FINAL REPORT

As Required By

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. E-3-1

Endangered and Threatened Species Conservation

Project No. 50:
Site Characteristics and Management of Johnston's frankenia
(*Frankenia johnstonii*)

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December 15, 1999

FINAL REPORT

State: TEXAS
Grant Number E- 3 - 1
Grant Title: Endangered and Threatened Species Conservation

Project 50:

Site Characteristics and Management of Johnston's frankenia (*Frankenia johnstonii*)

I. Objectives/Segment Objectives:

Develop landowner confidence and public support for the conservation of Johnston's frankenia. Quantitatively determine habitat, plant abundance and distribution of Johnston's frankenia. Examine historical landuse practices and their impact on the species. Experimentally test the effects of certain landuse practices employed on landowner property. Establish a refugium at Southwest Texas State University. Determine phenology. Conduct reproductive biology studies to determine flower, fruit, and seed production. Determine seed viability and germination requirements. Determine pollination syndrome, pollination vector, and pollen viability. Conduct anatomical studies on the leaves, flowers, fruits and seeds of Johnston's frankenia.

II. Summary of Progress:

Project Completed. Summary Attached.

III. Significant Deviations:

1) A refugium for *F. johnstonii* was not established at Southwest Texas State University (explanation attached). Instead, seeds were sent to Desert Botanical Gardens, a Center for Plant Conservation affiliated garden in Phoenix, Arizona. 2) Anatomical studies were conducted on the leaves of *F. johnstonii* only.

IV. Preliminary Findings:

Project Completed. Summary Attached.

V. Costs:

$60,000 for a three-year project (1993-1996); TPWD funded the additional years needed for completion.

VI.

Prepared by: Gena K. Janssen **Date:** December 15, 1999

Approved by: [signature] **Date:** 2-14-2000

CHAPTER 1

The Distribution, Habitat Characteristics, and Anatomical Adaptations of Johnston's frankenia (*Frankenia johnstonii*), an Endangered South Texas Halophytic Subshrub

PART 1: SURVEYS AND LANDOWNER/COMMUNITY OUTREACH

INTRODUCTION

Johnston's frankenia (*Frankenia johnstonii*) FRANKENIACEAE is a low-growing, unarmed, perennial halophytic sub-shrub. Johnston's frankenia was first collected on March 16, 1966, in the northeastern corner of Zapata County, Texas, by Donovan Stewart Correll. On March 17, 1966, Correll also collected this species in Starr County, Texas, just east of El Sauz. Later that same year, Correll named and described "this distinctive species for my friend and college, Marshall C. Johnston, who kindly directed my attention to its uniqueness" (Correll 1966).

In 1973, Dr. Billy Turner, a University of Texas at Austin Botany Professor, collected what he believed to be a new species of *Frankenia* from gypseous soil in north central Mexico (Turner 1973). He named the species *Frankenia leverichii* for a graduate student who accompanied him on his trip to Mexico, Mr. William Richard Leverich (who Turner colorfully described as a "quasi-hippie"). However, in her 1980 doctoral Dissertation on the genus *Frankenia*, Molly Whalen sunk *F. leverichii* into *F. johnstonii*. Whalen (1980) stated that although the plants in Mexico appear reduced in stature (smaller leaves, smaller flowers), she believed the differences to be slight and caused by less favorable growing conditions.

In 1980 Dr. Billy Turner completed the Status Report for *F. johnstonii*, and among other observations concluded that the species was "on its last leg" (Turner 1980).

Johnston's frankenia was listed as an endangered species by the U. S. Fish and Wildlife Service (USFWS) on August 7, 1984 (USFWS 1984). At the time of listing, there were five confirmed populations of *F. johnstonii*: two in Zapata County, Texas; two in Starr County, Texas; and, one along the border of the states of Coahuila and Nuevo Leon, Mexico (the site formerly known as *F. leverichii*). Within the body of the Final Rule to list *F. johnstonii* however, there was reference that the Type Locality (one of the Zapata County sites) could not be relocated despite extensive searches and it was concluded that the site "probably only consisted of a few plants" (USFWS 1984).

Johnston's frankenia was listed as endangered by the state of Texas in January 1987 (Poole and Riskind 1987), and it was not long after that that local Soil Conservation Service representatives and local South Texas landowners began questioning the rarity of *F. johnstonii*. Soon there were tales that *F. johnstonii* was "everywhere" and that it should be taken off of the endangered species list. But there was a problem. All these sites were located on private ranches, and getting the locality data from these ranchers proved to be a little sticky. The local ranchers were too scared to tell USFWS and Texas Parks and Wildlife Department (TPWD) biologists where these sites were, and the USFWS and TPWD could not do anything about the listing status without any new locality data. This was an impasse of Texas proportions. No one was budging.

How do you gain the trust of landowners to allow for endangered species surveys and studies on their private property? In a state that is more than 90% privately owned, cooperation with private landowners and access to private property is essential for gathering status information and biological data on rare plants. Cooperatively, the Texas Parks and Wildlife Department and Southwest Texas State University submitted a proposal for funding in 1993 under Section 6 of the Endangered Species Act to accomplish this very thing.

METHODS AND MATERIALS

Surveys for *F. johnstonii* were conducted from 1993 to the summer of 1995. Soil surveys for Maverick, Dimmit, Webb, Zapata and Starr Counties were reviewed for areas of saline soil that possibly held potential for *F. johnstonii* occurrences. A tremendous amount of time was spent driving roads within the above counties searching for occurrences that may have been visible from the road. If an area of high potential was pinpointed, research was conducted to determine the landowner. Most access to private ranches however, was achieved simply by meeting more and more landowners and asking for permission to survey for *F. johnstonii* on their property. When approached, an overwhelming majority of landowners allowed access to their property for *F. johnstonii* surveys. Although I must admit that they usually did not allow access the first time I asked—it was more like the third or forth time I asked. Many landowners felt more comfortable doing the initial ranch surveys with me. After that, most landowners allowed me unlimited access to the ranch.

Populations were mapped onto 7.5 minute topographic maps with the complete knowledge and assistance from the landowners. Most ranches were surveyed over and over again to make sure a thorough survey had been completed for each ranch. Multiple surveys usually revealed multiple *F. johnstonii* occurrences. Populations of *F. johnstonii* were hiked on foot to determine the extent of each population. Population boundaries were drawn as accurately as possible onto the 7.5 minute topographic maps. Area covered by the populations was calculated using an English Area Grid (Forestry Suppliers, Inc. 1977) overlay atop the 7.5 minute topos and calculating acres using the conversion factor for 1:24,000 scale maps. Numbers of individuals were counted within some of the first populations to be discovered. Using three or four people side by side, we would sweep through the population counting number of individuals. The number counted was usually double the number estimated upon first discovery. Carr (1995) also found this to be true. Getting multiple people at each *F. johnstonii* population for accurate counts soon proved to be impossible, so population numbers were then estimated.

As more and more *F. johnstonii* occurrences were uncovered, we had to standardize what we considered a "population". It was decided that all clumps or occurrences of *F. johnstonii* that were less than a mile apart from one another would be considered one population while any occurrence greater than a mile from another would be considered a separate population. Therefore, a population could be a single clump or occurrence of

plants, or it could be made up of several clumps that cover several miles. Since genetic analysis was not a part of this project, we have no way of actually knowing the extent of gene flow; and, therefore the true boundaries of a "population". In the meantime, for the sake of consistency and standardization, all clumps within a mile of one another will be referred to as *sub-populations* that make up the larger *populations*.

Specific soil types were identified at each *F. johnstonii* locality using U. S. Department of Agriculture, Soil Conservation Service, County Soil Survey books (or sheets if detailed books were not available).

Underlying site geology was determined using the Bureau of Economic Geology, Geologic Atlas of Texas.

Efforts to develop landowner confidence and public support for *F. johnstonii* were conducted simultaneously during the survey work. Many community outreach projects were created and implemented to familiarize ranchers and local county residents with the endangered *F. johnstonii*. These projects included but were not limited to: articles in the local newspapers; development of an *F. johnstonii* fact sheet and color picture pages to hand out the landowners and other interested individuals; an endangered species booth at the Zapata County Fair for three years running; assisting the Zapata Middle School Gifted and Talented 6th graders to create an endangered plant County Fair Project; presentations to local elementary school kids in Webb and Zapata Counties (especially on Earth Day); creating a six day Conservation Camp for kids (along with an Americorp Volunteer working for the Zapata County Agricultural Extension Office) which was held at the Zapata County Library; magazine articles, along with many meetings with local Soil and Water Boards, local District Conservationists, other conservation professionals, and, of course, landowners (see Appendix A).

Establishing amicable working relationships with local Natural Resource Conservation Service District Conservationists and local Soil and Water Board members proved to be the most helpful to achieve the goals of this project. Their knowledge of the landscape and local landowners was invaluable. Although I must admit that no one ever came out and told me where to go or who to call, they all supported me, even if sometimes it was only to say "Good luck" as I walked out the door with the same amount of information that I walked in with.

More than any one thing, I just talked (and talked and talked) with ranchers. I got to know them, and I let them get to know me. What an adventure (see Appendix B, Janssen and Williamson 1996)! I also spent a lot of time trying to get to know the local people. From Game Wardens to bankers to newspaper editors to gagers to wildlife rescue operators to restaurant owners to City Council members to local gas company employees to ranchers to shiftless nomads—I had the pleasure of meeting and befriending the most unique, interesting, and genuine people that I have ever encountered. This project was nothing more than a pleasure trip (although some days I was challenged to find the actual pleasure).

In May of 1995, a landowner meeting was held at the Zapata County Library. We discussed the conservation needs of *F. johnstonii* and contemplated what it would take to get *F. johnstonii* delisted. After much discussion, many landowners agreed that the concept of a voluntary Conservation Agreement was interesting and worth pursuing further. After the meeting, a draft voluntary Conservation Agreement was written with the assistance of the former Zapata County District Conservationist and some Zapata County Soil and Water Board members (see Appendix C).

RESULTS AND DISCUSSION

The current total of verified *F. johnstonii* occurrences in Texas and Mexico is 62.

A total of 58 populations of *F. johnstonii* have now been verified for the State of Texas, in Webb, Zapata and Starr Counties (see Figure A). Many of these populations are quite extensive. While all 58 occur primarily on private land, portions of three sites belong to the federal government, and a portion of one belongs to Texas Department of Transportation. Seven sites are known from Webb County (Labeled 1 – 7); 35 sites are known from Zapata County (Labeled 8 – 42); and, 16 are known from Starr County (Labeled 43 – 58).

Since continued surveys revealed more and more clumps of plants, the "1 mile" standardization regarding the mapping of populations began to weaken. As more clumps or sub-populations were uncovered, populations slowly began to morph together. Therefore, within the body of this report there are areas containing populations of plants that may be closer than a mile.

Currently 19 populations are being protected by private landowners who have signed voluntary Conservation Agreements with Texas Parks and Wildlife. Many other landowners have promised to sign their agreements but have yet to actually follow through.

Additionally, there are currently four known sites for *F. johnstonii* in neighboring Mexico (Labeled M1 – M4) (see Figure B). One site occurs in the state of Tamaulipas; one along the border of the states of Coahuila and Nuevo Leon; and the two remaining sites are located within the state of Nuevo Leon.

Frankenia johnstonii has a restricted geographic range, but it is locally abundant in specific habitats. Although Turner (1980) stated that *F. johnstonii* populations are small with the number of individuals ranging from three to about 500, this study refutes his report. I personally have never found a population of *F. johnstonii* consisting of only three individuals. Moreover, I have found that 500 is about the average number of individuals found at a particular population or sub-population. The smallest population or sub-population of *F. johnstonii* located during this study was composed of approximately 50 individuals while the largest populations located contain literally hundreds of thousands of individuals.

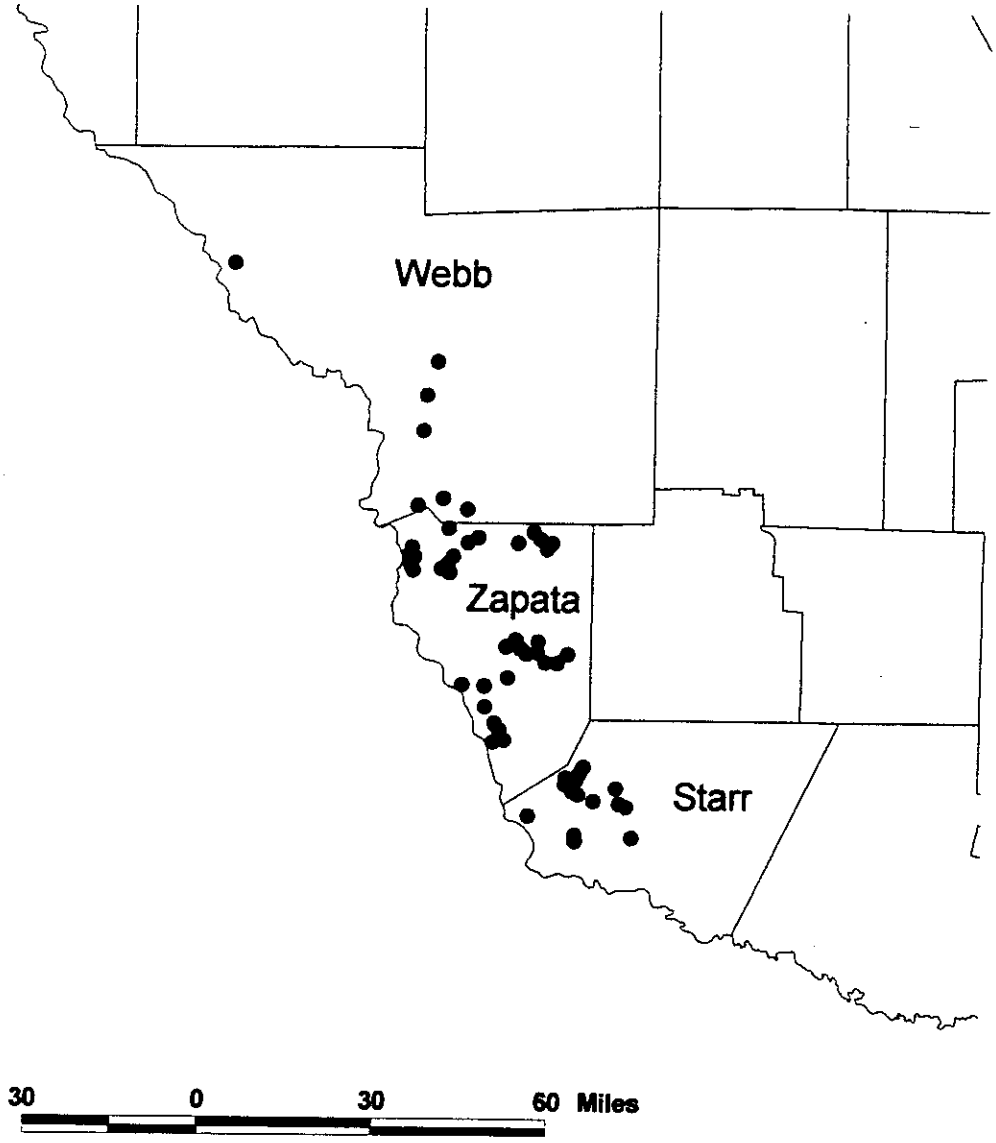

Figure A: Distribution of Johnston Frankenia in South Texas

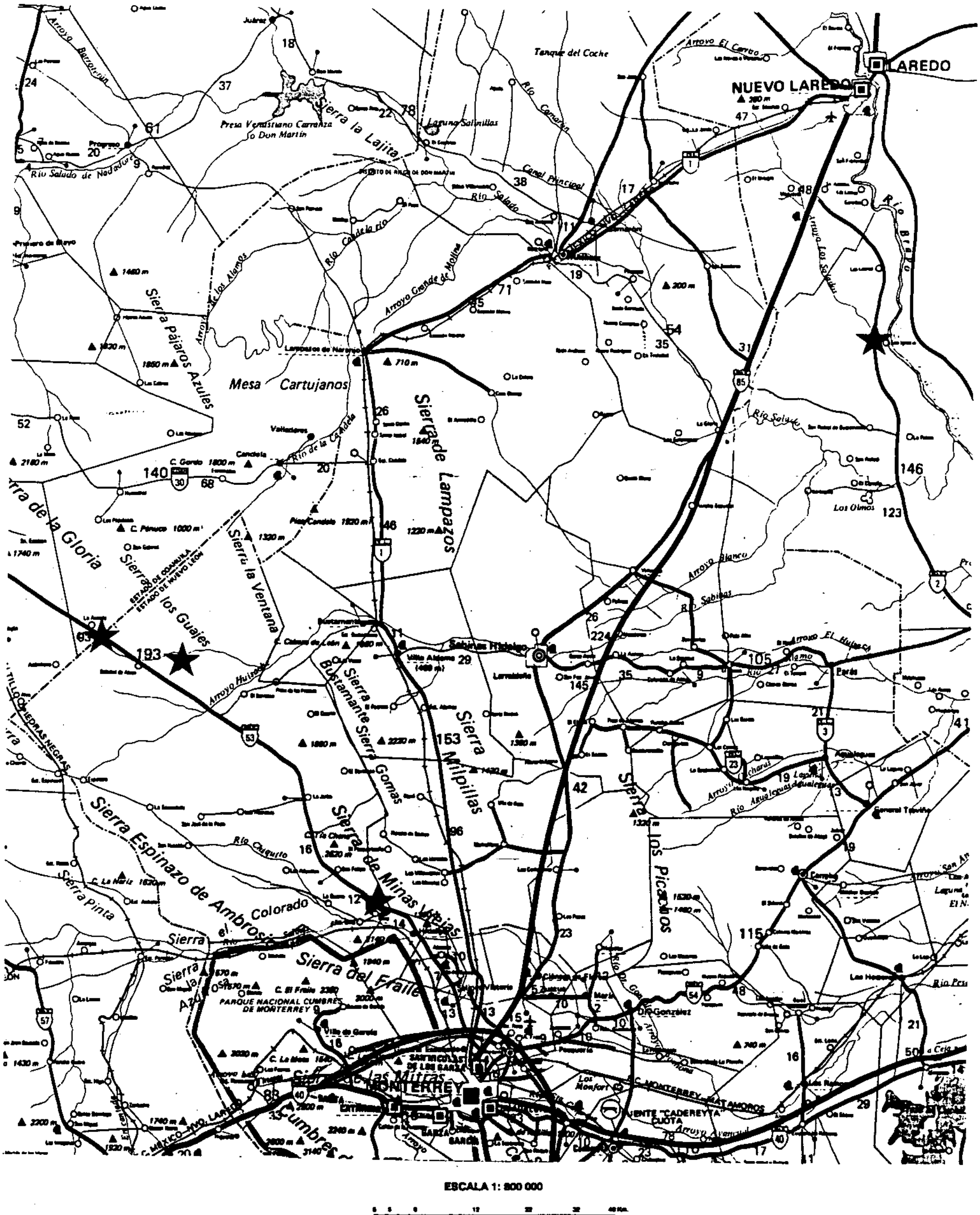

Figure B. Distribution of Johnston's frankenia (*Frankenia johnstonii*) in Mexico.

Both Turner (1980) and the USFWS (1984) made reference to *F. johnstonii* populations occurring on private lands subjected to heavy grazing and that all plants had a "hedged or clipped appearance as is common in plants which have been grazed by cattle". Since these statements were all based on casual field observations, I will also share my observations. I have observed populations on ranches with cattle and without cattle and have found little, if any, difference in appearance. Population 9 for example, has always stocked cattle and that site is one of the most phenomenal sites that I have ever seen. Populations 13, 16, and 17 took the cattle off years ago and although all the plants are in good to excellent condition, they look no different than those found on other ranches that do a good job managing their cattle. I have personally seen cotton-tailed rabbits and jackrabbits nibbling on *F. johnstonii* individuals. I have never seen any other native mammal (e. g. white-tailed deer) browse of *F. johnstonii* individuals, but I believe that it probably occurs. Native mammal browsing can cause the clipped or hedged appearance, but I question this sort of neatness in a cow.

Conversely, I have seen two sites that I believe are so poorly managed that any thing can be eating the *F. johnstonii*: 1) Population 27, sub-population (*e*); and 2) Population 53, eastern portion. Population 27(e) is by far the worst case of browsing/grazing on *F. johnstonii* individuals. Many of the plants within this sub-population have been eaten down to virtual nubs, but miraculously they are all still alive. The eastern portion of Population 53 is simply an example of a very poor range site that is very poorly managed.

After years of observing *F. johnstonii* on private ranches, I have concluded that cattle grazing is not a direct threat to *F. johnstonii*. Some management practices that are utilized by cattle ranches are, however, detrimental to *F. johnstonii* in the short term. Clearing in the form of bulldozing or root-plowing does eliminate *F. johnstonii* from the landscape. However, I have found that *F. johnstonii* is capable of revegetating these areas within five to 10 years. I have personally observed plants growing in a six year, 10 year and 15 year old root-plows. Today, private landowners are much more savvy about land management. In the past few years there has been a real change in attitude regarding land clearing and ranch management. Many of the landowners that I have worked with are making a big effort to re-establish the brush, manage for wildlife, and look at hunters as more of an income source rather than relying solely on cattle. Of course, there will always be the diehard cattlemen.

What I believe *F. johnstonii* has no chance of recovering from is the complete destruction or landuse change at a given population site. These sorts of activities include the establishment of a new gas well pad site on an *F. johnstonii* population, coal mining, and urbanization.

Support from landowners and other South Texas community members for this project has been overwhelming. The Association of Texas Soil and Water Conservation Districts actually passed a resolution in support of this project (see Appendix D). We have all worked together to get this place that we are today. Johnston's frankenia was listed as an endangered species in 1984 based on the best biological data at that time. I'm sure that

some may argue that *F. johnstonii* should have never been listed in the first place (myself included); however, to base the delisting of this species on that point alone would be to completely disregard the contribution that many private landowners and others have made to our knowledge of the true distribution and status of this species. This report is the result of their trust, communication, and cooperation.

Survey results and population details are as follows:

Maverick and Dimmit Counties, Texas

Surveys were conducted in both Maverick and Dimmit Counties with negative results. Although soils and habitat characteristics were similar to those of known sites for *F. johnstonii* in Webb and Zapata Counties, no populations were found. Additionally, interviews and visits with local Natural Resource Conservation Service representatives and local Texas Parks and Wildlife Technical Guidance Biologists found that no one had ever encountered *F. johnstonii* in these two counties.

Webb County, Texas

To date, there are a total of seven confirmed populations of Johnston's frankenia *(Frankenia johnstonii)* in Webb County, Texas. All populations occur on private land. Three of these populations are being voluntarily protected by a private landowner who has signed a Conservation Agreement with Texas Parks and Wildlife. An Agreement for one additional population has been promised, but is still pending.

Each of these sites occur within soils mapped as the Maverick-Catarina complex (see Table 1). Six of the sites are underlain by the Yegua geologic formation, and one is underlain by the El Pico Clay geologic formation.

Table 1. Soils and Geology for the verified Webb County *Frankenia johnstonii* populations.

Webb County Population #	Topographic Quadrangle	Soil Name	Geologic Formation
1	Pinto Creek	Maverick-Catarina complex	El Pico Clay
2	Cibolo Ranch	Maverick-Catarina complex	Yegua
3	Laredo East & Tios Creek	Maverick-Catarina complex	Yegua
4	Laredo South & Blancas Creek N.	Maverick-Catarina complex	Yegua
5	Blancas Creek South	Maverick-Catarina complex	Yegua
6	Blancas Creek	Maverick-Catarina	Yegua

	South	complex	
7	O'Keefe Lake	Maverick-Catarina complex	Yegua

Webb County Soils

According to Sanders and Gabriel (1985) the Maverick-Catarina complex soils are gently rolling, moderately deep, and deep soils on hills and in narrow valleys. This soil complex is 55 to 70 percent Maverick and similar soils, and 20 to 40 percent Catarina soil. The Maverick soil is on the summit and side slopes of hills. The slopes range from three to 10 percent. The Catarina soil is in the narrow valleys and on foot slopes of hills. Slopes are less than two percent. The areas of the Maverick-Catarina complex within Webb County range from 20 acres to several thousand acres in size. Both the Maverick and the Catarina soils are grayish brown saline clays (and shaly clays) that are calcareous and moderately alkaline throughout.

These soils (Sanders and Gabriel 1985) are used mostly as rangeland and as habitat for wildlife. Forage yields for cattle are medium. Under normal conditions, the native vegetation provided adequate food and cover for wildlife, including deer, javelina, and quail. The carrying capacity of these soils, however, is lower than that of the more productive surrounding soils. These soils are not suited for cropland due to salinity, very low available water capacity, the high content of exchangeable sodium, and the hazard of water erosion. These soils are also poorly suited for urban uses because of the clayey texture, hazard of flooding, and the shrinking and swelling.

Webb County Geology

According to Brown et al. (1976), the El Pico Clay is Eocene Age, and is composed of clay, sandstone, and coal (mostly clay). The clay portion being in part gypsiferous, and medium gray to brown in color. The sandstone portion being mostly fine grained, some medium to coarse, argillaceous, silty, in part glauconitic, gray to brown in color, thin bedded to massive, and friable to indurated. Aphanitic septarian concretions are common.

The Yegua formation (Brown et al., 1976) is Eocene Age, and is composed of clay and sandstone (mostly clay). This formation is lignitic, sandy, bentonitic, and mostly well laminated. It is chocolate brown to reddish brown in color with lighter colors upward, producing dark gray soil. There is sandstone, quartz, and some chert described as fine grained, friable, calcareous, glauconitic, and weathers to loose, ferruginous, yellow orange and reddish brown soil. There is some fossil wood.

Webb County Site Descriptions

Population 1: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Pinto Creek 7.5 minute topographic quadrangle.

Site Name:	The Galvan Ranch, River Pasture
Ownership:	Ed Rachal Foundation
Voucher:	Janssen & Williamson # 0523
Number of individuals:	~ 10,100
Area Covered:	~ 50 acres
Soils:	Maverick-Catarina complex
Geology:	El Pico Clay
Conservation Agreement:	Pending
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.3 moderately alkaline	1 ppm very low	30005 ppm very high	610 ppm high	9100 ppm very high	3520 ppm very high	Clay

Population 1 is located on a large private ranch in Webb County northwest of Laredo (see Figure 1). Population 1 is located west of the Mines Road in the River Pasture. This population consists of two sub-populations. The first sub-population contains approximately 10,000 or more individuals, and traverses the fence line of the River Pasture onto the adjacent Treviño Ranch. This site is a massive eroding hillside. Although some plants are on the top and the side of the hills, the majority of the plants are in the lower wash area of the hillside. The second sub-population is 4/10ths of a mile southwest of the larger one, and consists of approximately 100 or more individuals. This site is simply a non-eroding, saline opening within the brush. The total population area is approximately 50 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), broomrape (*Orobanche multiflora*), purple ground cherry (*Physalis lobata*), parralena (*Thymophylla pentachaeta*), candelilla (*Euphorbia antisyphilitica*), ephedra (*Ephedra antisyphilitica*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., creosote bush (*Larrea tridentata*), Texas kidneywood (*Eysenhardtia texana*), dutchman's breeches (*Thamnosma texana*), blackbrush (*Acacia rigidula*), squaw-bush (*Condalia spathulata*), calderona (*Krameria ramosissima*), guajillo (*Acacia berlandieri*), lotebush (*Ziziphus obtusifolia*), goat bush (*Castela texana*), dog's ear (*Tiquilia canescens*), guayacan (*Guaiacum angustifolium*), prickly pear cactus (*Opuntia engelmanii*), and Spanish dagger (*Yucca treculeana*).

