site 5 (6.5-7.25 miles) - hard surface over sandy loam; mesquite woodland; infrequent openings; grazed; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

Site 6 (7.4-7.5 miles) - hard surface over sandy loam; mesquite woodland; infrequent openings; grazed on west side and improved pasture on east side; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

Site 7 (7.6-7.85 miles) - very soft loose sand; mesquite woodland; frequent openings; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

West along dirt road from its junction with Highway 649 at mile 7.65

Site 8 (0.2-0.3 miles) - very soft loose sand; mesquite woodland; frequent openings; heavily grazed; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

Site 9 (0.4-0.65 miles) - hard surface over sandy loam; mesquite woodland; frequent to infrequent openings dependent on ownership; grazed; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

Site 10 (0.75-1.15 miles) - hard surface over sandy loam; mesquite woodland; frequent to infrequent openings dependent on ownership; heavily grazed; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23

West along FM 2687 from the intersection of Highway 652 and FM 2687

Site 11 (1.1-1.5 miles) - brownish-red sandy loam; mesquite-blackbrush shrubland; small scattered patchy openings between shrubs; Guerra 7.5' topographic map; Jim Hogg County Soil Survey sheet 23