Population 1 is in good condition, and the plants are large with no significant browse or grazing pressure noticeable. There is active coal mining taking place all around this area, however. Farco Mines (now owned by Chevron) is aware of the population and has promised to avoid it [contact person: David Wadsack, Mine Engineer, (956) 727-2354]. There have been very good about calling for a survey every time they open up a new permit area.

Mr. Paul Altide, CEO of the Ed Rachal Foundation, is aware of the endangered Johnston's frankenia, and has promised to sign a conservation agreement numerous times. However, to date, one still has not been signed. This could surely be accomplished with a face to face meeting with Mr. Altide.

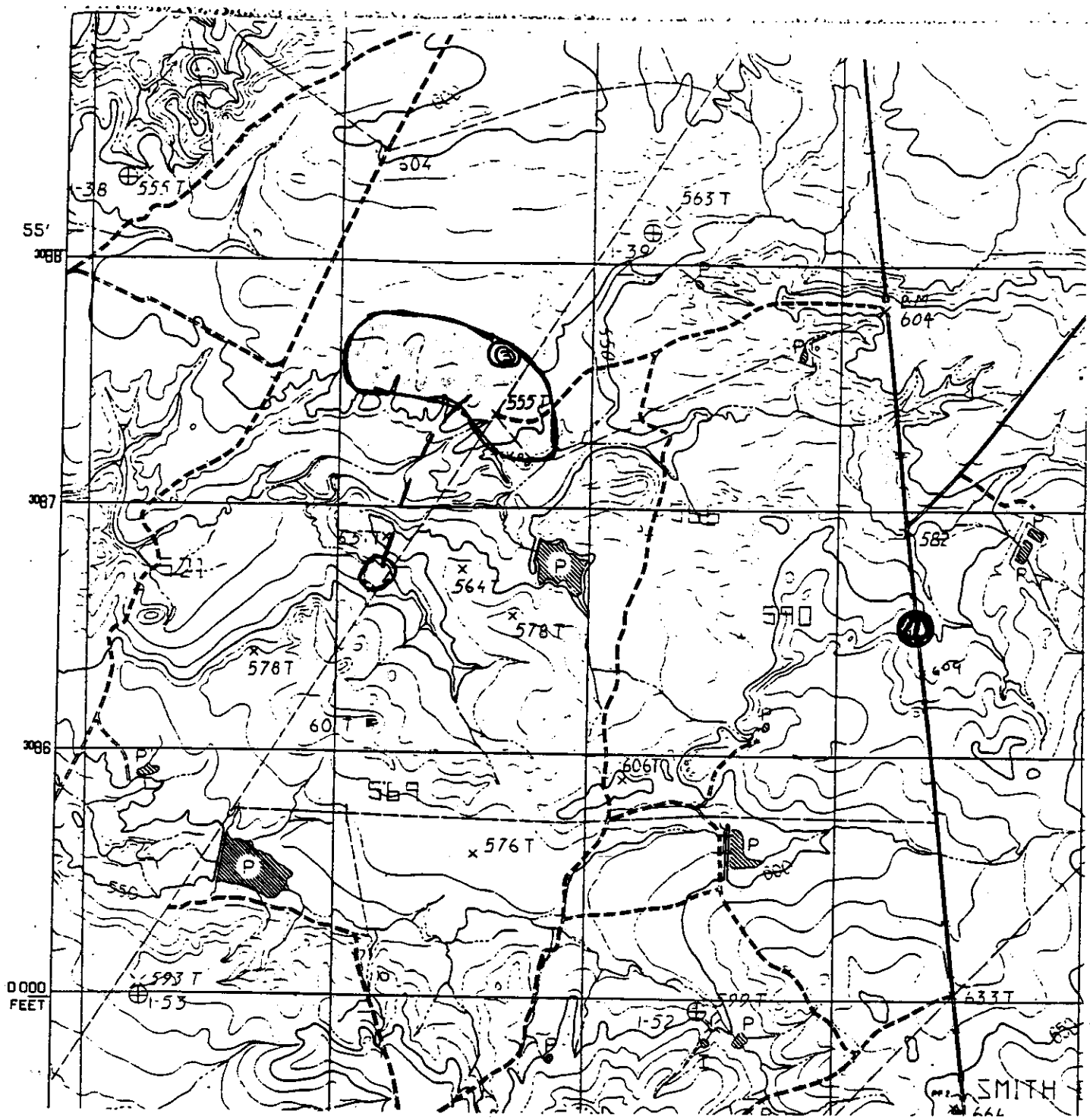

Figure 1. Population 1: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Pinto Creek 7.5 minute topographic quadrangle.

Population 2: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Cibolo Ranch 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 5,000
Area Covered:	~ 30 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Secure
Soil Sample Results:	Not collected

Population 2 is located on a large private ranch in Webb County northeast of Laredo (see Figure 2). This landowner prefers that the exact locality of this site be confidential, and identified only to topographic map.

This population is situated on a small eroding hillside, and consists of approximately 5,000 or more individuals. Total population area is approximately 30 acres. Population 2 is in good condition. The plants are large and vigorous, with no significant browse or grazing pressure noted.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *mesquite (Prosopis glandulosa*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), South Texas fishhook *(Ancistrocactus sheeri*), horse crippler (*Ferocactus setispinus*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush *(Ziziphus obtusifolia*).

Although the landowner always allows access and has granted permission for annual photo-monitoring of his populations, he is leery of endangered species in general and refuses to sign anything. He requested that his name be kept confidential.

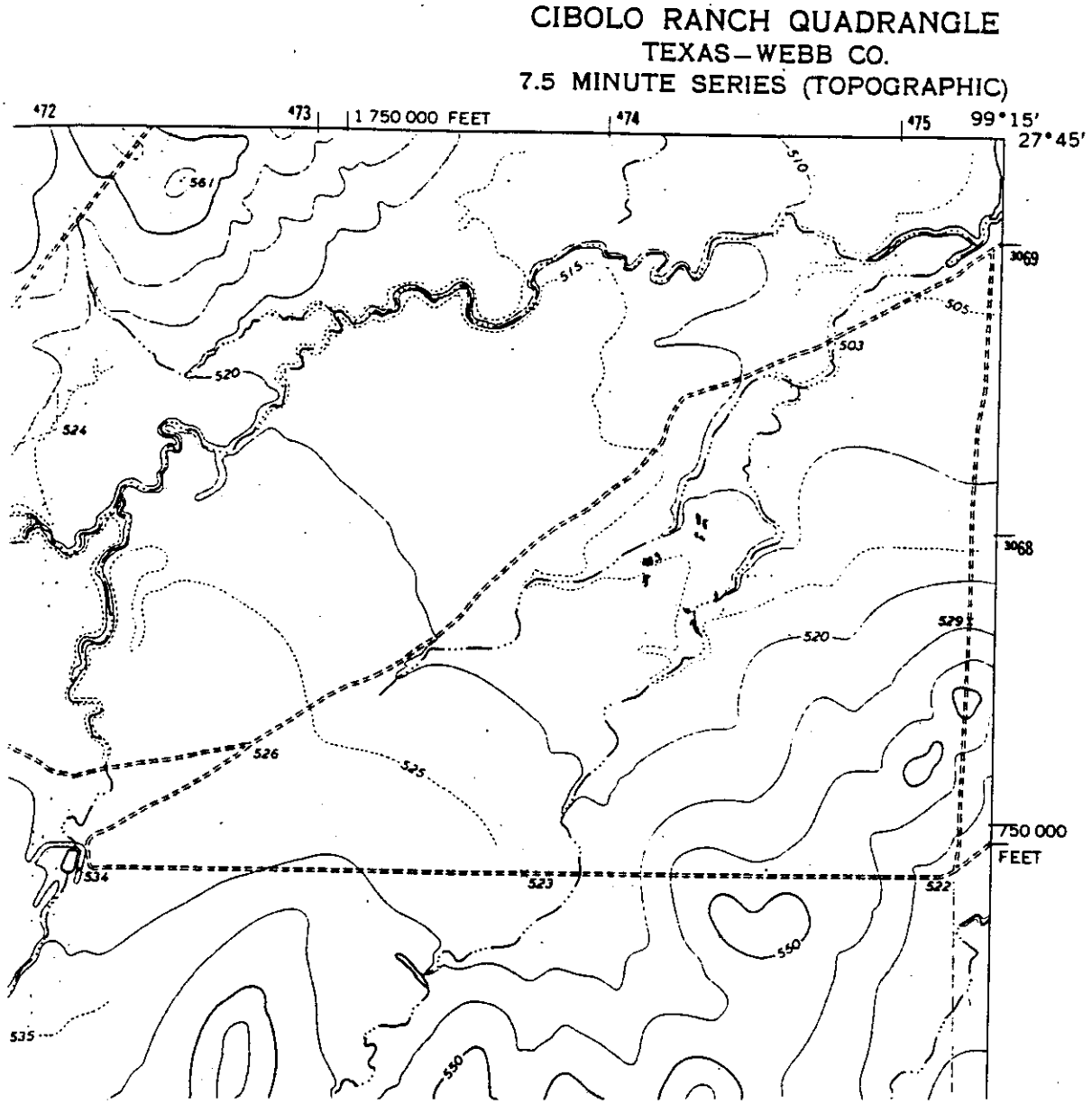

Figure 2. Population 2: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Cibolo Ranch 7.5 minute topographic quadrangle. The landowner prefers that the locality be recorded generally to topographic map.

Population 3: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on both the Laredo East and Tios Creek 7.5 minute topographic quadrangles.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Janssen & Williamson # 0535
Number of individuals:	~ 5,000
Area Covered:	~ 100 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.5 strongly alkaline	3 ppm very low	30047 ppm very high	489 ppm high	5850 ppm very high	33438 ppm very high	Clay

Population 3 occurs on a large private ranch in Webb County east of Laredo (see Figure 3). This landowner prefers that the exact locality of this site be confidential, and identified only to topographic map.

This site is situated on a saline flat opening within the brush, and consists of 5,000 or more scattered individuals. Total population area is approximately 100 acres. Population 3 is in fair condition. It appears as though the site may have been root-plowed in the past. Some plants are large and vigorous, while others are small and spindly. Some browse or grazing pressure was noted.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., parralena (*Thymophylla pentachaeta*), leatherstem (*Jatropha dioica*), prickly pear cactus (*Opuntia engelmanii*), screw bean mesquite (*Prosopis reptans*), armed salt bush (*Atriplex acanthocarpa*), *mesquite (Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), dog's ear (*Tiquilia canescens*), pencil cactus (*Opuntia leptocaulis*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), South Texas fishhook (*Ancistrocactus sheeri*), Tom Thumb cactus (*Mammalaria roberti*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), creosote bush (*Larrea tridentata*), coma (*Bumelia celastrina*), guayacan (*Guaiacum angustifolium*), allthorn (*Koeberlinia spinosa*), and lotebush (*Ziziphus obtusifolia*).

Although the landowner (same as Population 2 above) always allows access and has granted permission for annual photo-monitoring of his populations, he is leery of endangered species in general and refuses to sign anything. He requested that his name be kept confidential.

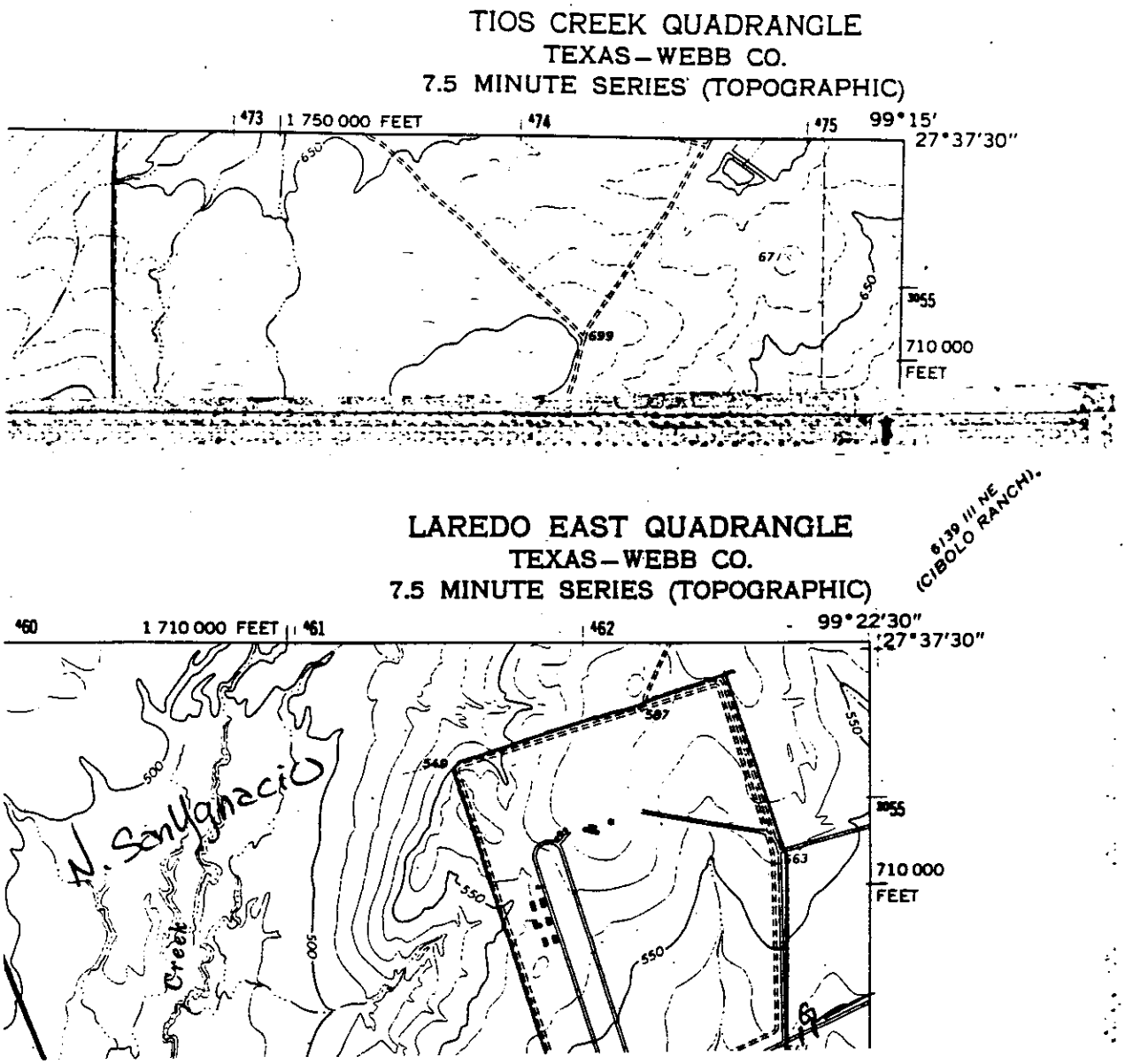

Figure 3. Population 3: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on both the Laredo East and Tios Creek 7.5 minute topographic quadrangles. The landowner prefers that the locality be recorded generally to topographic map.

Population 4: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on both the Laredo South and Blancas Creek North 7.5 minute topographic quadrangles.

Site Name:	The Tonquesitos Colonia (or more affectionately known as "The Dump")
Ownership:	Many 5-acre ranchettes with various owners
Voucher:	Janssen & Williamson # 0502
Number of individuals:	~ 2,500
Area Covered:	~ 50 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Grim to Doomed

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.9 strongly alkaline	3 ppm very low	18733 ppm very high	537 ppm high	2470 ppm high	3808 ppm very high	Sandy Clay

Population 4 occurs primarily on the small rocky hillsides within an undeveloped block of the Tonquesitos Colonia (see Figure 4) which is just north of Hwy 359 heading east out of Laredo. Plants are scattered and clumped throughout this area, and number at least 2,500 or more. The total area covered by this population is approximately 50 acres.

Although the plants that occur at this site are large and vigorous and appear to be in good condition, the site itself is in a poor state. It is currently used as a dump and contains everything from old televisions to mattresses to large animal bones.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), yellow show (*Amoreuxia wrightii*), *Euphorbia* sp., common goldenweed (*Isocoma coronopifolia*), squaw bush (*Condalia spathulata*), Turner's sida (*Billieturnera helleri*), broomrape (*Orobanche multiflora*), ephedra (*Ephedra antisyphilitica*), screw bean mesquite (*Prosopis reptans*), *mesquite (Prosopis glandulosa*), tetramerium (*Tetramerium platystegium*), purple ground cherry (*Physalis lobata*), desert olive (*Forestieria angustifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), shoregrass (*Monanthochloe littoralis*), orange zexmenia (*Wedelia hispida*), desert lantana (*Lantana macropoda*), granjeno (*Celtis pallida*), coyotillo (*Karwinskia humboldtiana*), cenizo (*Leucophyllum frutescens*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), alicoche (*Echinocereus* sp.), nipple cactus (*Mammalaria heyderi*), Tom Thumb cactus (*Mammalaria roberti*), yellow dumpling cactus (*Mammalaria sphaerica*), South Texas fishhook *(Ancistrocactus sheeri*), horse crippler (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), snake-

eyes (*Phaulothamnus spinescens*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

DeAnda Real Estate sold off property in this colonia in 5-acre ranchette parcels. There are many owners of this site, some local Laredo residents, others as far away as Indiana. Many of them are still making monthly payments to the DeAnda's. Although this site appears to be doomed, there may be some hope. A local city councilman, Louis Bruni, once offered to buy the site for conservation purposes, and make it into a park. He may still be willing to do this. It is a great place for a park, and according to the Webb County Planner, Webb County does have a green space requirement. It would take a lot of work to get the site cleaned up, but I believe it would clean up well. It could be a pretty little place if the right people in Laredo got together to make it happen. I am quite fond of this site for some crazy reason, and I don't want to see it go. Keep this site in mind if there is ever any need for a mitigation site.

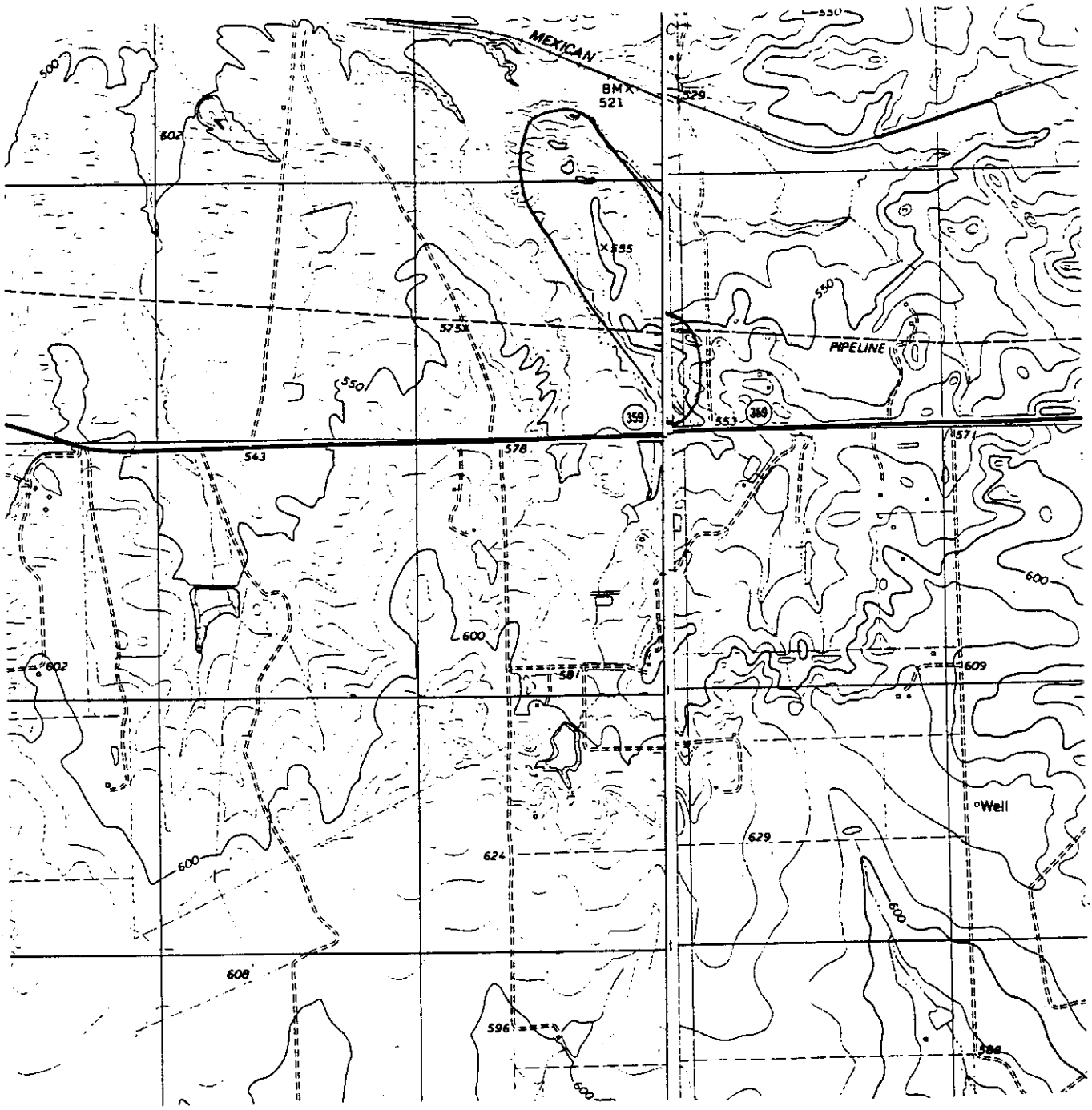

Figure 4. Population 4: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on both the Laredo South and Blancas Creek North 7.5 minute topographic quadrangles.

Population 5: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Site Name:	The Alexander Estate and The San Antonio Ranch, Capones Pasture
Ownership:	Confidential and J. C. Martin
Voucher:	Janssen & Williamson # 0663
Number of individuals:	Hundreds of thousands
Area Covered:	~ 300 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	Yes, for the San Antonio Ranch No, for the Alexander Estate
Population Future:	Secure on The San Antonio Ranch Questionable to Grim for the Alexander Estate
Soil Sample Results:	Not collected

Population 5 occurs on two private ranches in Webb County just off of Mangana-Hein Road, southeast of Laredo (see Figure 5). This site is a large, continuous population on the Alexander Estate to the west and the San Antonio Ranch to the east. There are hundreds of thousands of individuals within this population, which is approximately 1.3 miles long, and covers approximately 300 total acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), *mesquite (Prosopis glandulosa*), creosote bush (*Larrea tridentata*), desert olive (*Forestieria angustifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), yellow dumpling cactus (*Mammalaria sphaerica*), South Texas fishhook *(Ancistrocactus sheeri*), dog cholla (Opuntia schottii), horse crippler (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush *(Ziziphus obtusifolia*).

The majority of the population occurs on the San Antonio Ranch. This area is a vast expanse of rocky eroding hills that are a part of the Dolores Creek watershed. The individuals on this ranch are large and vigorous, and in good condition. Both landowners are aware that they have the endangered Johnston's frankenia. Mr. Martin, owner of the San Antonio Ranch has signed his conservation agreement and is happy to help with conserving it. [He is also aware that he has two populations of the endangered ashy dogweed (*Thymophylla tephroleuca*).] If there are any plants or animals that are still alive on the Alexander Estate it is only by the grace of God. The property has been root-plowed continuously over the years, yet some pockets of Johnston's frankenia seem to hang on (and the ashy dogweed keeps regenerating). Although I have spoken with the

owners of the Alexander Estate on numerous occasions regarding the occurrence of both the endangered Johnston's frankenia and ashy dogweed on the property, the annual root plowing continues. I do not foresee the management on the Alexander Estate changing any time soon.

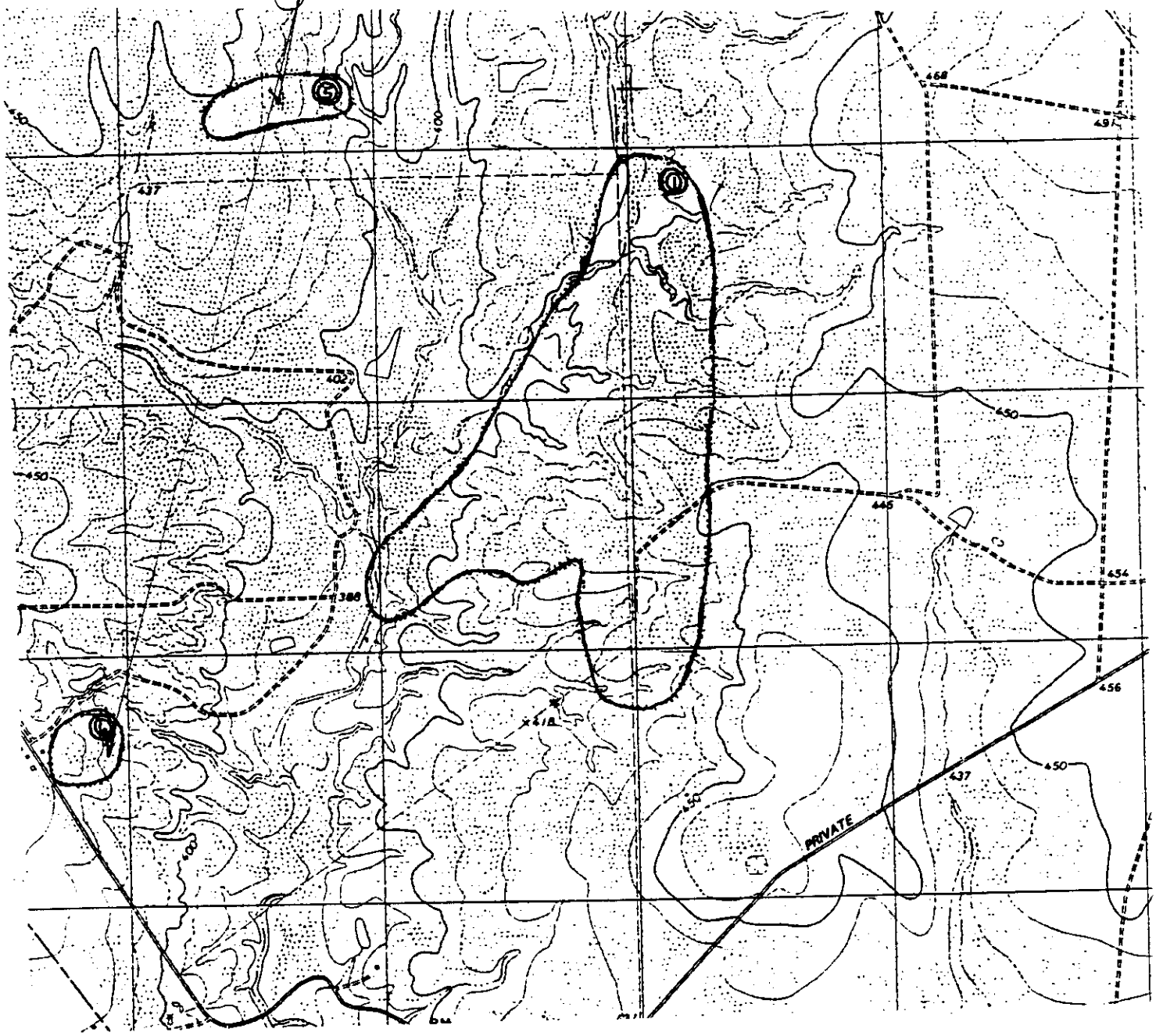

Figure 5. Population 5: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Population 6: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Site Name:	The San Antonio Ranch, Capones Pasture
Ownership:	J. C. Martin
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 5 to 10 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	Yes
Population Future:	Secure
Soil Sample Results:	Not collected

Population 6 occurs on a large private ranch in Webb County just off of Mangana-Hein Road, southeast of Laredo (see Figure 6). This site is a small rocky hillside that occurs near El Jaral Creek. This population contains approximately 500 or more individuals, and covers approximately 5 to 10 acres. Plants are in good condition. The landowner is aware of the species and has signed a voluntary Conservation Agreement with Texas Parks and Wildlife agreeing to protect them.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), *mesquite (Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), South Texas fishhook (*Ancistrocactus sheeri*), horse crippler (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

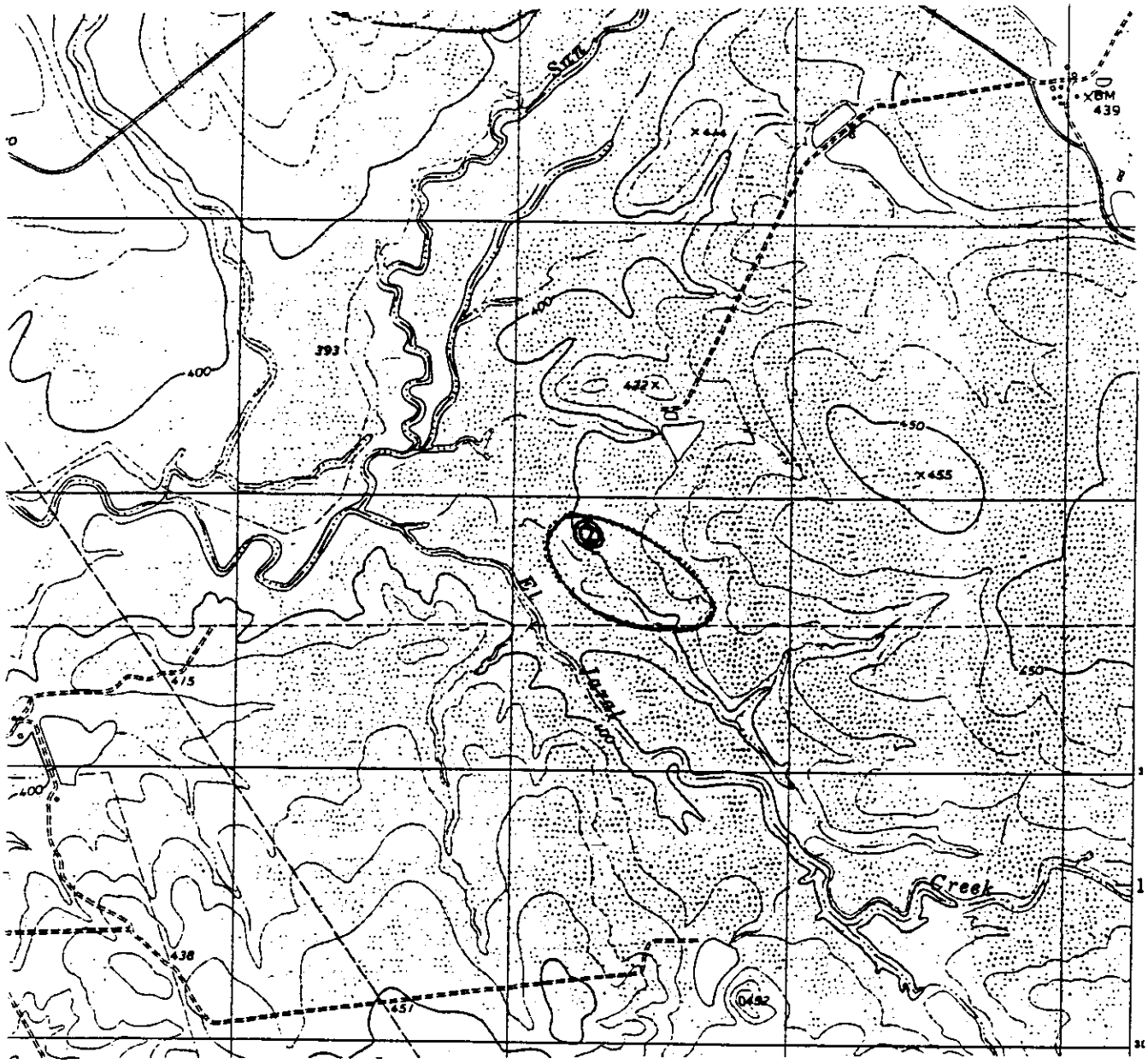

Figure 6. Population 6: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Population 7: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the O'Keefe Lake 7.5 minute topographic quadrangle.

Site Name:	The San Antonio Ranch, Hermanas Pasture
Ownership:	J. C. Martin
Voucher:	Not Collected
Number of individuals:	~ 2,050
Area Covered:	~ 15 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	Yes
Population Future:	Secure
Soil Sample Results:	Not collected

Population 7 occurs on a large private ranch in Webb County just off of Mangana-Hein Road, southeast of Laredo (see Figure 7). This site consists of 3 sub-populations. The northern-most sub-population is a very small, rocky opening within the brush and contains only about 50 individuals. The two sub-populations to the south are both rocky hillsides with approximately 1,000 or more individuals each. The total area covered by the three sub-populations is approximately 15 acres. All individuals in this population are in good condition. The landowner is aware of the species and has signed a voluntary Conservation Agreement protecting them.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), *mesquite (Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), South Texas fishhook (*Ancistrocactus sheeri*), horse crippler (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), creosote bush (*Larrea tridentata*), and lotebush (*Ziziphus obtusifolia*).

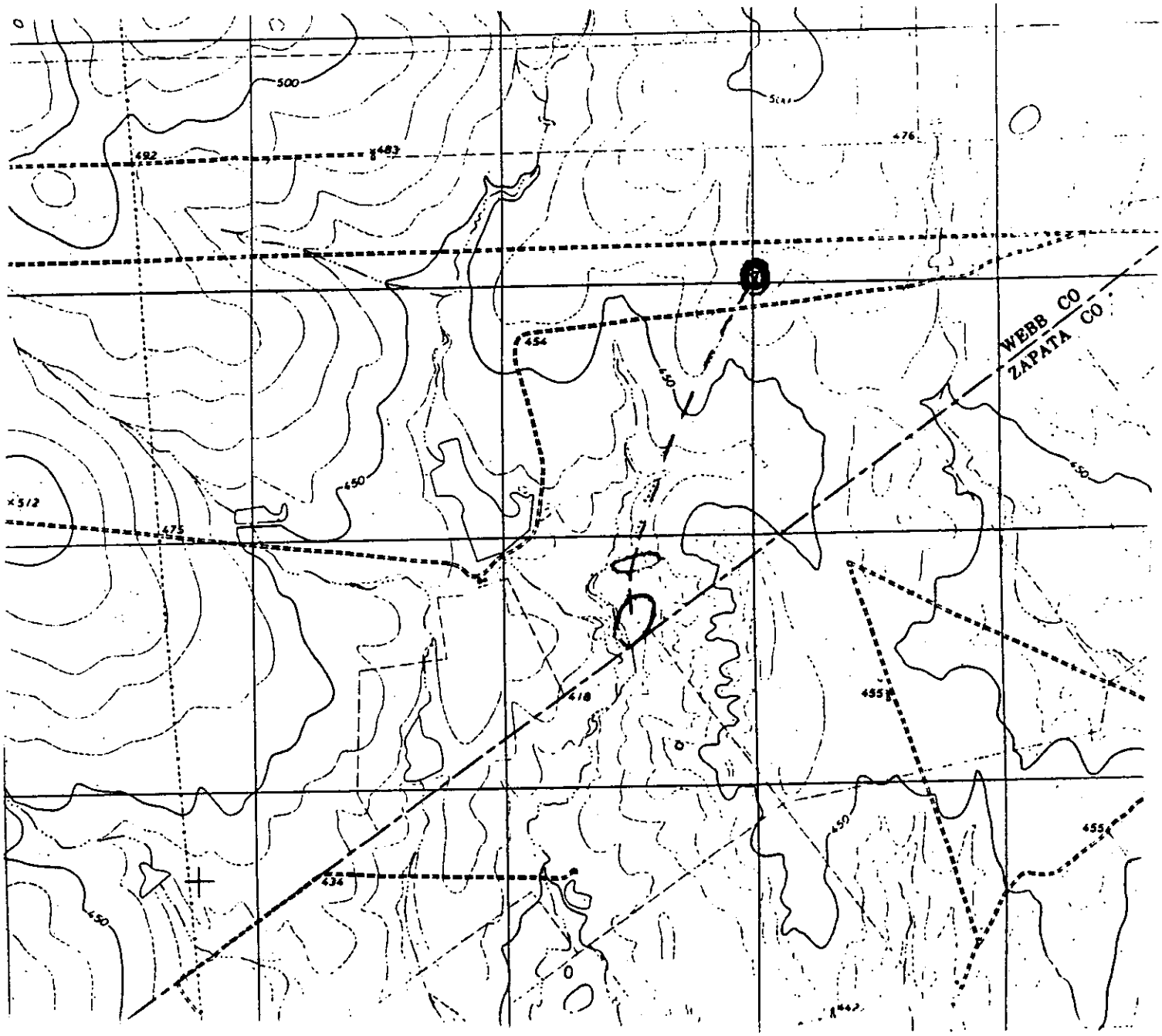

Figure 7. Population 7: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Webb County, on the O'Keefe Lake 7.5 minute topographic quadrangle.

Zapata County, Texas

To date, there are 35 confirmed populations of Johnston's frankenia in Zapata County, Texas. All populations occur on private land; however, a portion of one occurs on state owned Texas Department of Transportation right-of-way; a portion of another occurs on property owned by the International Boundary and Water Commission (IBWC), and an additional site may belong to IBWC altogether. Fifteen of these populations are currently being voluntarily protected by private landowners who have signed Conservation Agreements with Texas Parks and Wildlife. Agreements for seven additional populations have been promised, but are still pending.

Twenty-one of these sites occur on soils mapped as the Maverick-Catarina complex (see Table 2). Seven sites occur upon Zapata-Maverick soils; five on Copita-Brennan; and, two on Copita-Zapata. Sixteen of the sites are underlain by the Jackson Group geologic formation; 12 by the Laredo geologic formation; and seven by the Yegua geologic formation.

Table 2. Soils and Geology for the verified Zapata County *Frankenia johnstonii* populations.

Zapata County Population #	Topographic Quadrangle	Soil Name	Geologic Formation
8	Blancas Creek South	Maverick-Catarina complex	Yegua
9	Agua Azul Creek East, Las Ovejas Creek, & Chargos Creek	Maverick-Catarina complex	Jackson Group
10	Chargos Creek	Maverick-Catarina complex	Jackson Group
11	Chargos Creek	Maverick-Catarina complex	Jackson Group
12	Chargos Creek	Maverick-Catarina complex	Jackson Group
13	Las Ovejas Creek	Maverick-Catarina complex	Jackson Group
14	Las Ovejas Creek	Maverick-Catarina complex	Jackson Group
15	Arroyo Salado East	Maverick-Catarina complex	Jackson Group
16	Arroyo Salado East	Maverick-Catarina complex	Yegua
17	Arroyo Salado East	Maverick-Catarina complex	Yegua
18	Arroyo Salado East	Maverick-Catarina complex	Yegua
19	Arroyo Salado East	Maverick-Catarina	Yegua

		complex	
20	Arroyo Salado West	Maverick-Catarina complex	Laredo
21	Arroyo Salado West	Maverick-Catarina complex	Laredo
22	Arroyo Salado West	Maverick-Catarina complex	Laredo
23	Arroyo Salado West	Maverick-Catarina complex	Laredo
24	Arroyo Salado West	Maverick-Catarina complex	Laredo
25	Arroyo Salado West	Maverick-Catarina complex	Laredo
26	Zapata & Zapata SE	Zapata-Maverick	Laredo
27	Arroyo Veleño & Arroyo Huisache	Maverick-Catarina complex & possibly some Copita-Brennan	Jackson Group
28	Arroyo Huisache	Copita-Brennan	Jackson Group
29	Arroyo Huisache	Copita-Brennan	Jackson Group
30	Arroyo Huisache	Copita-Brennan	Yegua
31	Arroyo Huisache	Copita-Brennan	Jackson Group
32	Arroyo Huisache	Copita-Brennan	Jackson Group
33	Arroyo Huisache	Maverick-Catarina complex	Jackson Group
34	Arroyo Veleño	Copita-Zapata	Jackson Group
35	Arroyo Veleño	Maverick-Catarina complex	Jackson Group
36	Arroyo Veleño	Copita-Zapata	Jackson Group
37	Arroyo Clareño	Zapata-Maverick	Laredo & Yegua
38	Arroyo Clareño	Zapata-Maverick	Laredo
39	Arroyo Clareño	Zapata-Maverick	Laredo
40	Arroyo Clareño & Beckwith Arm	Zapata-Maverick	Laredo
41	Beckwith Arm	Zapata-Maverick	Laredo
42	Beckwith Arm	Zapata-Maverick	Laredo

Zapata County Soils

Detailed soil information for Zapata County does not exist. A very broad, general soils map for Zapata County is all that is available. Therefore, the accuracy and the reliability of the soils listed in the above table are perhaps tenuous at best. The following descriptions of the above soils were taken from either the Webb County or Starr County soil survey books.

According to Sanders and Gabriel (1985) the Maverick-Catarina complex soils are gently rolling, moderately deep, and deep soils on hills and in narrow valleys. This soil complex is 55 to 70 percent Maverick and similar soils, and 20 to 40 percent Catarina soil. The Maverick soil is on the summit and side slopes of hills. The slopes range from three to 10 percent. The Catarina soil is in the narrow valleys and on foot slopes of hills. Slopes are less than two percent. The areas of the Maverick-Catarina complex within Webb County range from 20 acres to several thousand acres in size. Both the Maverick and the Catarina soils are grayish brown saline clays that are calcareous and moderately alkaline throughout. These soils are used mostly as rangeland and as habitat for wildlife. Forage yields for cattle are medium. Under normal conditions, the native vegetation provided adequate food and cover for wildlife, including deer, javelina, and quail. The carrying capacity of these soils, however, is lower than that of the more productive surrounding soils. These soils are not suited for cropland due to salinity, very low available water capacity, the high content of exchangeable sodium, and the hazard of water erosion. These soils are also poorly suited for urban uses because of the clayey texture, hazard of flooding, and the shrinking and swelling.

Zapata soils (Thompson et al., 1972) are gently sloping, grayish-brown loamy soils that are very shallow over caliche. Angular caliche fragments make up five to 10 percent of the surface layer. These soils occupy low ridges on upland divides. The entire acreage is used for range. The use of heavy equipment is often very difficult because the soil is very shallow over cemented caliche. There are many caliche pits within areas of these soils.

Maverick soils (Thompson et al., 1972) are moderately deep, somewhat excessively drained, undulating olive-brown, saline clay soils on uplands. Salt threads, cemented concretions, soft lumps of calcium carbonate, weathered shale and gypsum crystals are common throughout the profile. Maverick soils are mainly used for range. They are not cultivated because they contain salts and the climate is dry.

Copita soils (Thompson et al., 1972) are moderately deep, well-drained, nearly level to gently undulating fine sandy loam soils of the uplands. Internal drainage is medium, permeability is moderate, and the available water capacity is high. Copita soils are used mainly for range, but a few are dry-farmed. Some areas that were formerly cultivated have been seeded to grasses and used for pasture.

Brennan soils (Thompson et al., 1972) are deep, well-drained, nearly level, brown, fine sandy loams on uplands. Internal drainage is medium, permeability is moderate, and the available water capacity is high. Brennan soils are used mainly for range, but a few areas are dry-farmed. Some areas that were formerly cultivated have seeded to pasture.

Zapata County Geology

The Yegua formation (Brown et al., 1976) is Eocene Age, and is composed of clay and sandstone (mostly clay). The clay portion is lignitic, sandy, bentonitic, and mostly well laminated. It is chocolate brown to reddish brown in color with lighter colors upward, producing dark gray soil. The sandstone is mostly quartz and some chert described as fine grained, friable, calcareous, glauconitic, and weathering to loose, ferruginous, yellow orange and reddish brown soil. There is some fossil wood.

The Jackson Group formation (Brown et al., 1976) is Eocene Age, and is composed of sandstone and clay (mostly sandstone). The sandstone is fine to coarse grained, friable to quartzitic, commonly laminated and crossbedded. The color is white, gray, greenish brown, or light brownish yellow, and fossiliferous. The clay is sandy and calcareous. The color is greenish gray, pink, or red. Silicified wood is abundant. Some beds of white volcanic ash, and large dark limestone concretions composed of calcite crystals are common.

The Laredo formation (Brown et al., 1976) is Eocene Age and is composed of sandstone and clay. Thick sandstone members in the upper and lower part, very fine to fine grained, in part glauconitic, micaceous, ferruginous, crossbedded, and dominantly red and brown in color. There is clay in the middle that weathers to orange-yellow. Dark gray limestone concretions are common, some fossiliferous. Marine megafossils are abundant.

Zapata County Site Descriptions

Population 8: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Janssen & Williamson # 0665
Number of individuals:	~ 750
Area Covered:	~ 22 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.4 moderately alkaline	6 ppm very low	26520 ppm very high	657 ppm high	10400 ppm very high	3829 ppm very high	Silty Clay

Population 8 occurs on a private ranch in northern Zapata County just south of Webb-Zapata County line (see Figure 8). This population is composed of two sub-populations approximately 6 to 7/10ths of a mile apart. The western sub-population is situated on a small eroding, rocky hillside near the fence line, and contains approximately 500 individuals. The second sub-population to the east occurs on a salt-flat area, and contains approximately 200 to 300 individuals. The total area covered by the plants is approximately 22 acres. The plants appear to be in good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., screw bean mesquite (*Prosopis reptans*), goat bush (*Castela texana*), pencil cactus (*Opuntia leptocaulis*), blackbrush (*Acacia rigidula*), lotebush (*Ziziphus obtusifolia*), guayacan (*Guaiacum angustifolium*), dog's ear (*Tiquilia canescens*), leatherstem (*Jatropha dioica*), cenizo (*Leucophyllum frutescens*), Spanish dagger (*Yucca treculeana*), desert lantana (*Lantana macropoda*), desert yaupon (*Schaefferia cuneifolia*), prickly pear cactus (*Opuntia engelmanii*), skeleton-leaf goldeneye (*Viguiera stenoloba*), *mesquite (Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), coyotillo (*Karwinskia humboldtiana*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), South Texas fishhook *(Ancistrocactus sheeri*), horse crippler (*Ferocactus setispinus*), creosote bush (*Larrea tridentata*), whitebrush (*Aloysia gratissima*), and tulipan del monte (*Hibiscus cardiophyllus*).

The landowner of this site lives in San Antonio. She can be a bit cantankerous, and prefers that her name be kept confidential. However, I have established a good relationship with Jose L. Gonzales who leases the property. He has leased this site ever

since I first gained access to the ranch in 1994. Mr. Gonzales is knowledgeable about the *F. johnstonii* sites on the ranch, and has promised to make sure that they remain untouched.

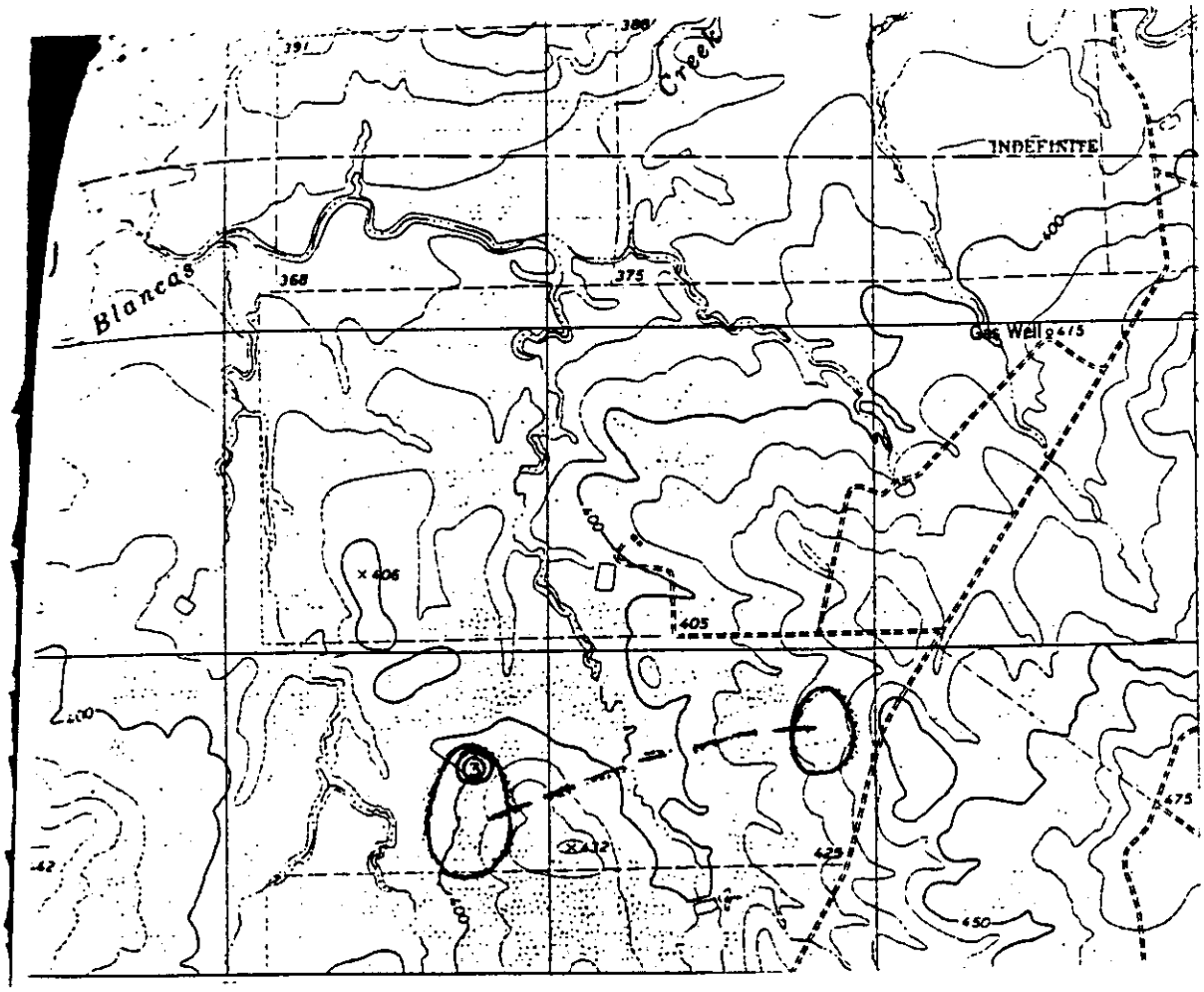

Figure 8. Population 8: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Blancas Creek South 7.5 minute topographic quadrangle.

Population 9: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Agua Azul Creek East, Las Ovejas Creek and Chargos Creek 7.5 minute topographic quadrangles.

Site Name:	Confidential and The Barrocito, East and West Pastures
Ownership:	Confidential and The Fred M. Bruni Estate
Voucher:	D. S. Correll # 32254; Janssen & Williamson # 0534
Number of individuals:	~ 1,000,000 or more
Area Covered:	150 to 200 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes, for The Barrocito
Population Future:	Secure
Soil Sample Results:	

Sub-population (a)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	3 ppm very low	18780 ppm very high	396 ppm high	1560 ppm moderate	1011 ppm high	Sandy Clay Loam

Sub-population (i)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.7 strongly alkaline	8 ppm very low	18713 ppm very high	208 ppm high	9100 ppm very high	4540 ppm very high	Clay Loam

Sub-population (m)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
7.7 mildly alkaline	5 ppm very low	11845 ppm very high	425 ppm high	3900 ppm very high	1833 ppm very high	Clay

Population 9 occurs on two private ranches in northeastern Zapata County (see Figure 9). The majority of the plants occur on the Barrocito Ranch. This population is tremendous, and a corner of it [sub-population (*g*)] corresponds with the original Type Locality collected by D. S. Correll (Correll 1966). Interestingly, the Final Rule (USFWS 1984) determining *F. johnstonii* an endangered species states that this site was extensively searched for (in 1980) and not relocated. Additionally, the Final Rule also stated that the type locality was "probably only a few plants". Yeah, try a few million. Thirty-three years after discovery, this site remains extant and thriving.

There are 13 sub-populations that make up this impressive population measuring 2.5 air miles across (from west to east) and about one mile long (from north to south). There are easily a million or more individuals within the population. The smallest sub-population [(*m*) the southern-most] contains approximately 1,000 individuals, while the largest sub-population [(*b*) the long site with the short dogleg] contains hundreds of thousands of individuals. The *F. johnstonii* individuals within this population cover approximately 150 to 200 acres. All plants are in excellent to good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite

(*Prosopis reptans*), mesquite (*Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), alicoche (*Echinocereus* sp.), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), yellow dumpling cactus (*Mammalaria sphaerica*), South Texas fishhook (*Ancistrocactus sheeri*), dog cholla (Opuntia schottii), horse crippler (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guajillo (*Acacia berlandieri*), peyote (*Lophophora williamsii*), guayacan (*Guaiacum angustifolium*), creosote bush (*Larrea tridentata*), and lotebush (*Ziziphus obtusifolia*).

My contact for the Fred M. Bruni Estate is Mr. Louis Bruni, Fred Bruni's son. Louis Bruni is a City Councilman for the City of Laredo. Fred Bruni passed away in the early 90's, but Mrs. Bruni, Louis's mother, is still alive. Mrs. Bruni and Louis Bruni are both very passionate about conservation, especially their endangered species. The Bruni family has been more than cooperative and supportive of Texas Parks and Wildlife and this project. They have signed a voluntary Conservation Agreement with Texas Parks and Wildlife protecting their populations.

Three and a half of the smaller clumps or sub-populations along the northern boundary of this population are on another private ranch owned by the Walker family (although historically Fred M. Bruni owned all the land in this area). It has become sort of a twisted ritual for me to, every year, ask either Gene or Rick Walker for permission to access their property. And, every year they tell me the same thing: "Our attorney advises us not to let you onto the property". Gene Walker, the father, almost let me on the first time I asked back in 1994. Then he got cold feet and changed his mind. Rick, Gene's son, is a member of the Webb County Soil and Water Board, and is a nice enough guy—just very scared and paranoid with regards to endangered species. They own in excess of 100,000 acres in both Webb and Zapata Counties. Access to their ranches would, I am sure, reveal several more *F. johnstonii* populations. There are many other populations of *F. johnstonii* that I can see on Walker property from various vantage points throughout Webb and Zapata County, but they are not counted or recorded (except for these small clumps that are part of this population) for the purposes of this report.

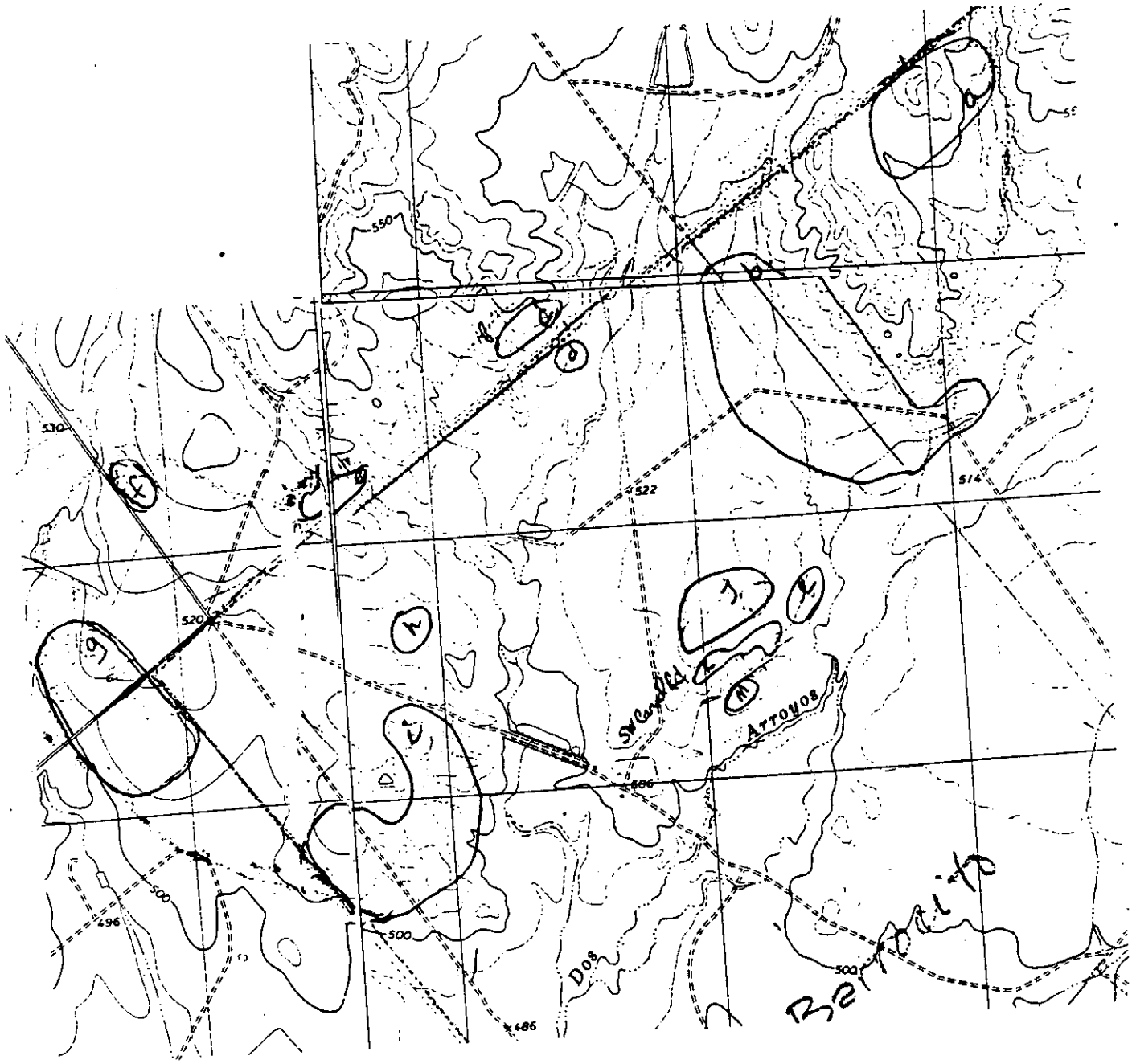

Figure 9. Population 9: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Agua Azul Creek East, Las Ovejas Creek and Chargos Creek 7.5 minute topographic quadrangles.

Population 10: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Site Name:	The Barrocito, East Pasture eroded hillside
Ownership:	The Fred M. Bruni Estate
Voucher:	Janssen & Williamson # 0535
Area Covered:	< 1 acre
Number of individuals:	~ 200
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.9 strongly alkaline	1 ppm very low	30007 ppm very high	551 ppm high	6500 ppm very high	7901 ppm very high	Clay

Population 10 occurs on a private ranch in northeastern Zapata County (see Figure 10). This site is small, containing approximately 200 individuals, and is situated on a rocky eroding hillside. The plants are in good condition and protected by a voluntary Conservation Agreement.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), mesquite (*Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), alicoche (*Echinocereus* sp.), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (Mammalaria heyderi), Tom Thumb cactus (*Mammalaria roberti*), South Texas fishhook (*Ancistrocactus sheeri*), desert yaupon (*Schaefferia cuneifolia*), granjeno (*Celtis pallida*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), peyote (*Lophophora williamsii*), guayacan (*Guaiacum angustifolium*), Spanish dagger (*Yucca treculeana*), cenizo (*Leucophyllum frutescens*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).

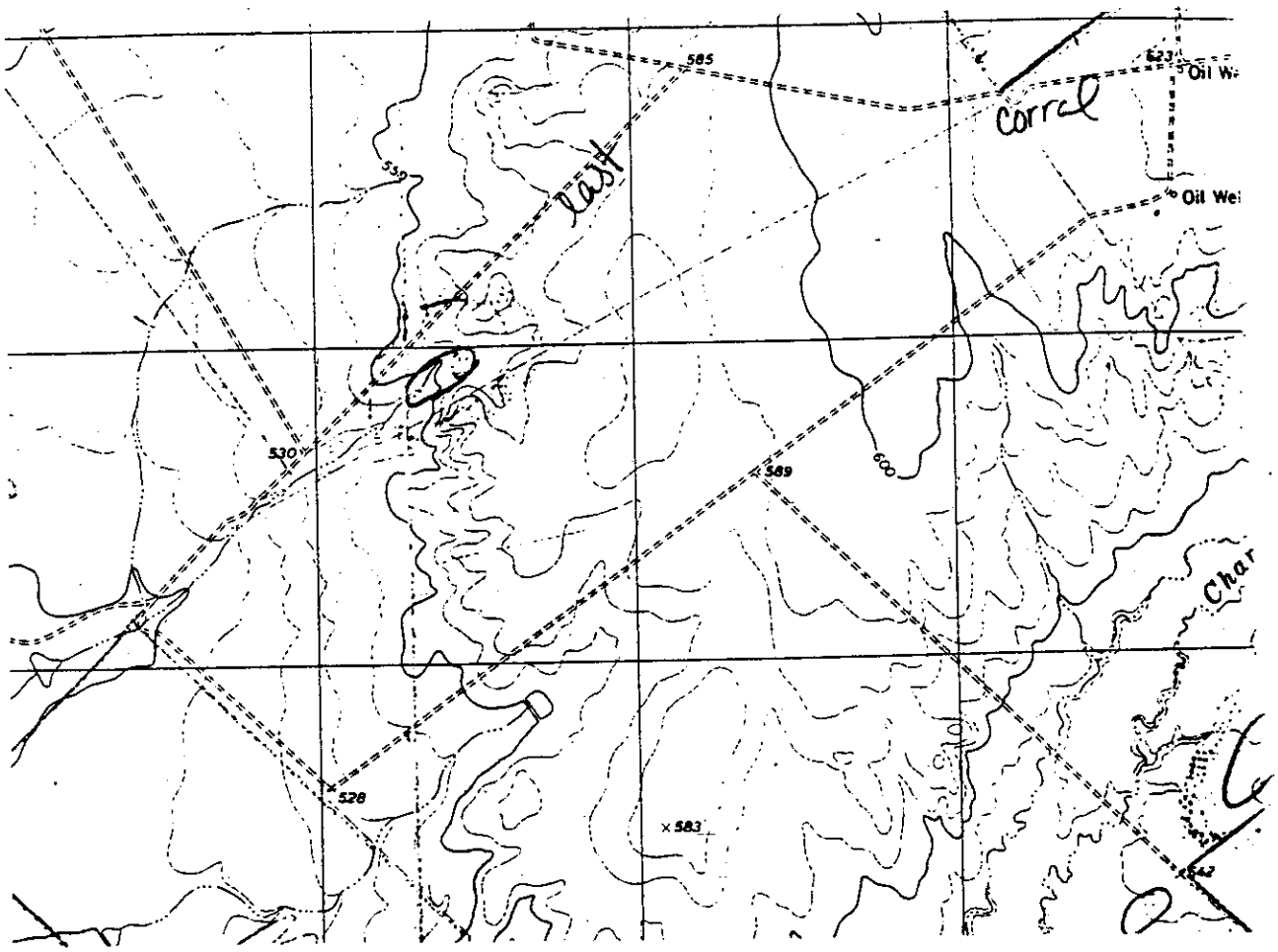

Figure 10. Population 10: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Population 11: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Site Name:	The Barrocito, Vaquillas pasture/Wells Pasture Gate
Ownership:	The Fred M. Bruni Estate
Voucher:	Janssen & Williamson # 0541
Number of individuals:	~ 1,150
Area Covered:	~ 11 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
7.7 mildly alkaline	1 ppm very low	2748 ppm high	263 ppm high	2405 ppm high	2292 ppm high	Clay

Population 11 occurs on a private ranch in northeastern Zapata County (see Figure 11). There are two sub-populations on a salt-flat opening within the brush that make up this population. The eastern-most sub-population has scattered individuals numbering at least 1,000, covering approximately 10 acres. The second sub-population is a small opening within the brush consisting of approximately 150 individuals covering about an acre. The plants are in good to excellent condition and are protected with a voluntary Conservation Agreement.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (Mammalaria heyderi), Tom Thumb cactus (*Mammalaria roberti*), South Texas fishhook (*Ancistrocactus sheeri*), desert yaupon (*Schaefferia cuneifolia*), creosote bush (*Larrea tridentata*), desert olive (*Forestieria angustifolia*), granjeno (*Celtis pallida*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), huisache (*Acacia farnesiana*), allthorn (*Koeberlinia spinosa*), squaw bush (*Condalia spathulata*), peyote (*Lophophora williamsii*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), Spanish dagger (*Yucca treculeana*), cenizo (*Leucophyllum frutescens*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).

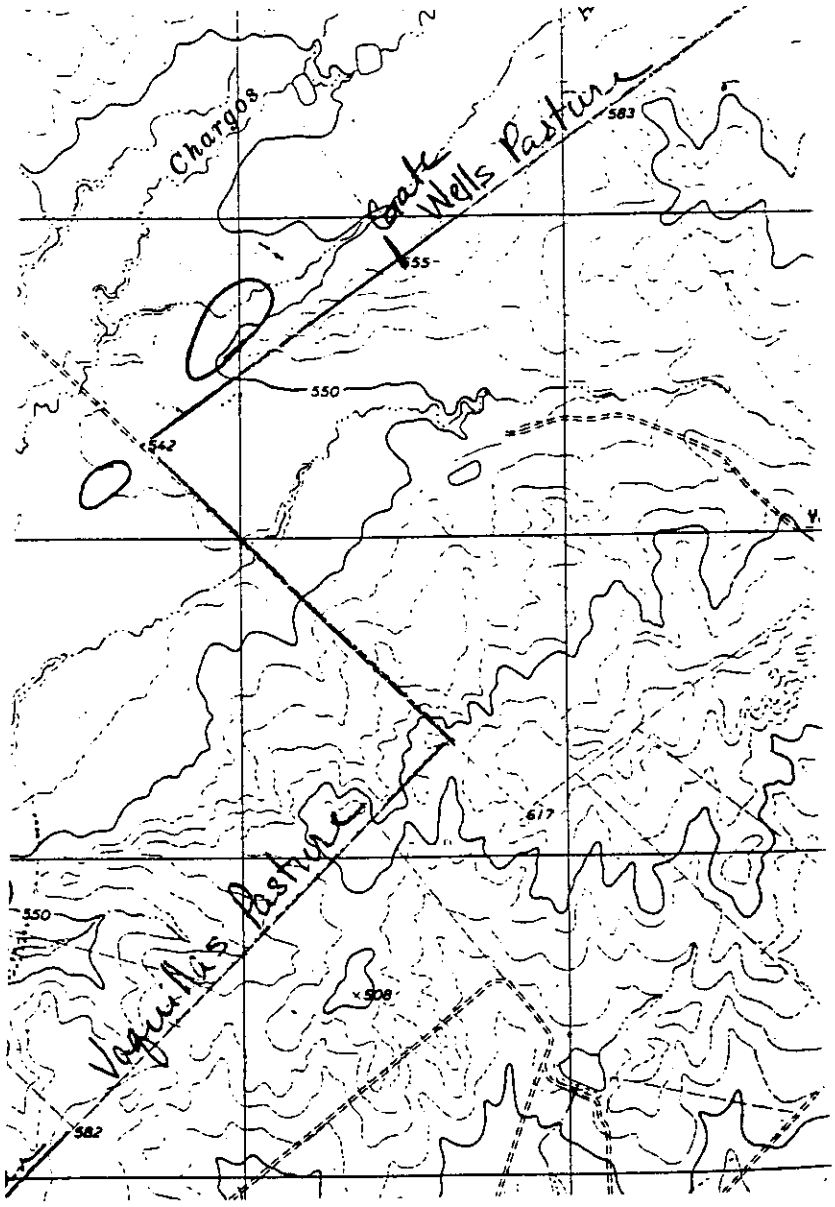

Figure 11. Population 11: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Population 12: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Site Name:	The Barrocito, Vaquillas Pasture
Ownership:	The Fred M. Bruni Estate
Voucher:	Not collected
Number of individuals:	~ 2,150
Area Covered:	~ 6 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	1 ppm very low	19323 ppm very high	431 ppm high	2535 ppm high	5218 ppm very high	Clay

Population 12 occurs on a private ranch in northeastern Zapata County (see Figure 12). There are two sub-populations that form this population. The larger sub-population, the northern-most, occurs upon a rocky, eroding hillside and flat rocky openings. The plants at this site total at least 2,000 and cover approximately five to six acres. The smaller sub-population to the south is situated on a salt-flat opening within the brush at the base of small, slightly rocky hill. There are approximately 150 individuals on an area less than an acre. The plants are in good to excellent condition and protected by a voluntary Conservation Agreement.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (Mammalaria heyderi), Tom Thumb cactus (*Mammalaria roberti*), South Texas fishhook (*Ancistrocactus sheeri*), alicoche (*Echinocereus* sp.), desert yaupon (*Schaefferia cuneifolia*), creosote bush (*Larrea tridentata*), desert olive (*Forestieria angustifolia*), granjeno (*Celtis pallida*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), huisache (*Acacia farnesiana*), allthorn (*Koeberlinia spinosa*), squaw bush (*Condalia spathulata*), peyote (*Lophophora williamsii*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), Spanish dagger (*Yucca treculeana*), cenizo (*Leucophyllum frutescens*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).

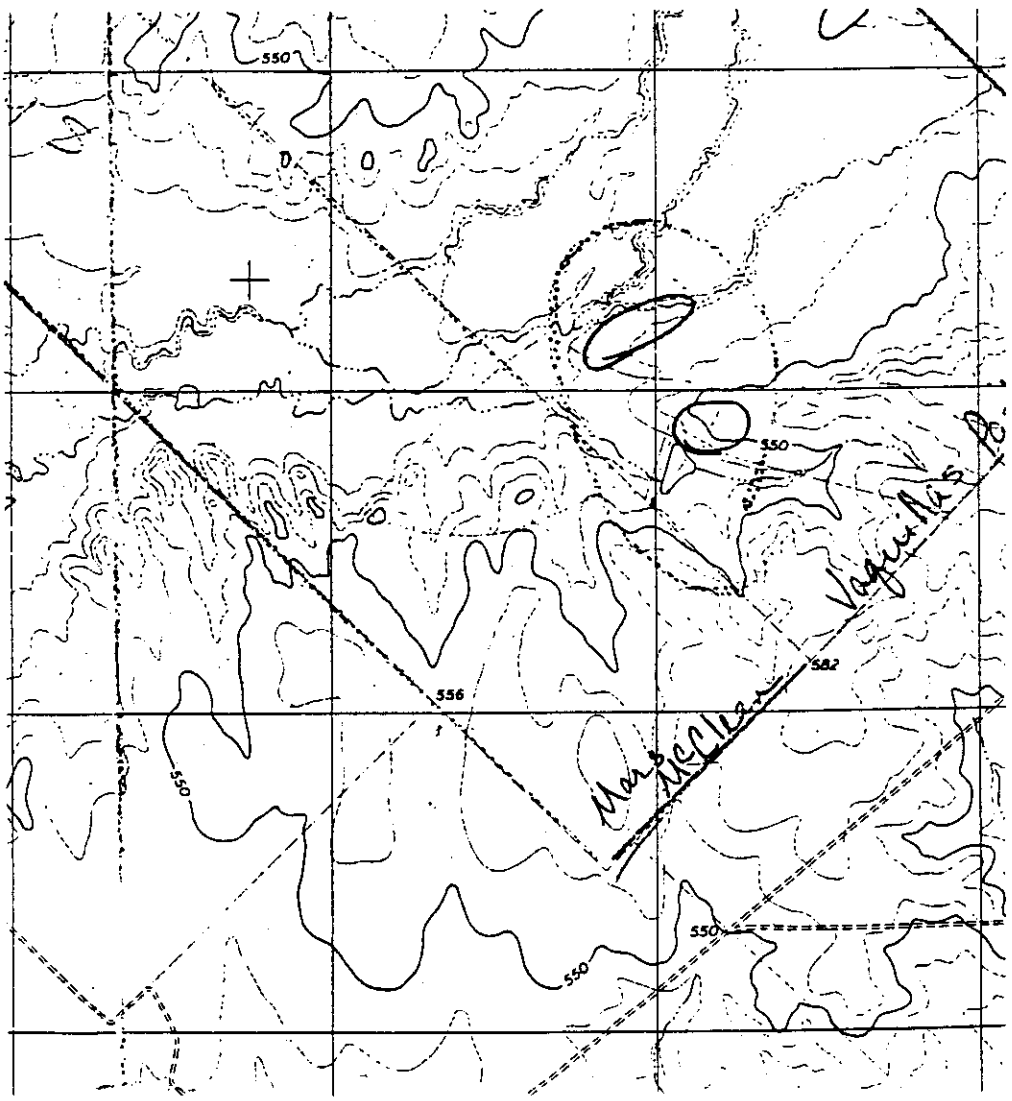

Figure 12. Population 12: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Chargos Creek 7.5 minute topographic quadrangle.

Population 13: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Las Ovejas Creek 7.5 minute topographic quadrangle.

Site Name:	The Barrocito, Bobby's side
Ownership:	The Fred M. Bruni Estate
Voucher:	Janssen & Williamson # 0548
Number of individuals:	~ 1,000,000
Area Covered:	~ 200 or more acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	3 ppm very low	25653 ppm very high	184 ppm high	2080 ppm high	7872 ppm very high	Clay

Population 13 occurs on a private ranch in northeastern Zapata County (see Figure 13). This population is phenomenal. The total length of this population is 2.3 air miles varying in width from .2 to .5 miles. Although the northern-most extent of this population is clumped, or discontinuous, the southern portion is 1.7 miles of solid *F. johnstonii* within an extensive salt-flat lowland surrounded by a few steep hills. There are easily millions of plants within this population that covers approximately 200 or more acres. This portion of the Barrocito is only used for hunting, and has not stocked cattle for some time. The plants are in excellent to good condition and protected by a voluntary Conservation Agreement.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., coma (*Bumelia celastrina*), whitebrush (*Aloysia gratissima*), ephedra (*Ephedra antisyphilitica*), creosote bush (*Larrea tridentata*), desert olive (*Forestieria angustifolia*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), allthorn (*Koeberlinia spinosa*), squaw bush (*Condalia spathulata*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).

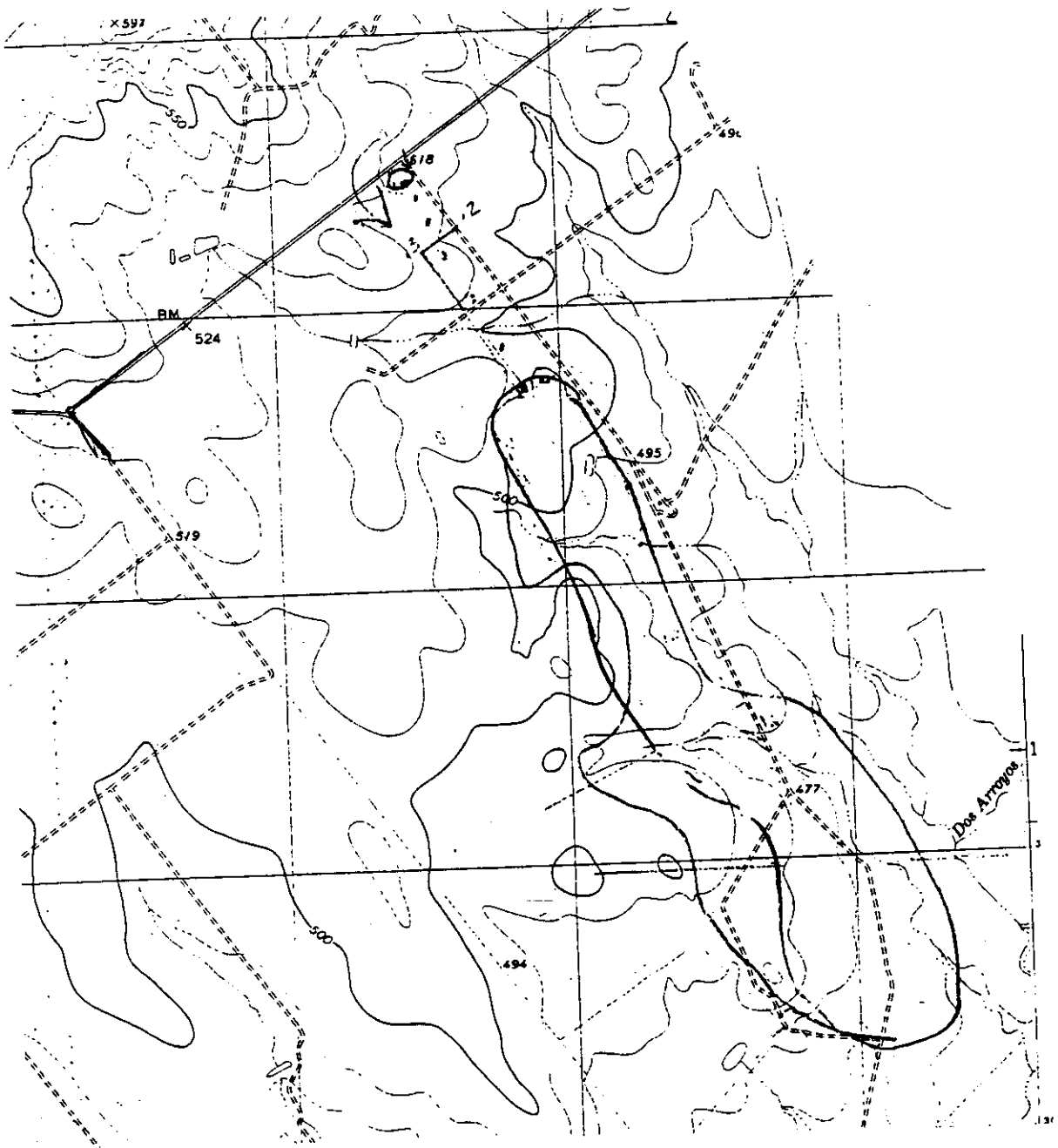

Figure 13. Population 13: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Las Ovejas Creek 7.5 minute topographic quadrangle.

Population 14: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Las Ovejas Creek 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Janssen & Williamson # 0670
Number of individuals:	~ 5,700
Area Covered:	~ 11 to 13 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Secure, unless it sells, then Unknown

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
9.0 strongly alkaline	1 ppm very low	30007 ppm very high	424 ppm high	1300 ppm moderate	2618 ppm very high	Clay

Population 14 occurs on a private ranch in north-central Zapata County (see Figure 14). This population is composed of two sub-populations that are closely situated. The larger sub-population to the east is on a rocky, salt-flat opening at the base of steep caliche hill. There are approximately 5,000 individuals in this dense sub-population, covering approximately 10 or 11 acres. The smaller sub-population to the west is also dense, and contains approximately 700 individuals in an area the size of 1 or 2 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), calderona (*Krameria ramosissima*), common golden weed (*Isocoma coronopifolia*), 4-wing salt bush (*Atriplex canescens*), orange zexmenia (*Wedelia hispida*), Texas kidneywood (*Eysenhardtia texana*), snake-eyes (*Phaulothamnus spinescens*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), South Texas fishhook (*Ancistrocactus sheeri*), desert yaupon (*Schaefferia cuneifolia*) desert olive (*Forestieria angustifolia*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), huisache (*Acacia farnesiana*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), cenizo (*Leucophyllum frutescens*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).

When I first requested access to this 17,000 acre ranch back in 1995, I was denied by the family lawyers. When I asked permission to speak with the lawyers, I was finally given permission to access for the purposes of this project. It took a couple of years before the landowner let me go on without him escorting me (with his trusty automatic weapon laying on the seat in-between us at all times). Although access is always granted on this ranch, and permission has been given to conduct annual monitoring on this property, this landowner refuses to sign anything and prefers that their information remain confidential. The family has been trying to sell this ranch for the past few years. Since this ranch also

contains a huge population of the endangered ashy dogweed (*Thymophylla tephroleuca*), I was given permission to let the Nature Conservancy of Texas know about its availability. James King talked with the family about the ranch, but simply could not afford the 5 million-dollar asking price (6 million with the house).

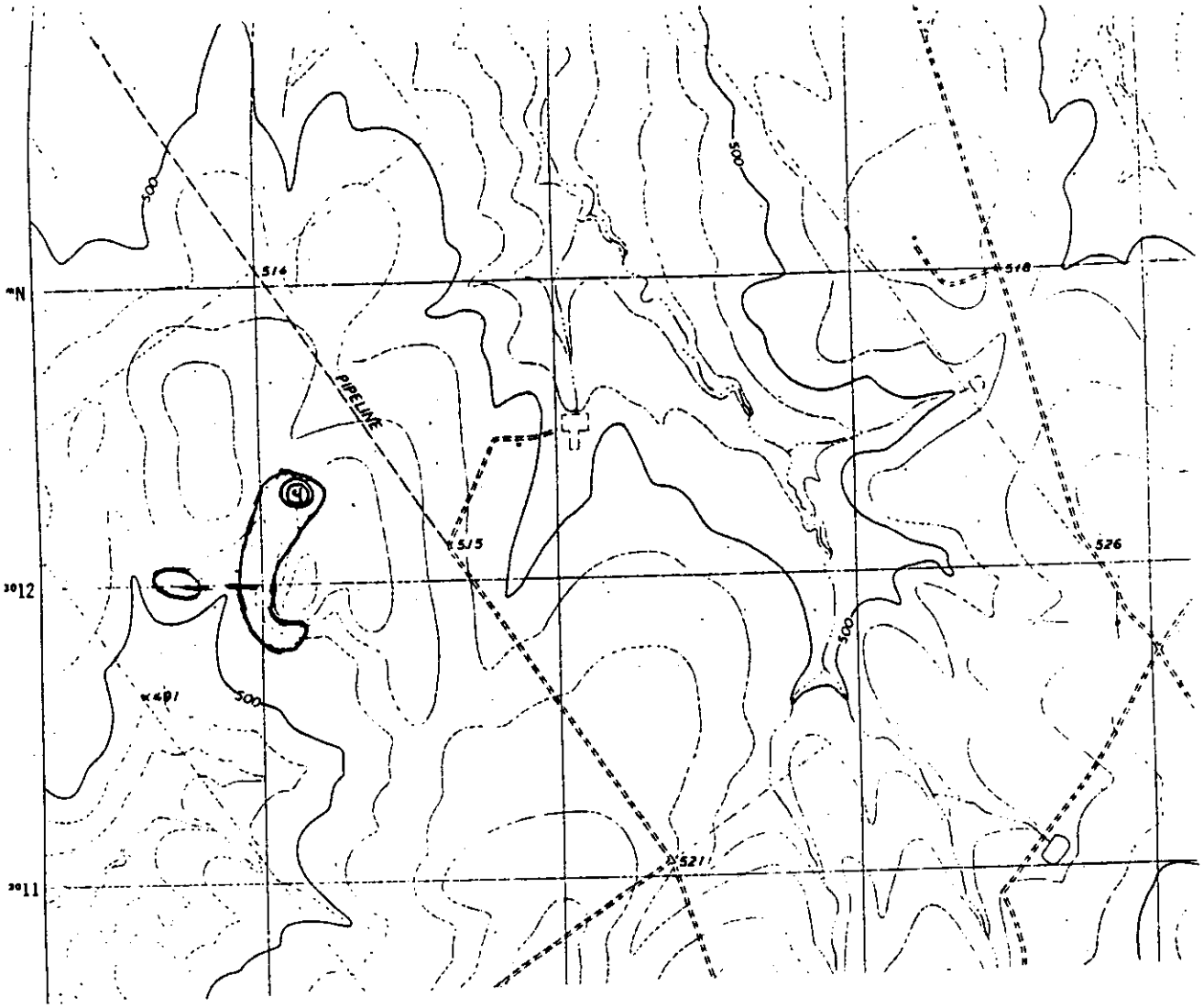

Figure 14. Population 14: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Las Ovejas Creek 7.5 minute topographic quadrangle.

Population 15: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Janssen & Williamson # 0671
Number of individuals:	~ 1,000
Area Covered:	~ 20 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Secure, unless it sells, then Unknown

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.3 moderately alkaline	17 ppm moderate	29998 ppm very high	266 ppm high	5525 ppm very high	6526 ppm very high	Silty Clay

Population 15 occurs on a private ranch in north-central Zapata County (Figure 15). This site is one continuous population that occurs upon a gently sloping rocky hillside and a small portion of it is on a saline-flat. There are approximately 1,000 individuals covering an area of approximately 20 acres. The plants are in excellent to good condition. This population is owned by the same family as Population 14 above.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *Sueada* sp., mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), nipple cactus (Mammalaria heyderi), desert yaupon (*Schaefferia cuneifolia*), creosote bush (*Larrea tridentata*), desert olive (*Forestieria angustifolia*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

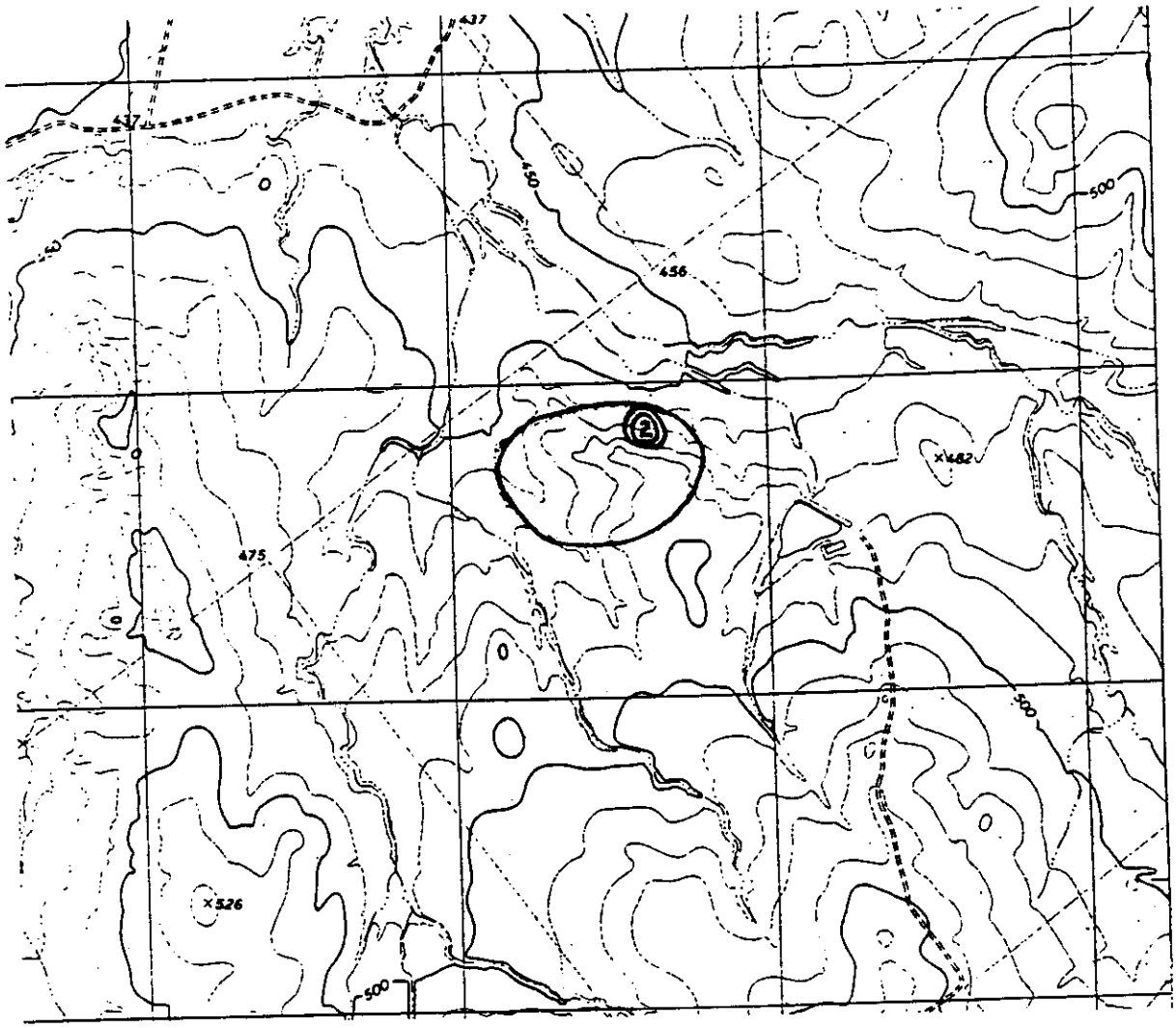

Figure 15. Population 15: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Population 16: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Site Name:	Canales Central & Fenceline
Ownership:	Gus T. Canales
Voucher:	Janssen & Williamson # 0672
Number of individuals:	~ 5,000,300
Area Covered:	~ 35 to 40 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	Pending
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.8 strongly alkaline	1 ppm very low	30044 ppm very high	586 ppm high	1690 ppm moderate	2920 ppm very high	Clay

Population 16 occurs on a private ranch in northern Zapata County (see Figure 16). This site is composed of two sub-populations. The larger sub-population to the west occurs upon vast saline-flat lowland bordered on the eastern edge by steep caliche hills. There are easily hundreds of thousands of individuals within this sub-population that covers approximately 34 or more acres. Approximately .75 air miles to the east a second smaller sub-population that is situated on a small eroding hillside near the property boundary. There are approximately 300 individuals within this site that covers an area of only an acre. The plants are in excellent to good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), mesquite *(Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), shoregrass (*Monanthochloe littoralis*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

The owner of this site, Gus T. Canales, is aware of his *F. johnstonii* sites, and has promised to sign a voluntary Conservation Agreement; however, that signed agreement is still only a promise at this point. He seems very committed to conservation and has always been very supportive of this project. This property is only used for hunting, and has not stocked cattle for years. Mr. Canales is also interested in selling his property and actually went so far as to offer to Texas Parks and Wildlife. Unfortunately, Texas Parks and Wildlife could not afford it, and they were not interested in owning a property that was land-locked by other ranches.

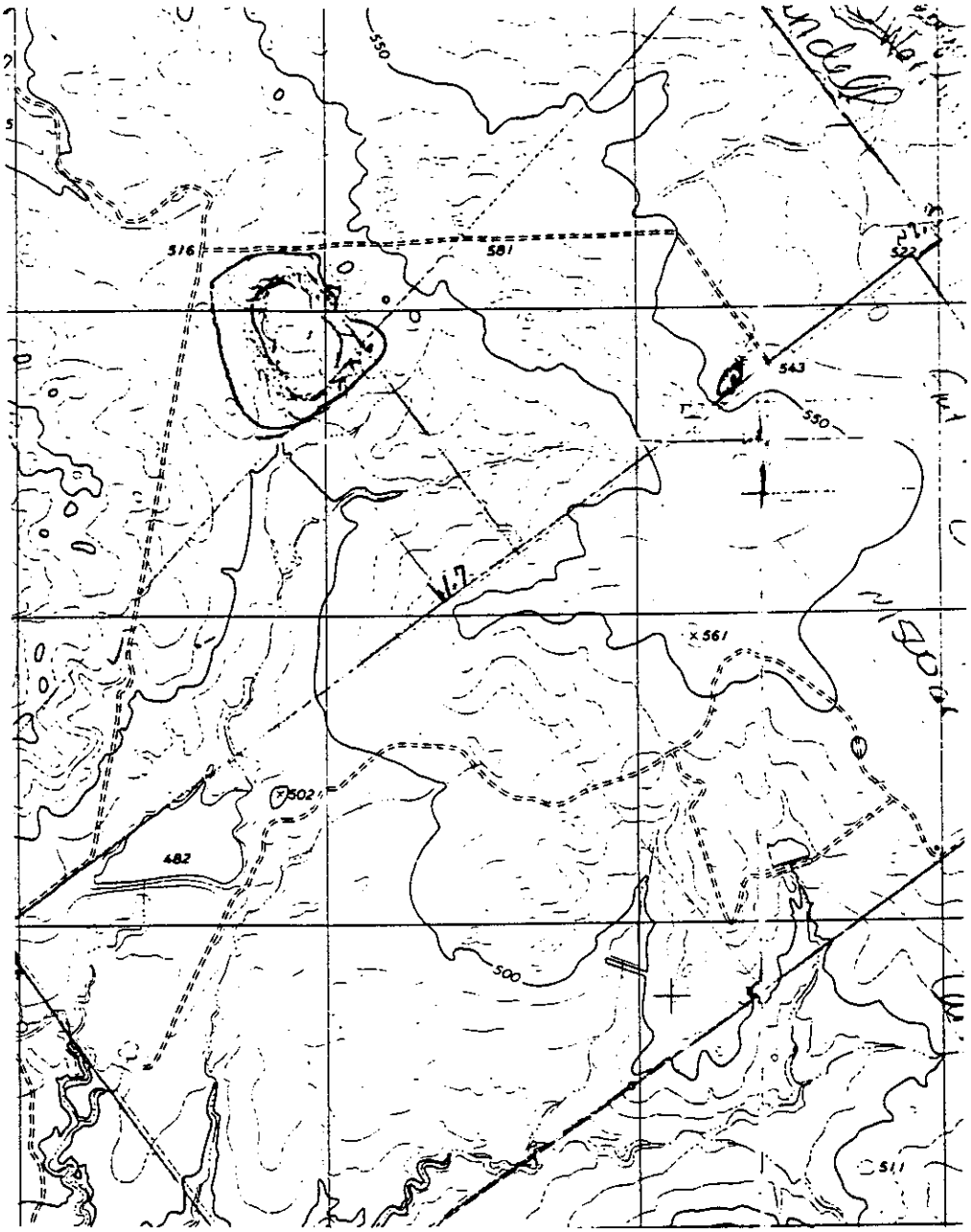

Figure 16. Population 16: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Population 17: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Site Name:	Canales South Gate
Ownership:	Gus T. Canales
Voucher:	Not collected
Number of individuals:	~ 100 or less
Area Covered:	< 1 acre
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	Pending
Population Future:	Secure
Soil Sample Results:	Not collected

Population 17 occurs on a private ranch in northern Zapata County (see Figure 17). This is probably the smallest of all *F. johnstonii* sites. This population is composed of two tiny sub-populations with approximately 25 to 50 plants each. The area covered is less than an acre.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

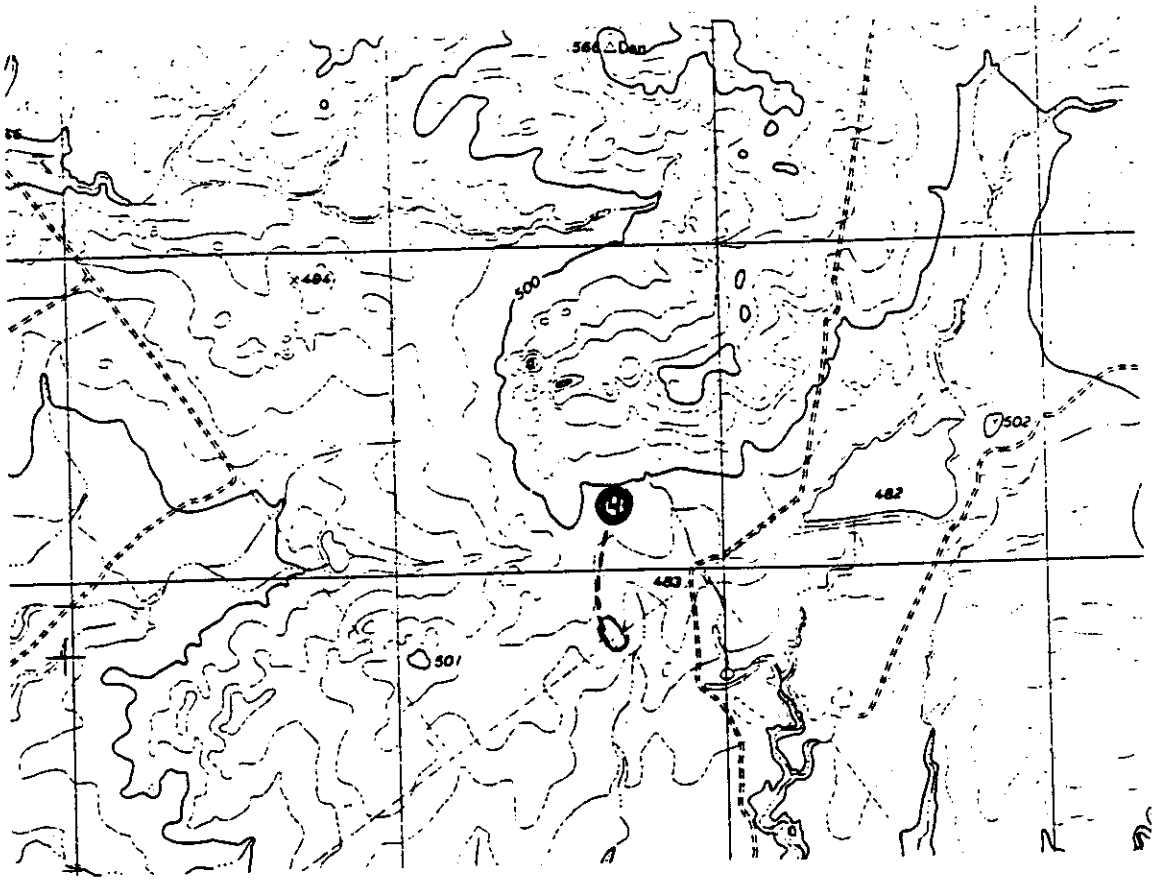

Figure 17. Population 17: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Population 18: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Janssen & Williamson # 0673
Number of individuals:	~ 500
Area Covered:	~ 10 acres
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Secure, unless it sells, then Unknown
Soil Sample Results:	Not collected

Population 18 occurs on a private ranch in northwestern Zapata County (see Figure 18). This population occurs on a very narrow continuum of rocky hillsides and measures approximately .6 to .7 mile long. There are approximately 500 individuals at this site that covers an area of approximately 10 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), calderona (*Krameria ramosissima*), common golden weed (*Isocoma coronopifolia*), 4-wing salt bush (*Atriplex canescens*), orange zexmenia (*Wedelia hispida*), Texas kidneywood (*Eysenhardtia texana*), snake-eyes (*Phaulothamnus spinescens*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), South Texas fishhook (*Ancistrocactus sheeri*), desert yaupon (*Schaefferia cuneifolia*) desert olive (*Forestieria angustifolia*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), huisache (*Acacia farnesiana*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), cenizo (*Leucophyllum frutescens*), coyotillo (*Karwinskia humboldtiana*), and lotebush (*Ziziphus obtusifolia*).
This population is owned by the same family that owns sites 14 and 15 above. This site does continue onto the ranch to the north, La Perla, but I could never get permission to access that property. Actually, I did get permission from the landowner (Rowena Dillion) but the man who leases the property, Tom Harper, is a big crump and will not let me on. The La Perla is another ranch on which I can see several localities of *F. johnstonii* from various vantage points surrounding the ranch, but since I could never gain access, I have not included them in this report.

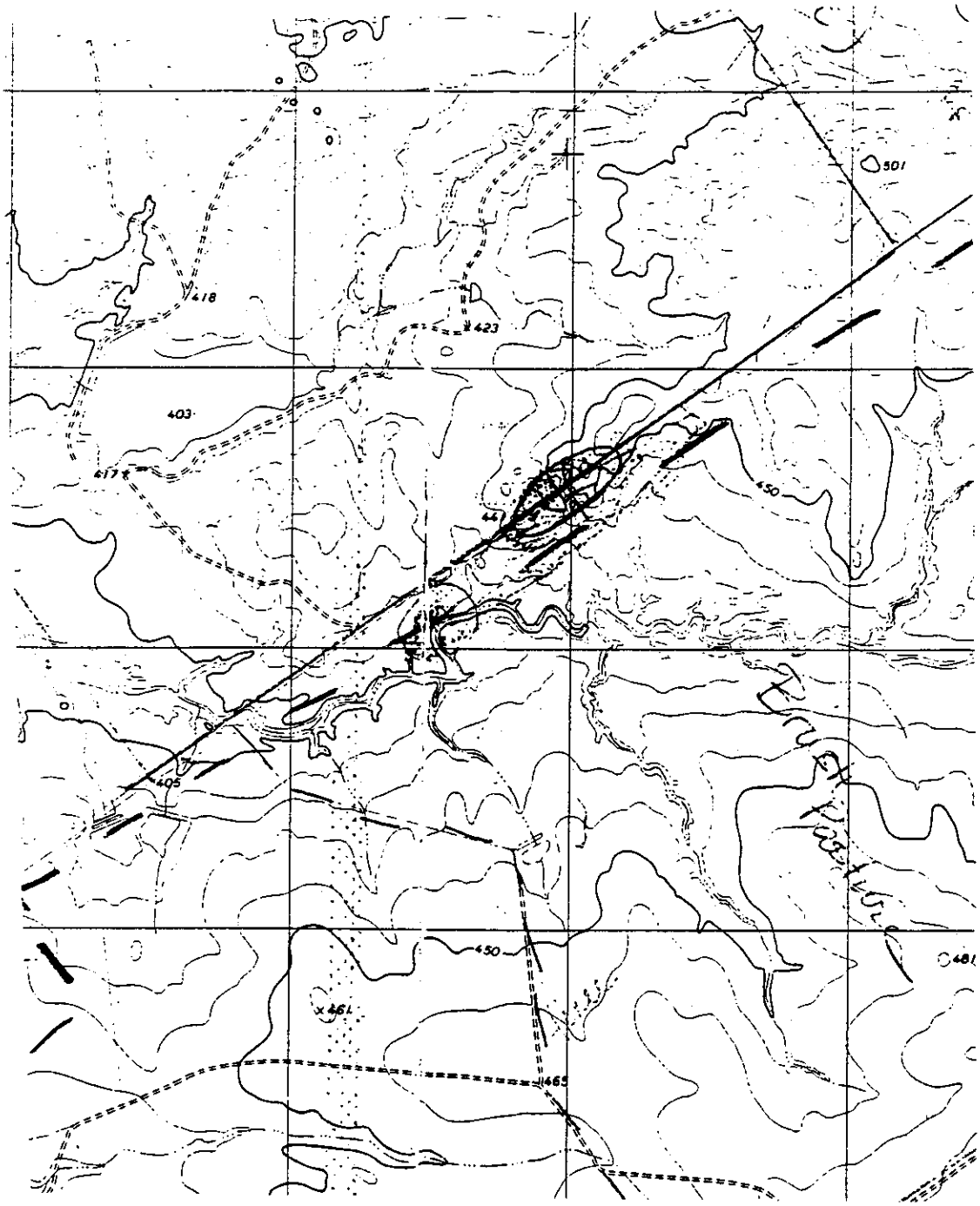

Figure 18. Population 18: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Population 19: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 250
Area Covered:	~ 1 acre
Soils:	Maverick-Catarina complex
Geology:	Yegua
Conservation Agreement:	No
Population Future:	Secure, unless it sells, then Unknown
Soil Sample Results:	Not collected

Population 19 occurs on a private ranch in northwestern Zapata County (see Figure 19). This population is relatively small containing approximately 250 individuals on an area of about an acre. The plants are in good condition. (Same landowners as above.)

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

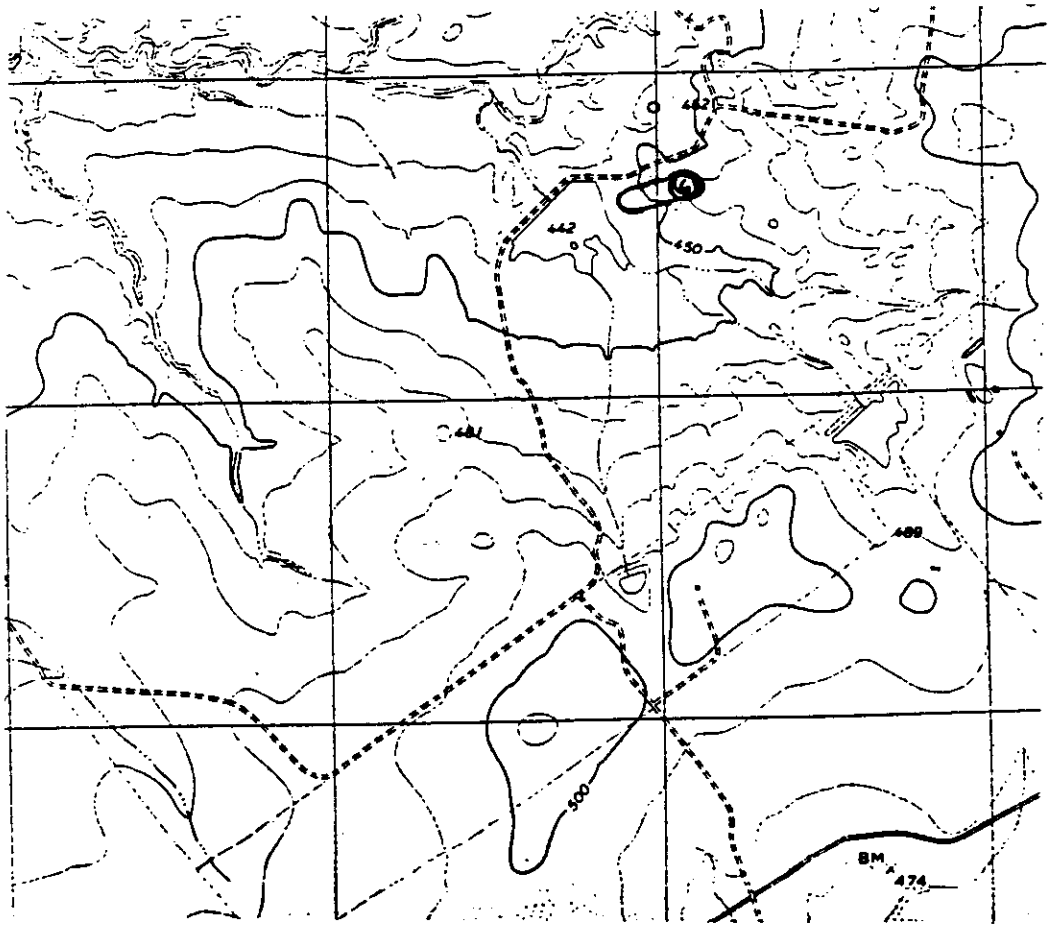

Figure 19. Population 19: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado East 7.5 minute topographic quadrangle.

Population 20: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	The Viduarri Estate, Jerry's part
Ownership:	The Viduarri Estate
Voucher:	Janssen & Williamson # 0675
Number of individuals:	~ 400
Area Covered:	~ 23 acres
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	Yes
Population Future:	Secure
Soil Sample Results:	Not collected

Population 20 occurs on a private ranch in northwestern Zapata County (see Figure 20). This population occurs upon a series of small eroding hills. Plants number approximately 400 and cover approximately 23 acres. This population continues onto the private ranch to the east, La Perla.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

This property belongs to the Heirs of Juan Viduarri, and this population occurs on a section given to Jerry Viduarri. Jerry works for the Webb County Agricultural Extension Office. Jerry and his family have signed a voluntary Conservation Agreement protecting this site.

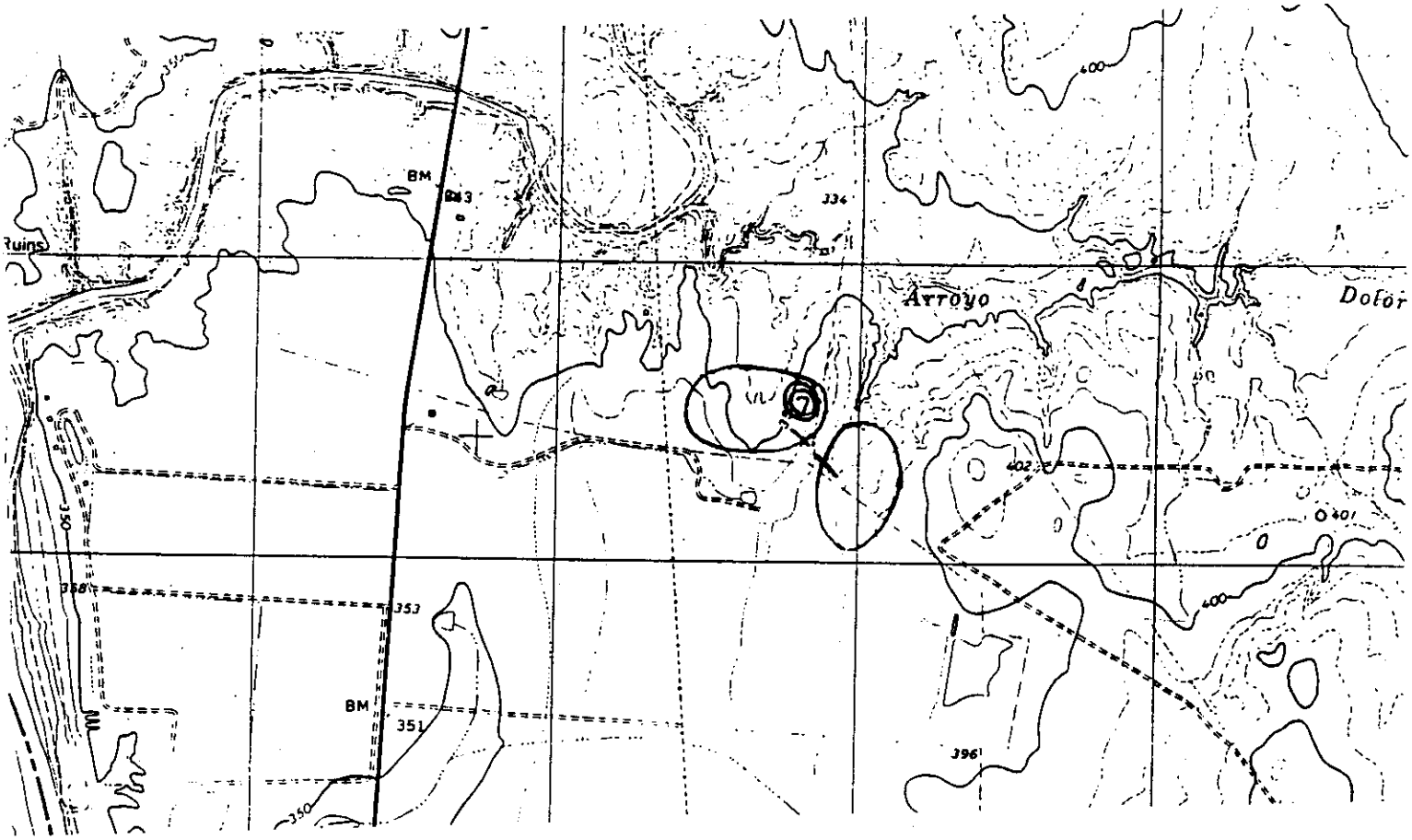

Figure 20. Population 20: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 21: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	The Tejon, arroyo wash
Ownership:	David Fender
Voucher:	Janssen & Williamson # 0546
Number of individuals:	~ 200
Area Covered:	~ 1 acre
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	Pending
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.8 strongly alkaline	40 ppm very high	29993 ppm very high	378 ppm high	8450 ppm very high	6245 ppm very high	Loam

Population 21 occurs on a private ranch in northwestern Zapata County (see Figure 21). This population is small and occurs within an erosion zone of an arroyo. There are approximately 200 plants at this site that covers an area of about an acre.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), cenizo (*Leucophyllum frutescens*), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., ephedra (*Ephedra antisyphilitica*), buffelgrass (*Cenchrus ciliaris*), creosote bush (*Larrea tridentata*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), desert lantana (*Lantana macropoda*), goat bush (*Castela texana*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

I have never met David Fender since he lives in Tyler, Texas, running his company called Zapata Fender. He only uses the property for hunting. He is aware of the *F. johnstonii* sites that occur on his ranch and has promised to make sure they remain in their natural state. We have talked on the phone many times, and he has promised to sign a voluntary Conservation Agreement (but still has not to date).

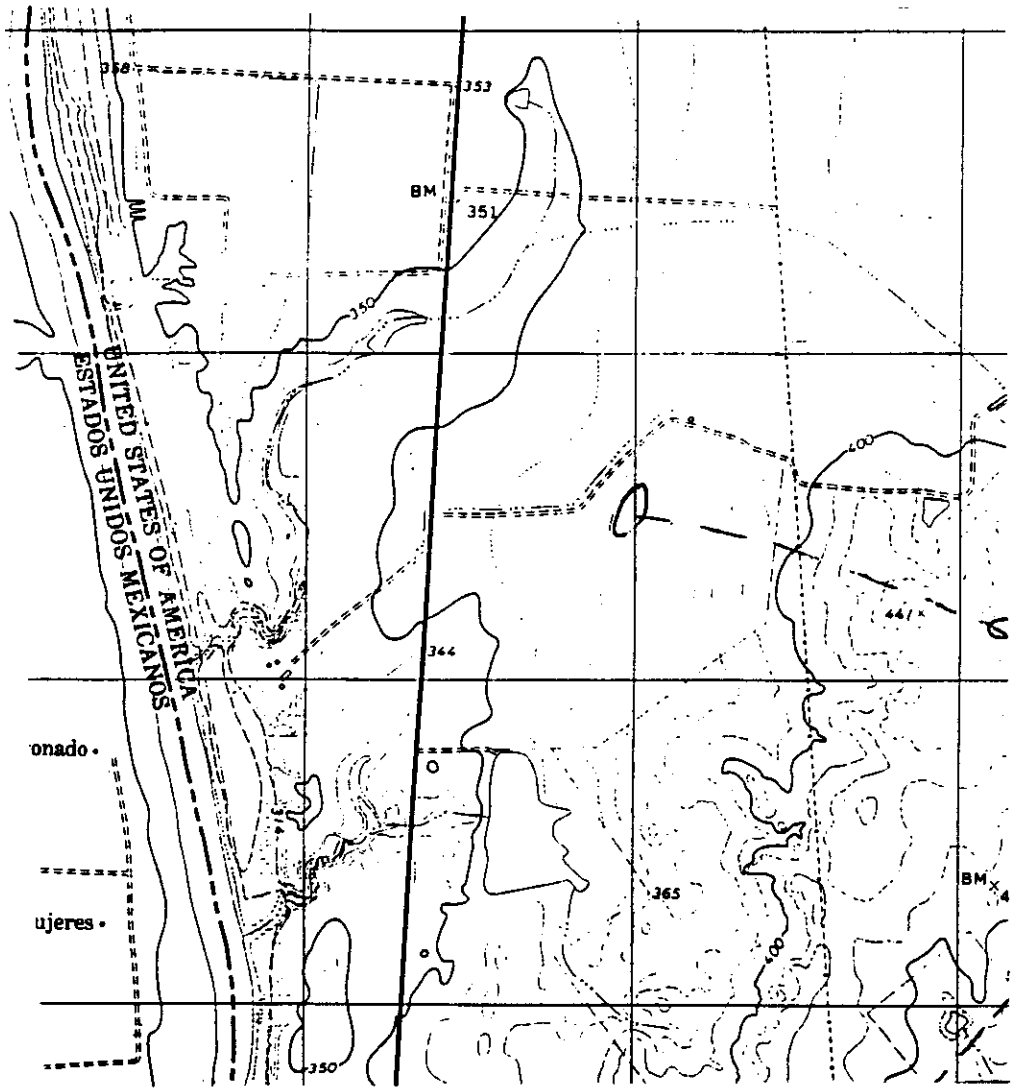

Figure 21. Population 21: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 22: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	The Tejon, fence line
Ownership:	David Fender
Voucher:	Janssen & Williamson # 0544
Number of individuals:	~ 3,400
Area Covered:	~ 12 or more acres
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	Pending
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
9.1 strongly alkaline	1 ppm very low	30006 ppm very high	561 ppm high	1716 ppm moderate	5297 ppm very high	Clay

Population 22 occurs on a private ranch in northwestern Zapata County (see Figure 22). This population is composed of three sub-populations. The first sub-population to the north is relatively small and occurs on saline opening within the brush. The plants are dense and number at least 300. The next sub-population occurs along the eastern fence line and continues well into the next ranch, the La Perla. The plants on the Tejon occur upon a salt-flat opening and number approximately 3,000. The third sub-population to the south occurs on a small saline flat opening and contains approximately 100 plants. The total area covered by the plants in this entire population is approximately 12 or more acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), whitebrush (*Aloysia gratissima*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp. buffelgrass (*Cenchrus ciliaris*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), fishhook cactus (*Ferocactus setispinus*), South Texas fishhook (*Ancistrocactus sheeri*), Pitaya (*Echinocereus enneacanthus*), cenizo (*Leucophyllum frutescens*), creosote bush (*Larrea tridentata*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), Spanish dagger (*Yucca treculeana*), coma (*Bumelia celastrina*), calderona (*Krameria ramosissima*), desert olive (*Forestieria angustifolia*), nipple cactus (*Mammalaria heyderi*), coyotillo (*Karwinskia humboldtiana*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and jicamilla (*Jatropha cathartica*).

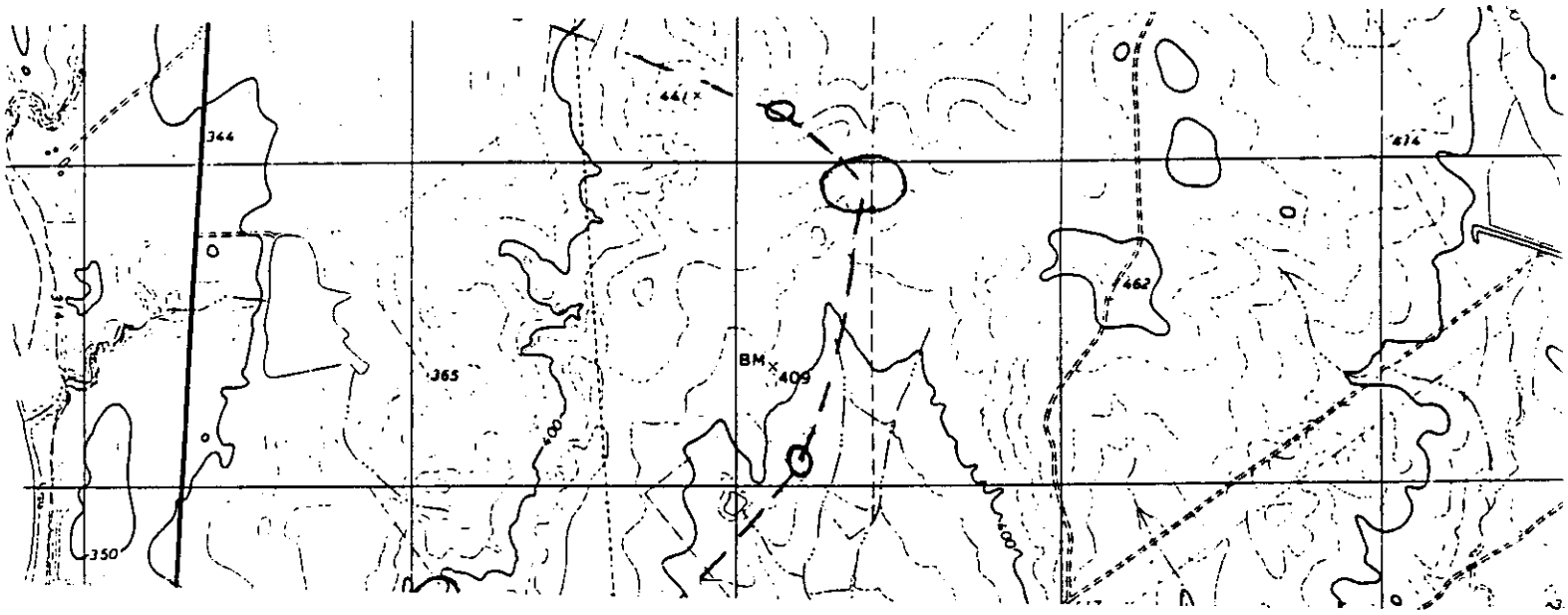

Figure 22. Population 22: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 23: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	The Tejon and La Perla Farms Road
Ownership:	David Fender and Francis Knapp
Voucher:	Janssen & Williamson # 0536
Number of individuals:	~ 10,500
Area Covered:	~ 15 acres
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	Pending
Population Future:	Secure, and Unknown

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
9.2 strongly alkaline	1 ppm very low	18733 ppm very high	313 ppm high	1235 ppm moderate	1605 ppm high	Sandy Clay Loam

Population 23 occurs on two private ranches in northwestern Zapata County (see Figure 23). This population is composed of two sub-populations. The larger sub-population to the east contains at least 10,000 or more densely clumped individuals on an area approximately 14 acres in size. The second smaller sub-population to the west occurs across the caliche road on another landowner's, Francis Knapp, property. This site is an eroding hillside with many fossilized oyster shells. There are approximately 300 individuals on an area smaller than an acre. The plants on the Tejon are in excellent to good condition, and the plants on the Knapp property are in fair to good condition on an area of about an acre.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), broomrape (*Orobanche multiflora*), common goldenweed (*Isocoma coronopifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), creosote bush (*Larrea tridentata*), desert lantana (*Lantana macropoda*), squaw bush (*Condalia spathulata*), orange zexmenia (*Wedelia hispida*), Fitch's hedgehog cactus (*Echinocereus fitchii*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), cenizo (*Leucophyllum frutescens*), desert yaupon (*Schaefferia cuneifolia*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

While the sites on the Tejon I believe are secure, the fate of the sites on the Knapp property are unknown. Francis Knapp, who lives in Brownsville, owns La Perla Farms, the fruits fields next to these populations. The *F. johnstonii* sites on this property occur on the hills surrounding the lowlands of the fruit fields. Mr. Knapp assured me, as did Steve McDaniel who lives on and runs the farm, that the hills surrounding the fruit fields will never be plowed. Mr. Knapp, however, was too leery to sign a conservation

agreement and thought that his word was good enough. There is no fence around these sites, and they are easily accessed.

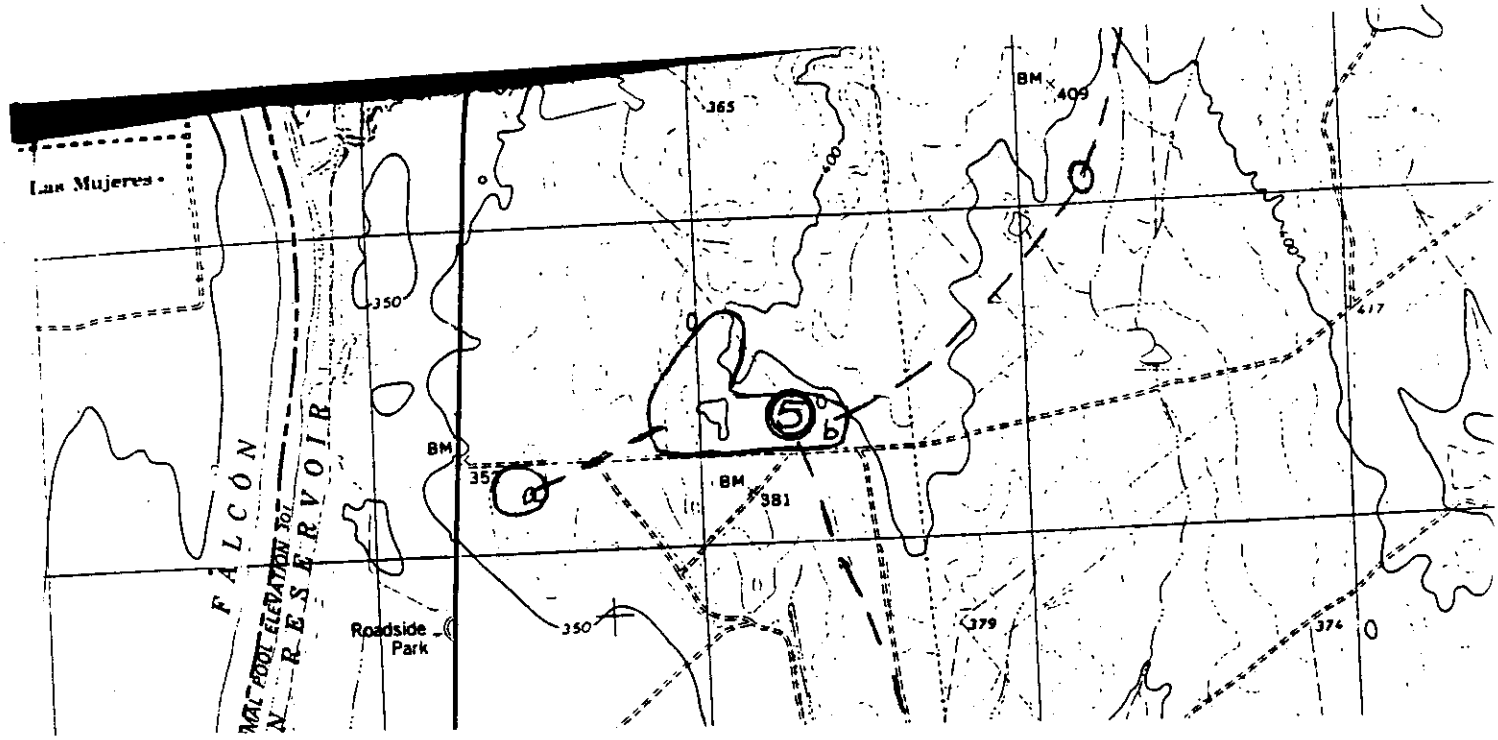

Figure 23. Population 23: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 24: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	Bee Hives
Ownership:	Francis Knapp
Voucher:	Janssen & Williamson # 0537
Number of individuals:	~ 300
Area Covered:	~ < 1 acre
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Questionable

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.9 strongly alkaline	1 ppm very low	30004 ppm very high	382 ppm high	7800 ppm very high	11121 ppm very high	Clay

Population 24 occurs on a private ranch in northwestern Zapata County (see Figure 24). This population occurs on an eroding rocky hillside and within a saline flat at the base of the hill. There are approximately 300 individuals in an area smaller than an acre. The plants are in good condition. The bee hives that house the bees for the fruit fields sit next to this site. This site is owned by Francis Knapp, as part of the population described above.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), creosote bush (*Larrea tridentata*), shorthorn zexmenia (*Zexmenia brevifolia*), desert lantana (*Lantana macopoda*), whitebrush (*Aloysia gratissima*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Spanish dagger (*Yucca treculeana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), squaw bush (*Condalia spathulata*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

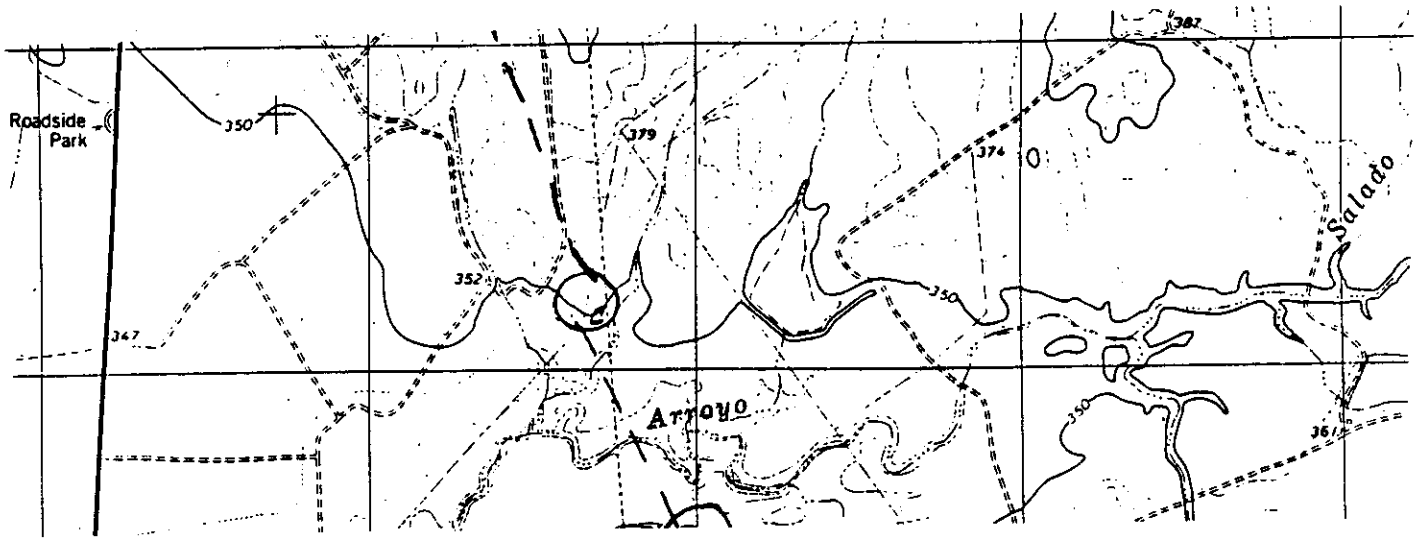

Figure 24. Population 24: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 25: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Site Name:	Los Corralitos, and Confidential
Ownership:	Laney Mecom and Confidential
Voucher:	Janssen & Williamson # 0676
Number of individuals:	~ 10,000 or more
Area Covered:	~ 130 to 150 acres
Soils:	Maverick-Catarina complex
Geology:	Laredo
Conservation Agreement:	Pending
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.5 strongly alkaline	4 ppm very low	8956 ppm very high	254 ppm high	3250 ppm very high	2476 ppm high	Clay Loam

Population 25 occurs on a private ranch in northwestern Zapata County (see Figure 25). This site is one continuous population that starts up on a saline flat (the southern portion) and proceeds down (north) following the contours of the rocky hills towards a portion of Arroyo Salado. There are tens of thousands of individuals within this population that cover at least 130 to 150 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), *Sueada* sp., screw bean mesquite (*Prosopis reptans*), Turner's sida (Billieturnera helleri), mesquite (*Prosopis glandulosa*), dog cholla (*Opuntia schottii*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., Fitch's hedgehog cactus (*Echinocereus fitchii*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (Ferocactus texensis), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert yaupon (*Schaefferia cuneifolia*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), jicamilla (*Jatropha cathartica*), and lotebush (*Ziziphus obtusifolia*).

The southern portion of this population occurs on the Los Corralitos Ranch owned by Laney Mecom. Years ago her father had the entire ranch root-plowed, seeded to grass, and had the place stocked with wild game animals from Africa. Everybody in Zapata County remembers when they used to drive by this ranch and see nothing but grass and things like giraffes and zebras. Today a lot of the brush has returned. It is obvious that the *F. johnstonii* site on this ranch was once root-plowed, but the plants have been able to re-establish. Laney Mecom said at one time that she would sign a conservation agreement, but she has not done it yet. The northern portion of this population occurs on the La Perla Ranch.

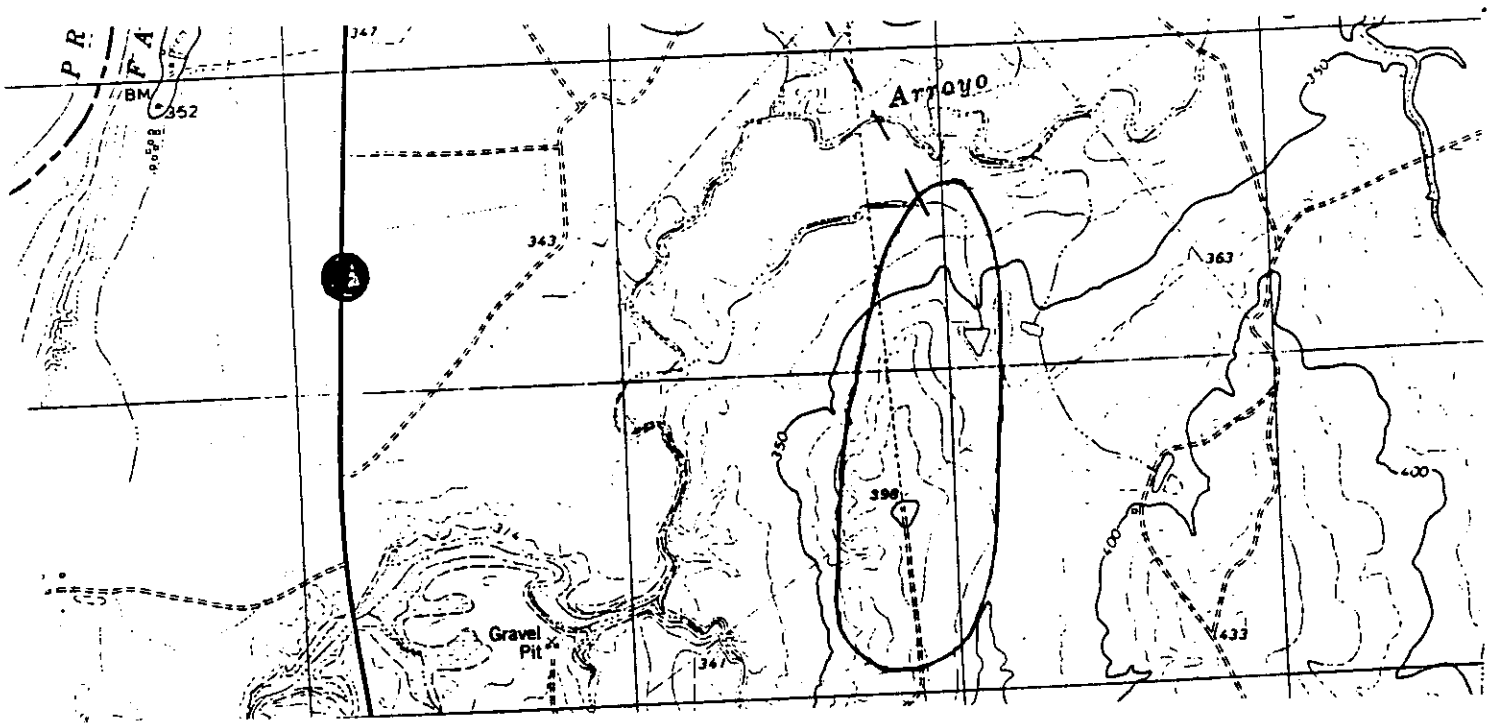

Figure 25. Population 25: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Salado West 7.5 minute topographic quadrangle.

Population 26: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Zapata and the Zapata SE 7.5 minute topographic quadrangles

Site Name:	Falcon Mesa Subdivision
Ownership:	Many within the subdivision and beyond
Voucher:	Janssen & Williamson # 0550
Number of individuals:	~ 2,150
Area Covered:	~ 3 or more acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Questionable to Grim

Soil Sample Results:

Sub-population (a)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.0 moderately alkaline	3 ppm very low	30036 ppm very high	909 ppm high	2600 ppm high	2798 ppm high	Clay

Sub-population (c)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.1 moderately alkaline	12 ppm low	26828 ppm very high	408 ppm high	10400 ppm very high	2836 ppm high	Clay Loam

Population 26 occurs on private tracts within the Falcon Mesa Subdivision just west of the Zapata proper (see Figure 26). There are three sub-populations that make up this "neighborhood" population. The first northern-most sub-population (*a*) occurs in a small open lot next to a house within the subdivision. There are approximately 100 plants in an area approximately 50 square meters. The second sub-population (*b*) to the south also occurs within a semi-developed neighborhood block next to an old shack. The plants are few, approximately 50, on a hilly site no bigger than 25 to 30 square meters. The third sub-population (*c*) is just outside of the neighborhood on a small tract of undeveloped brushland next to what used to be Falcon Reservoir (but is now a big dry hole). There are approximately 2,000 plants along the rocky hillside and saline flat that encompasses approximately 3 acres. Surprisingly all of the plants are in excellent to good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), Russian thistle (*Salsola australis*), dog cholla (*Opuntia schottii*), *Manfreda* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), desert hackberry (*Celtis pallida*), desert yaupon (*Schaefferia cuneifolia*),

calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), leatherstem (*Jatropha dioica*), and lotebush (*Ziziphus obtusifolia*).

The ownership of these sites has always been a complete headache to me. To make a very long story short, I currently do not know who owns any of these sites.

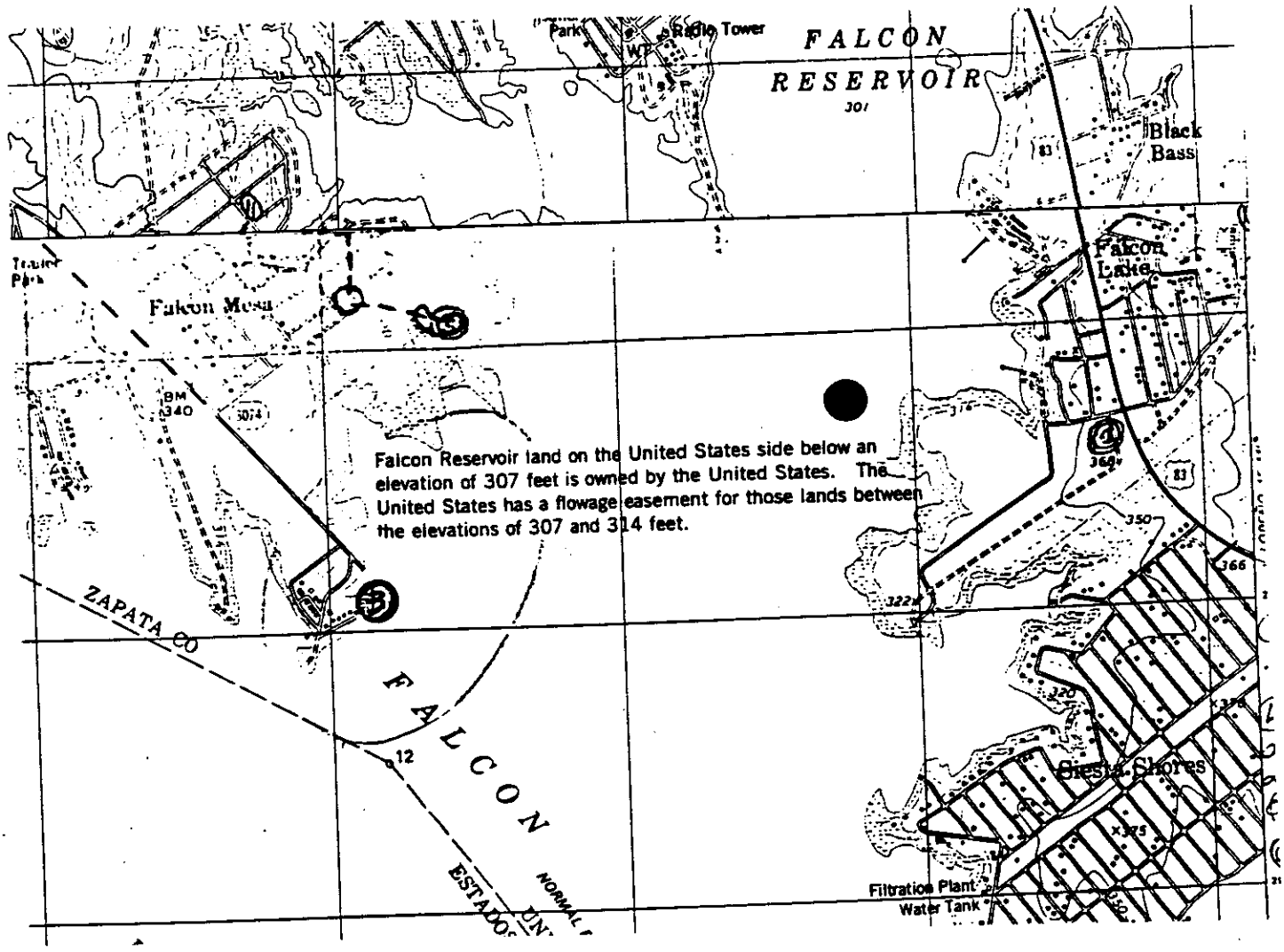

Figure 26. Population 26: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Zapata and the Zapata SE 7.5 minute topographic quadrangles.

Population 27: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Arroyo Veleño and Arroyo Huisache 7.5 minute topographic quadrangles

Site Name:	The Big Hwy 16 Cluster
Ownership:	Nine Landowners (from N to S: Gutierrez, Garcia, Gutierrez, Gutierrez, Alonzo, Confidential, Confidential, Don Jose Land & Cattle Co., and Flores)
Voucher:	Janssen & Williamson # 0661 (northern extent) and # 0662 (southern extent)
Number of individuals:	~ 40,450
Area Covered:	~ 150 to 170 acres
Soils:	Maverick-Catarina complex, and possibly some Copita-Brennan
Geology:	Jackson Group
Conservation Agreement:	Yes, the Southern Portion
Population Future:	Secure

Soil Sample Results:

Sub-population (b)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.5 strongly alkaline	24 ppm high	30003 ppm very high	282 ppm high	1560 ppm moderate	1497 ppm high	Clay

Sub-population (e)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	2 ppm very low	18774 ppm very high	350 ppm high	8450 ppm very high	3346 ppm very high	Sandy Clay

Sub-population (o)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	1 ppm very low	29995 ppm very high	264 ppm high	2340 ppm very high	4891 ppm very high	Sandy Clay

Population 27 occurs on nine private ranches in central Zapata County (see Figure 27). The grand population is 3.6 air miles long and 1.5 air miles wide at its widest point. The length of this site is bisected by Hwy. 16 (1.1 air miles from the northern boundary of this population). It could be argued that this is actually two populations separated by a major man-made structure that possibly interrupts gene/pollinator flow. However, for the sake of consistency, this site will be labeled as one population since all of the sub-populations are less than a mile apart from one another.

This population is composed of 17 sub-populations labeled (*a*) through (*q*), north to south respectively. Sub-population (*a*) occurs on a salt-flat opening adjacent to Salomoneño Creek, and contains approximately 500 individuals in good condition. Sub-population (*b*) occurs on a gently sloping rocky hillside with approximately 3,000 individuals in excellent to good condition. Sub-population (*c*) occurs on a rocky hillside opening within the brush and contains approximately 250 plants. Sub-population (*d*) occurs on a previously root-plowed salt-flat with approximately 1,000 scattered individuals in poor to

fair condition. Sub-population (*e*) contains approximately 5,000 or more plant along a gently sloping saline hill. Most of the plants within sub-population (*e*) have been browsed down to virtual nubs and should be considered in poor (but alive) condition (the browsed individuals) to good condition for the non-browsed individuals. Sub-populations (*f*) and (*g*) are both tiny rocky eroding hills with approximately 200 individuals total in good condition. Sub-population (*h*) is a highly dissected eroding rocky hill site with approximately 5,000 individuals. Sub-population (*i*) occurs on both eroding rocky hills and saline flats with approximately 10,000 or more individuals. Sub-populations (*j*) and (*k*) are both small salt-flat sites with approximately 300 plants total. Sub-populations (*l*) and (*m*) a both large, relatively level saline openings with approximately 10,000 plants total. Sub-population (*n*) is rocky hill that was root-plowed back in the 1980's. The plants have returned (some very large) are in fair condition, and number approximately 200. Sub-populations (*o*), (*p*) and (*q*) are all saline flat sites with a total of approximately 5,000 individuals in fair to good condition.

The total acreage covered by the 17 sub-populations is approximately 150 to 170 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), common goldenweed (*Isocoma coronopifolia*), screw bean mesquite (*Prosopis reptans*), yellow show (*Amoreuxia wrightii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., *Manfreda* sp., mesquite (*Prosopis glandulosa*), desert olive (*Forestieria angustifolia*), four-wing saltbush (*Atriplex canescens*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), goat bush (*Castela texana*), Pitaya (*Echinocereus enneacanthus*), Fitch's hedgehog cactus (*Echinocereus fitchii*), nipple cactus (*Mammalaria heyderi*), yellow dumpling cactus (*Mammalaria sphaerica*), South Texas fishhook (*Ancistrocactus sheeri*), dog cholla (*Opuntia schottii*), horse crippler (*Ferocactus texensis*), fishhook cactus (*Ferocactus setispinus*), desert yaupon (*Schaefferia cuneifolia*), blackbrush (*Acacia rigidula*), guajillo (*Acacia berlandieri*), calderona (*Krameria ramosissima*), snake-eyes (*Phaulothamnus spinescens*), coma (*Bumelia celastrina*), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), cenizo (*Leucophyllum frutescens*), guayacan (*Guaiacum angustifolium*), creosote bush (*Larrea tridentata*), Spanish dagger (*Yucca treculeana*), coyotillo (*Karwinskia humboldtiana*), leatherstem (*Jatropha dioica*), jicamilla (*Jatropha cathartica*), and lotebush (*Ziziphus obtusifolia*).

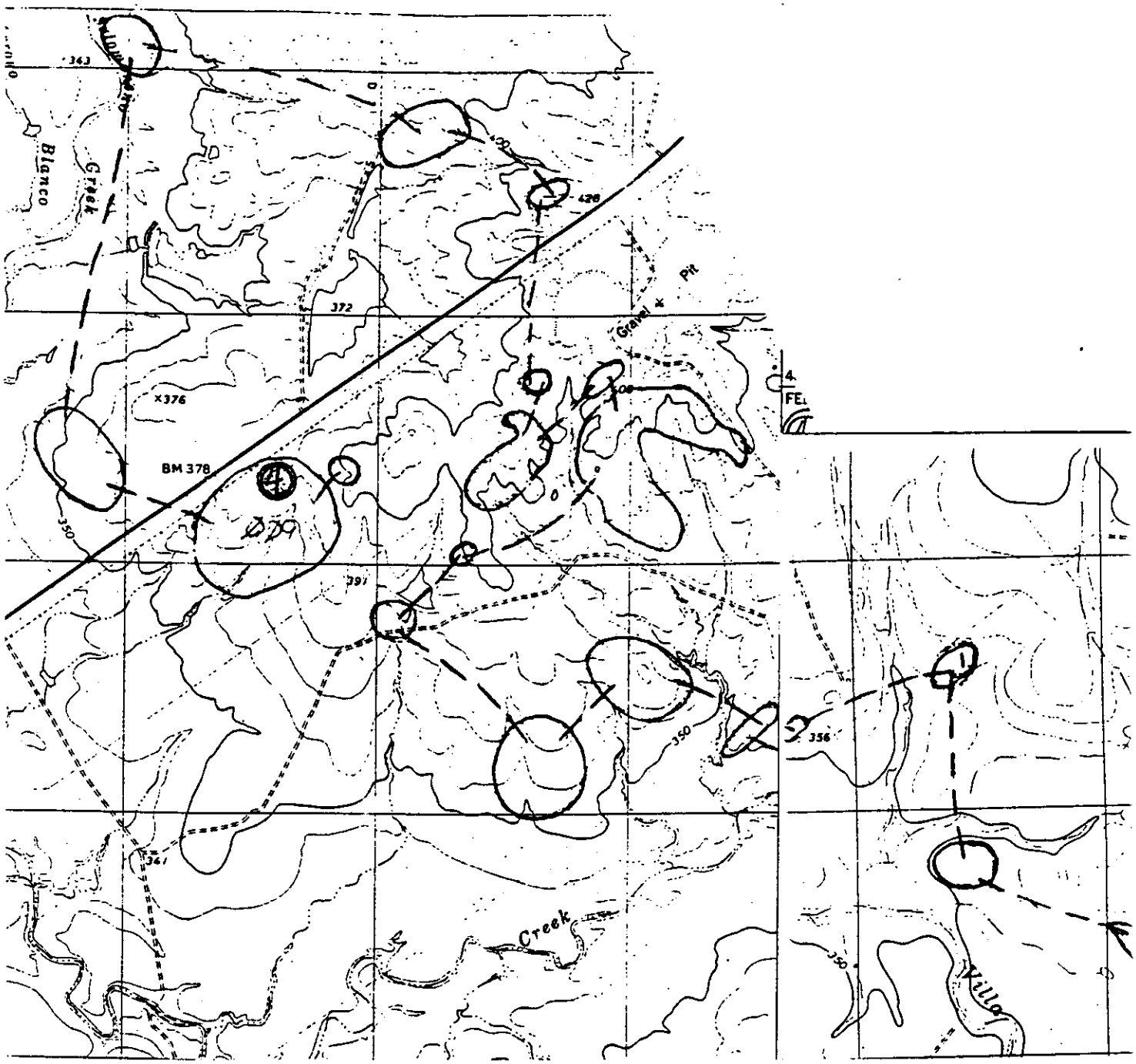

Figure 27. Population 27: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Arroyo Veleño and Arroyo Huisache 7.5 minute topographic quadrangles.

Population 28: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Rafa Central
Ownership:	Rafael Flores
Voucher:	Janssen & Williamson # 0553
Number of individuals:	~ 2,900
Area Covered:	~ 60 to 70 acres
Soils:	Copita-Brennan
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

Sub-population (b)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.5 strongly alkaline	9 ppm very low	26884 ppm very high	260 ppm high	9100 ppm very high	3359 ppm very high	Clay

Population 28 occurs on a private ranch in central Zapata County (see Figure 28). This population is composed of three sub-populations and measures approximately one mile across from sub-population (*a*) to (*c*).

Sub-populations (*a*), (*b*) and (*c*) are each saline flat openings within the brush. Sub-population (*a*) contains approximately 100 individuals; sub-population (*b*) contains approximately 2,500 individuals; and, sub-population (*c*) contains approximately 300 individuals. All plants are in good condition. The total area covered by this population is approximately 60 to 70 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

The owner of this site, Mr. Flores, is a lawyer in McAllen. Mr. Flores is very old and has been sick for quite a while. His son, Rafael Flores, has been my primary contact for this ranch. Rafa is very conservation minded and willing to go above and beyond what is needed to protect his endangered plants. He has signed a voluntary Conservation Agreement with Texas Parks and Wildlife Department. He always makes sure that any

seismic crews and gas companies do not destroy his populations. And, Rafa is just an all-around good guy.

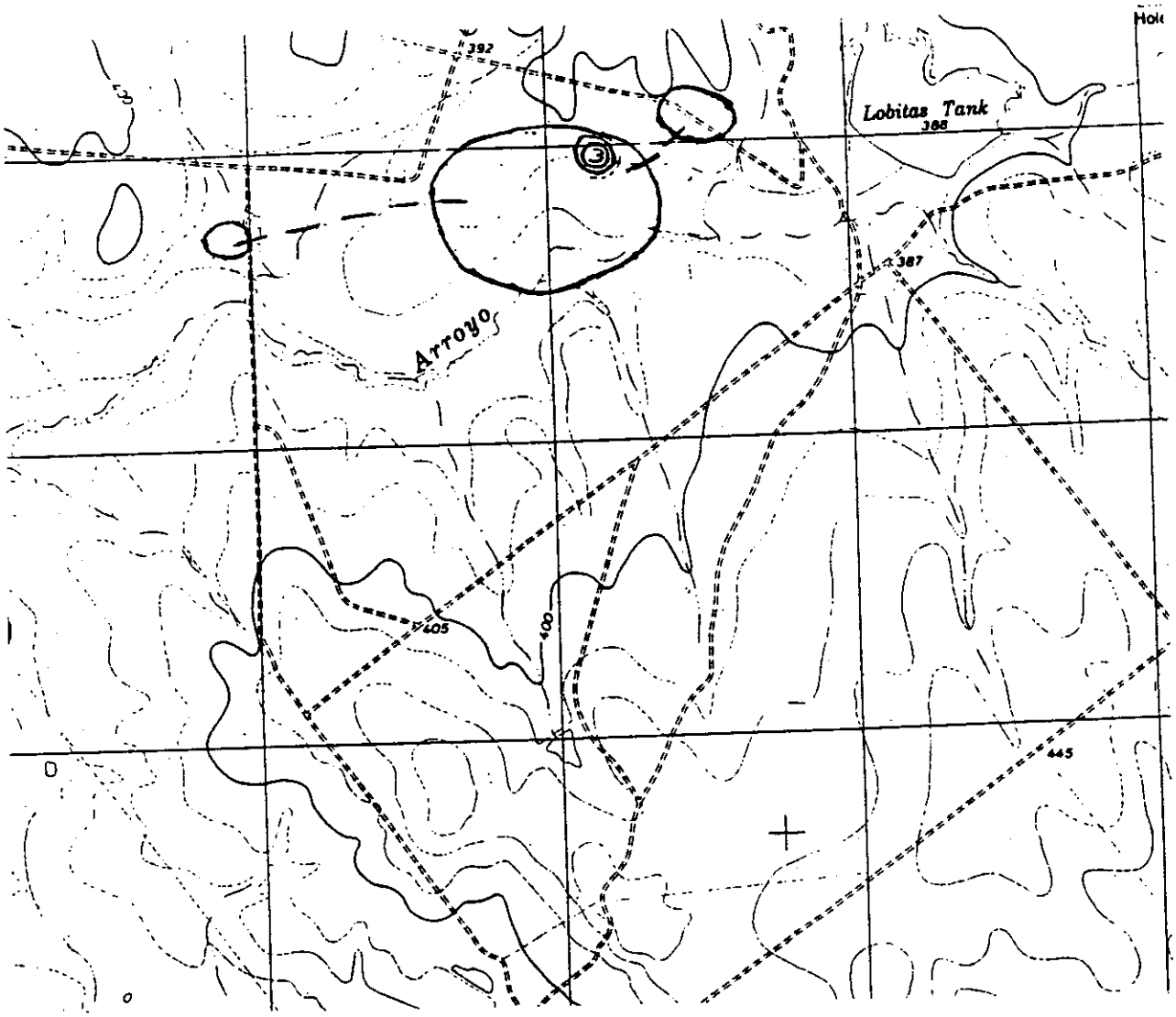

Figure 28. Population 28: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 29: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Rafa Fenceline
Ownership:	Rafael Flores
Voucher:	Janssen & Williamson # 0554
Number of individuals:	~ 300
Area Covered:	~ 1 acre
Soils:	Copita-Brennan
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.4 moderately alkaline	244 ppm very high	29999 ppm very high	460 ppm high	8450 ppm very high	12404 ppm very high	Clay

Population 29 occurs on a private ranch in central Zapata County (see Figure 29). This population occurs on a small eroding hillside and appears to have been previously disturbed by the bulldozer work on the tank in the area. The plants have started to re-colonize the area, and number approximately 300. The plants range from poor to good condition and cover approximately an acre. This site is owned by the same landowner as population 28 above.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., thorn-crested agave (*Agave lophantha*), fishhook cactus (*Ferocactus setispinus*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), coyotillo (*Karwinskia humboldtiana*), leatherstem (*Jatropha dioica*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

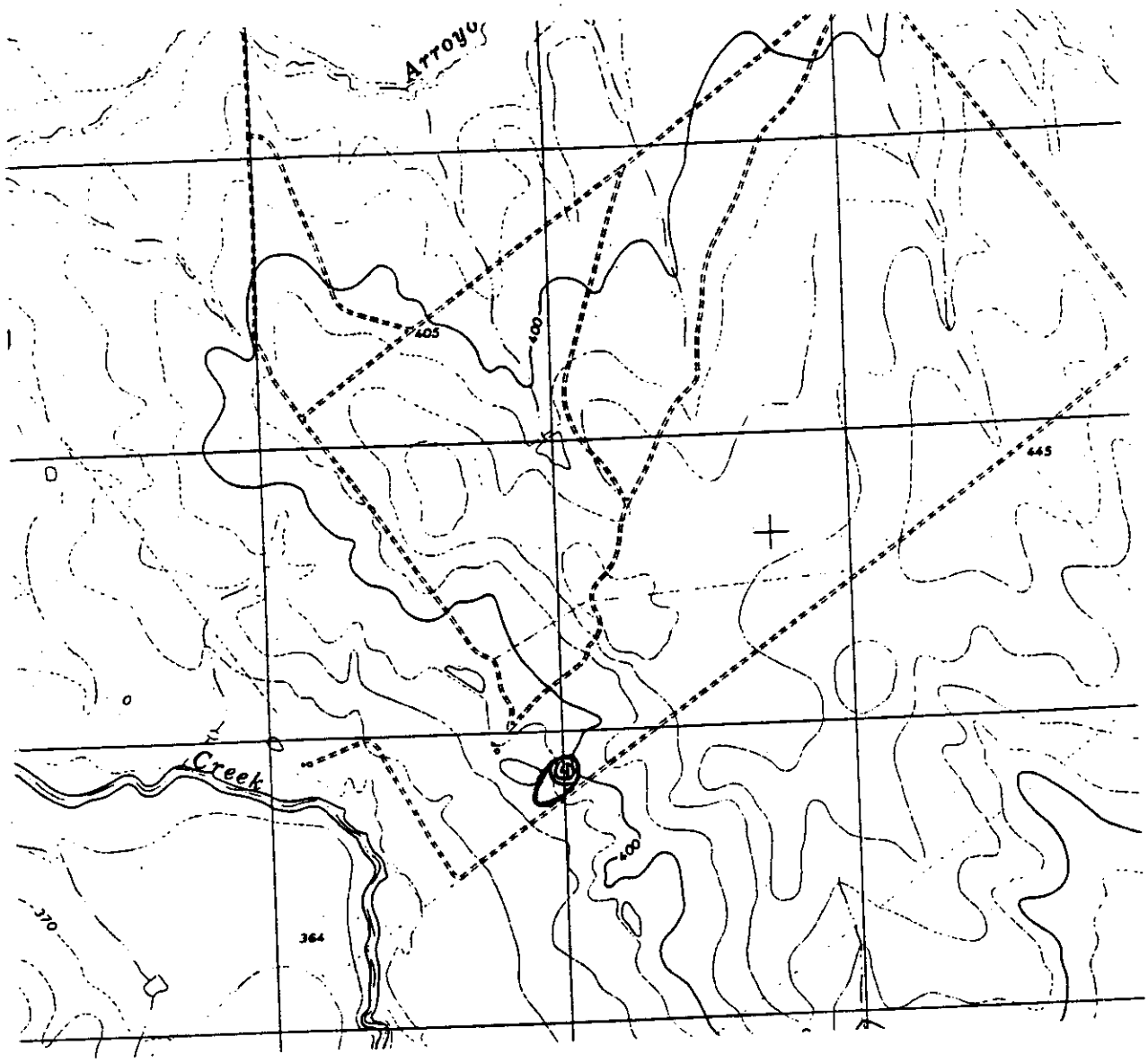

Figure 29. Population 29: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 30: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Baby Lopez
Ownership:	J. W. Lopez
Voucher:	Not collected
Number of individuals:	~ 50
Area Covered:	~ < 1 acre
Soils:	Copita-Brennan
Geology:	Yegua
Conservation Agreement:	Yes
Population Future:	Secure
Soil Sample Results:	Not collected

Population 30 occurs on a private ranch in central Zapata County (see Figure 30). This population is very small and contains only about 50 individuals on a tiny saline flat area at the base of a hill. The area covered is about 50 square meters. The plants are in good condition.

Associated species not recorded.

Mr. Lopez owns this site and Population 37 below. He is aware of the species on his property and has promised keep theses sites in their natural state. He has signed a voluntary Conservation Agreement with Texas Parks and Wildlife.

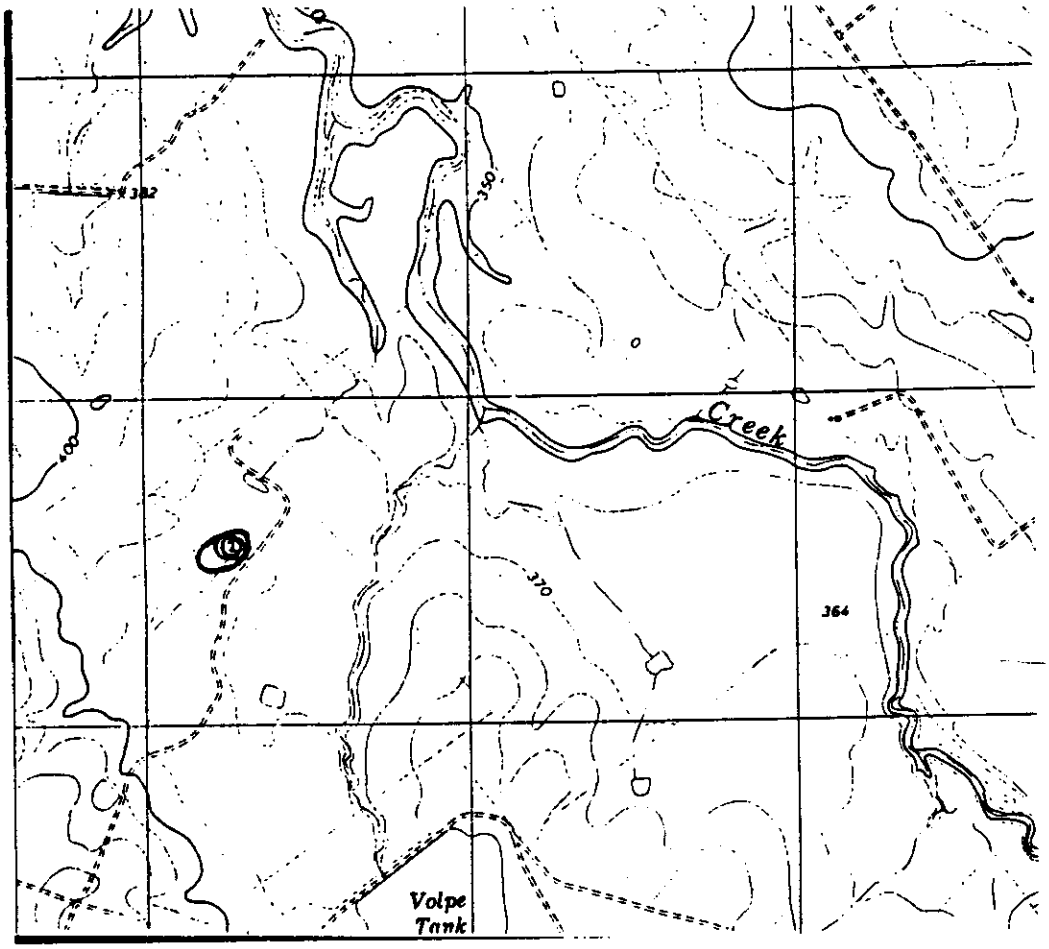

Figure 30. Population 30: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 31: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Haynes
Ownership:	Roberto Haynes Estate
Voucher:	Janssen & Williamson # 0555
Number of individuals:	~ 2,600
Area Covered:	~ 40 acres
Soils:	Copita-Brennan
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
9.1 strongly alkaline	13 ppm very low	30044 ppm very high	497 ppm high	1170 ppm slight	2324 ppm high	Clay

Population 31 occurs on a private ranch in central Zapata County (see Figure 31). This site is composed of two sub-populations. The first sub-population to the west occurs upon a highly eroding rocky hill and contains approximately 100 individuals. The second sub-population occurs on a rocky saline opening within the brush and is composed of approximately 2,500 or more individuals. The total area covered by the plants on this ranch is about 40 acres. All the plants on this ranch are in excellent to good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), yellow dumpling cactus (*Mammalaria sphaerica*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), rat-tail cactus (*Wilcoxia poselgeri*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Tom Thumb cactus (*Mammalaria roberti*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), Texas kidneywood (*Eysenhardtia texana*), whitebrush (*Aloysia gratissima*), desert yaupon (*Schaefferia cuneifolia*), desert olive (*Forestieria angustifolia*), blackbrush (*Acacia rigidula*), calderona (*Krameria ramosissima*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Roberto Haynes passed away a few years ago, as did one of their sons. His wife Hilda controls all the assets now. Mrs. Haynes lives in Laredo and has signed a voluntary Conservation Agreement with Texas Parks and Wildlife promising to keep her populations in their natural state.

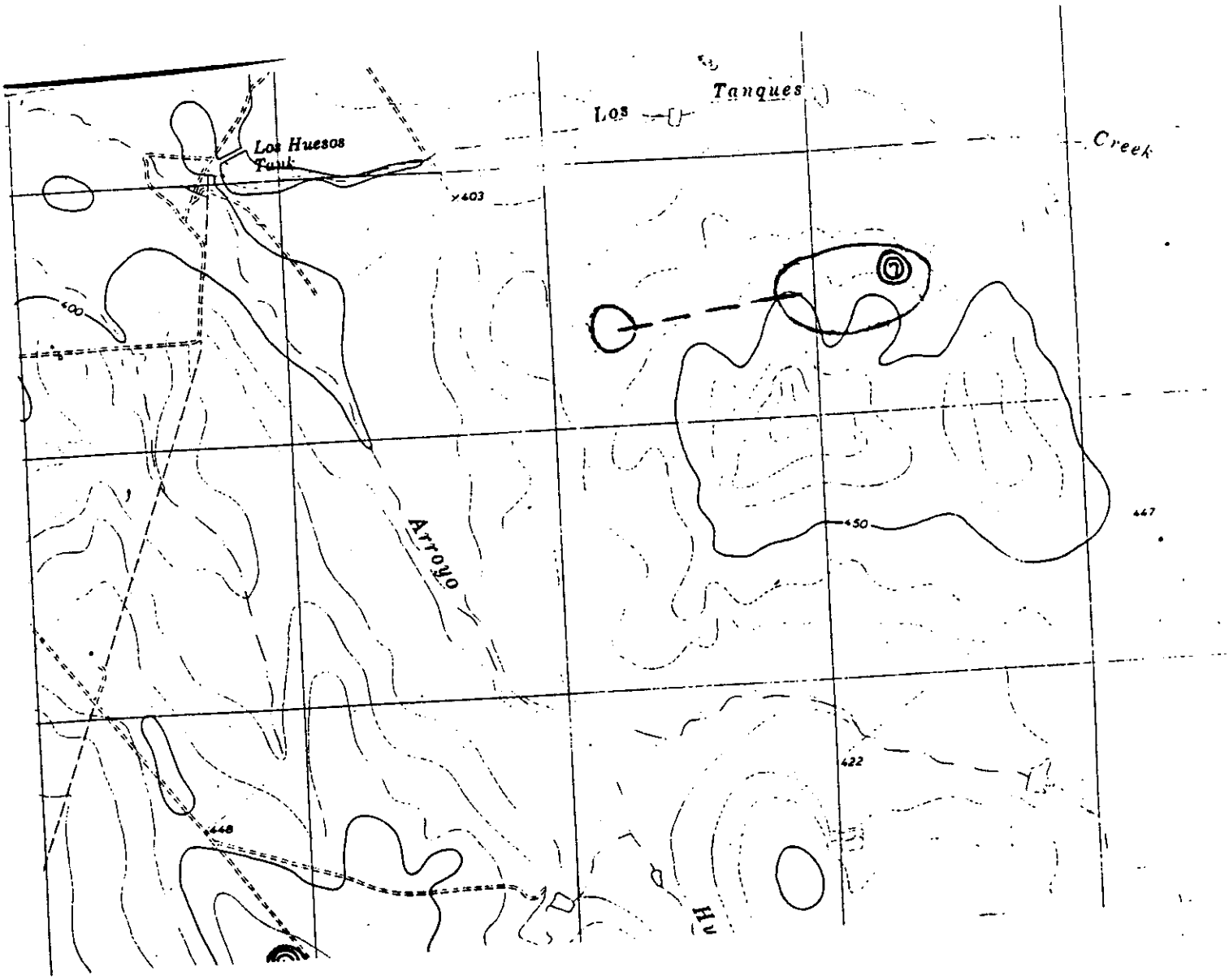

Figure 31. Population 31: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 32: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Pete Central
Ownership:	The Villareal Estate
Voucher:	Janssen & Williamson # 0660
Number of individuals:	~ 500,000 to 1,000,000
Area Covered:	~ 175 to 185 acres
Soils:	Copita-Brennan
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.3 moderately alkaline	4 ppm very low	30007 ppm very high	333 ppm high	2470 ppm high	3897 ppm very high	Clay

Population 32 occurs on a private ranch in central Zapata County (see Figure 32). This population is tremendous. It is 1.25 miles long and approximately .3 miles wide at its widest point. The plants are continuous within this combination of small rocky hills and large saline flat openings. There are hundreds of thousands of individuals within this site that covers approximately 175 to 185 solid acres. The plants are in excellent to good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), shoregrass (*Monanthochloe littoralis*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), yellow dumpling cactus (*Mammalaria sphaerica*), desert olive (*Forestieria angustifolia*), whitebrush (*Aloysia gratissima*), ephedra (*Ephedra antisyphilitica*), blackbrush (*Acacia rigidula*), snake-eyes (*Phaulothamnus spinescens*), guayacan (*Guaiacum angustifolium*), Spanish dagger (*Yucca treculeana*), and lotebush (*Ziziphus obtusifolia*).

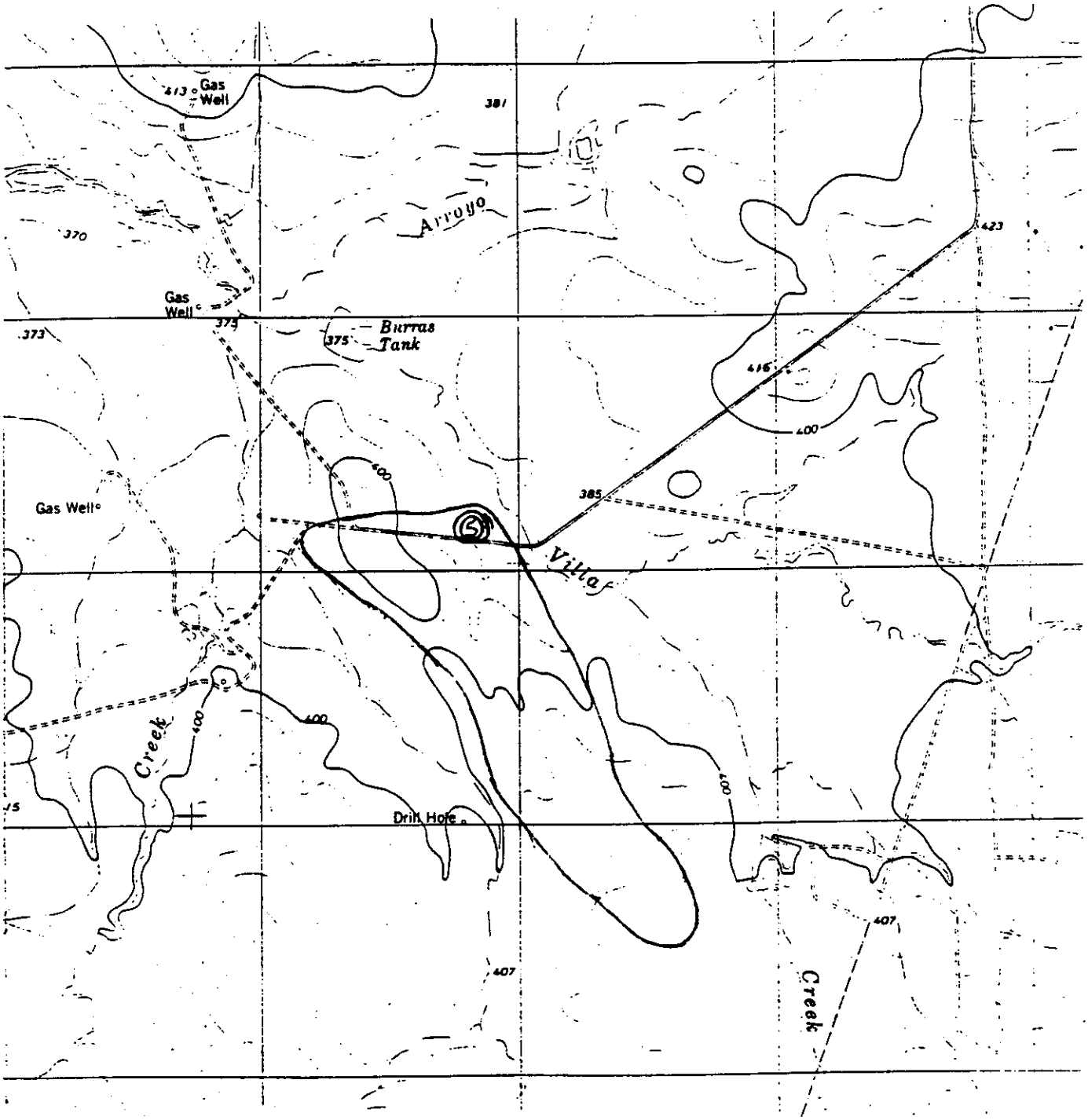

Figure 32. Population 32: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 33: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Site Name:	Pete Fenceline
Ownership:	The Villareal Estate
Voucher:	Janssen & Williamson # 0559
Number of individuals:	~ 5,000
Area Covered:	~ 20 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.5 strongly alkaline	13 ppm low	30000 ppm very high	505 ppm high	10400 ppm very high	3987 ppm very high	Clay

Population 33 occurs on private ranch in central Zapata County (see Figure 33). This population occupies a rocky saline flat opening within the brush and contains approximately 5,000 or more individuals. Plants are in excellent to good condition covering an area of approximately 20 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), shoregrass (*Monanthochloe littoralis*), *Euphorbia* sp., leatherstem (*Jatropha dioica*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), rat-tail cactus (*Wilcoxia poselgeri*), yellow dumpling cactus (*Mammalaria sphaerica*), desert olive (*Forestieria angustifolia*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

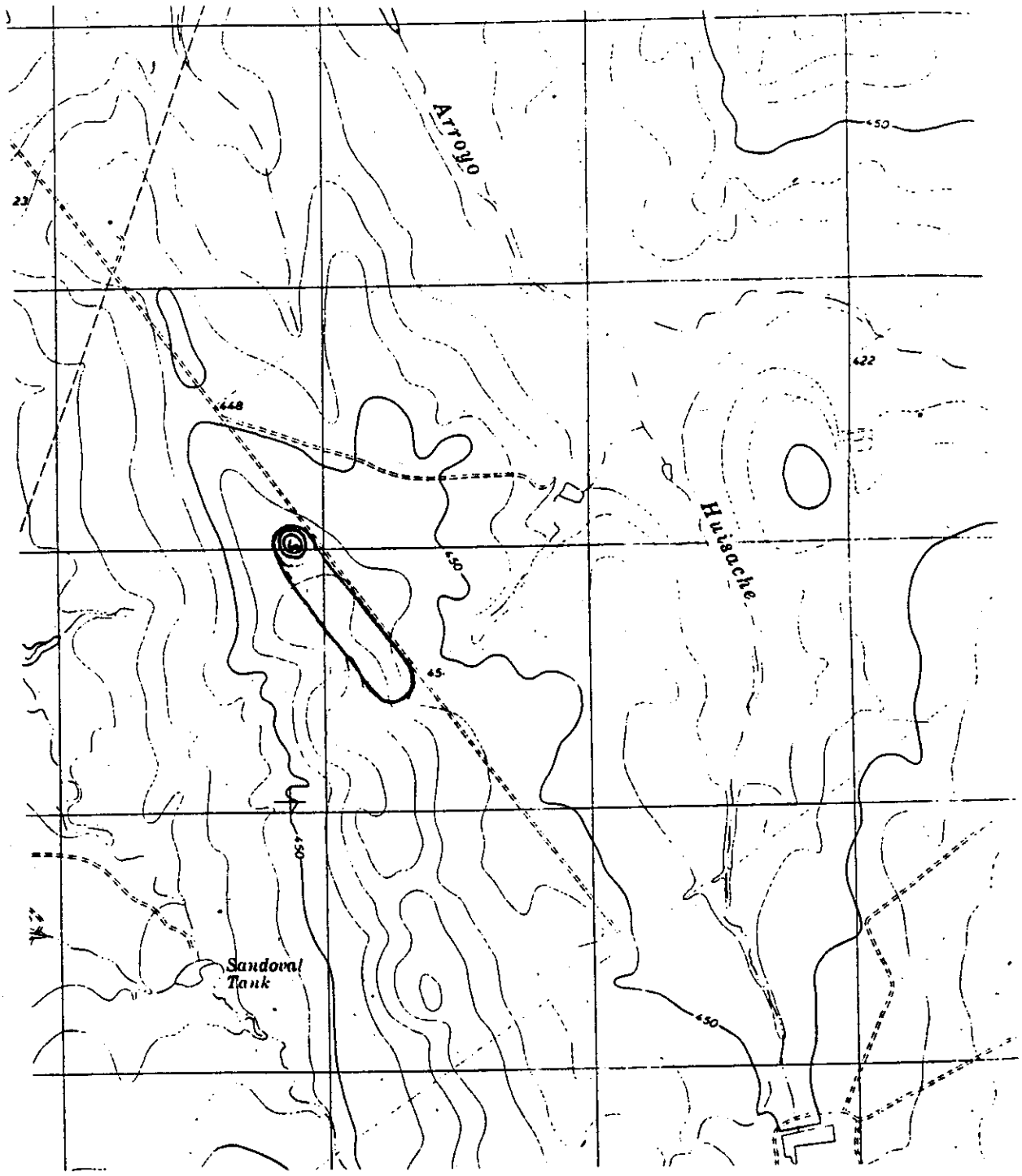

Figure 33. Population 33: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Huisache 7.5 minute topographic quadrangle.

Population 34: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Site Name:	Higinio's
Ownership:	Higinio Gutierrez and I. M. Singer
Voucher:	Janssen & Williamson # 0556
Number of individuals:	~ 10,000
Area Covered:	~ 80 to 100 acres
Soils:	Copita-Zapata
Geology:	Jackson Group
Conservation Agreement:	Yes, on most it (Mr. Gutierrez's ranch)
Population Future:	Secure

Soil Sample Results:

Sub-population (a)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	6 ppm very low	30009 ppm very high	358 ppm high	949 ppm slight	7431 ppm very high	Clay

Population 34 occurs on two private ranches in central Zapata County (see Figure 34). This site is composed of three sub-populations and is one air mile in length. The northern-most sub-population (*a*) occurs primarily at the base of a steeply eroding hill and contains approximately 5,000 individuals. The central sub-population (*b*) is in a salt flat area at the base of a small hill with approximately 5,000 individuals. The third sub-population (*c*) is quite large, although discontinuous in some places, and occurs on two ranches. The northern portion occurs on Mr. Guttierez's ranch, and the southern portion on Mr. Singer's ranch. There are 10,000 or more individuals within this sub-population. The plants cover approximately 80 to 100 acres and all are in good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), calderona (*Krameria ramosissima*), coyotillo (*Karwinskia humboldtiana*), leatherstem (*Jatropha dioica*), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Mr. Higinio Gutierrez is aware of the species on his ranch has promised to keep those areas in their natural state. He has signed a voluntary Conservation Agreement with Texas Parks and Wildlife. Although Mr. Singer is aware of the species on his property,

he did not quite understand the meaning of the conservation agreement and did not want to sign it.

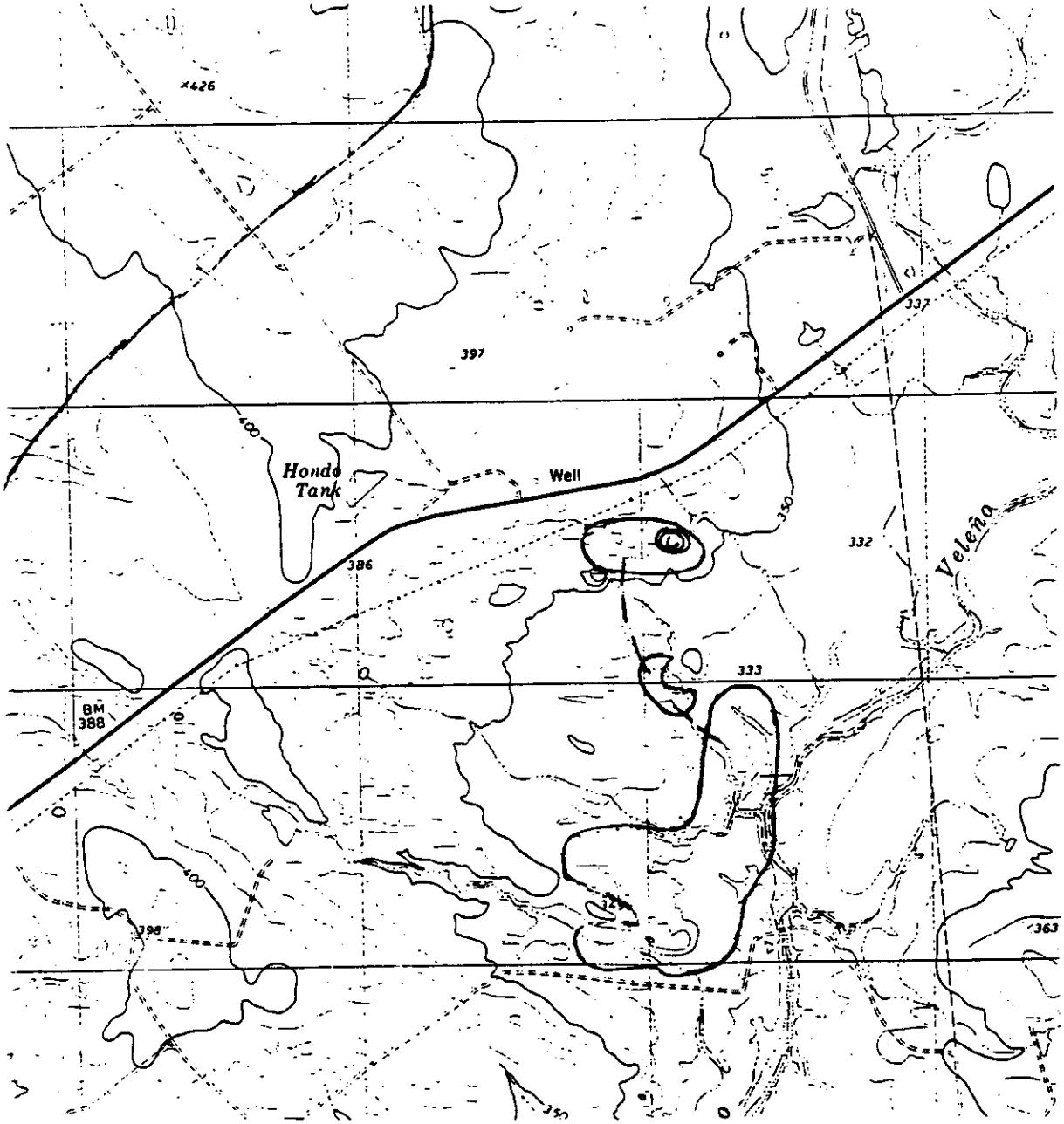

Figure 34. Population 34: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Population 35: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Site Name:	The Tank and the Hills WNWWHEGB
Ownership:	Don Jose Land & Cattle Co.
Voucher:	Janssen & Williamson # 0557
Number of individuals:	~ 25,550
Area Covered:	~ 50 acres
Soils:	Maverick-Catarina complex
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.7 strongly alkaline	1 ppm very low	4621 ppm very high	218 ppm high	1560 ppm moderate	1243 ppm high	Sandy Loam

Population 35 occurs on a private ranch in central Zapata County (see Figure 35). This site is composed of five sub-populations and is 1.5 air miles wide. Sub-populations are labeled (*a*) through (*e*), west to east. Sub-population (*a*) occurs on a salt flat expanse and contains approximately 20,000. Sub-population (a) appears to have endured some disturbance from the adjacent tank construction, but rebounding well. Sub-population (*b*) occurs on a rocky hillside with approximately 200 individuals. Sub-population (*c*) starts on a hilltop and follows the gently sloping contours down the hill. Sub-population (*c*) contains approximately 5,000 individuals. Sub-population (*d*) occurs on an open saline hilltop and contains approximately 200 individuals. Sub-population (*e*) occurs on a rocky hillside and contains approximately 150 individuals. The total area covered by the plants within this entire population is approximately 45 to 50 acres. The plants within sub-population (*a*) are in fair to good condition, while plants within the remaining sub-populations are in good condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., yellow show (*Amoreuxia wrightii*), *Manfreda* sp., leatherstem (*Jatropha dioica*), jicamilla (*Jatropha cathartica*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), alicoche (*Echinocereus* sp.), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), calderona (*Krameria ramosissima*), coyotillo (*Karwinskia humboldtiana*), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

This site is owned by Don Jose Land and Cattle Company. Mr. Jose O. Dodier, Sr. died a few years back and now the sons own the ranch. My contact for this site is Mr. Jose O. Dodier, Jr. (or Joe, as I call him), who is on the Zapata County Soil and Water Board and the Vice President of South Texas South and Water Conservation Districts. Most of this ranch has been root-plowed through the years [sub-population 27 (*n*) above occurs on this same ranch.]. However, management practices have changed and today more of the native habitats are being conserved. Mr. Dodier, Jr. was one of the original landowners requesting that research be done on *F. johnstonii* back in the late 80's and early 90's. Mr. Dodier has been the number one supporter of this project, and has bent over backwards to see that we all work together to get this species conserved and delisted. Mr. Dodier has promised to conserve and protect all the populations that occur on his property and has signed a voluntary Conservation Agreement with Texas Parks and Wildlife.

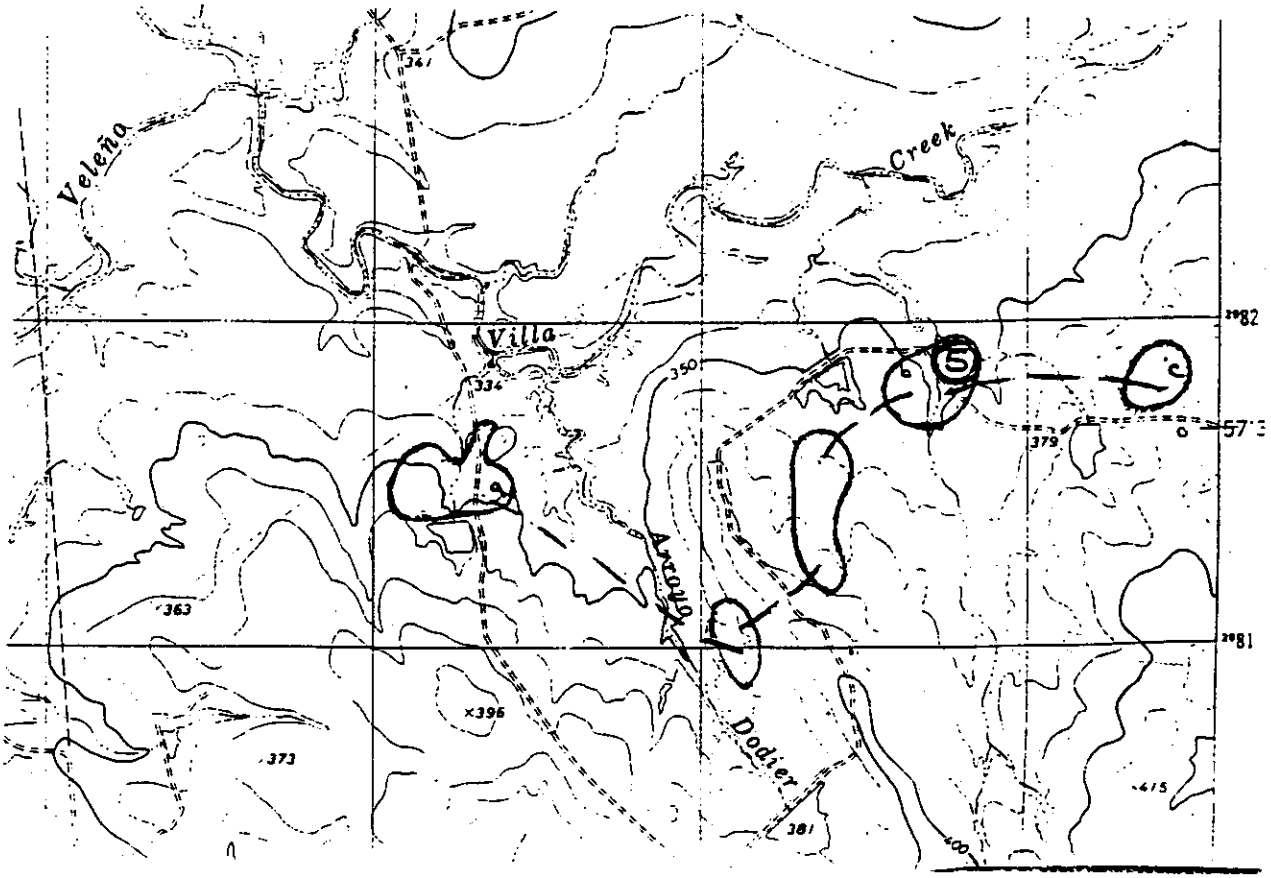

Figure 35. Population 35: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Population 36: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Site Name:	Joe's Daddy's Place
Ownership:	Don Jose Land & Cattle Co.
Voucher:	Janssen & Williamson # 0558
Number of individuals:	~ 5,000
Area Covered:	~ 40 acres
Soils:	Copita-Zapata
Geology:	Jackson Group
Conservation Agreement:	Yes
Population Future:	Secure
Soil Sample Results:	Not collected

Population 36 occurs on a private ranch in west central Zapata County (see Figure 36). This site was root-plowed in the 1980's but the plants have been able to re-establish. The plants are widely scattered throughout this vast saline flat. There are approximately 5,000 individuals that cover approximately 40 acres. The plants are in fair to good condition. This site is owned by the same owners as Population 35 above.

Associated species not recorded.

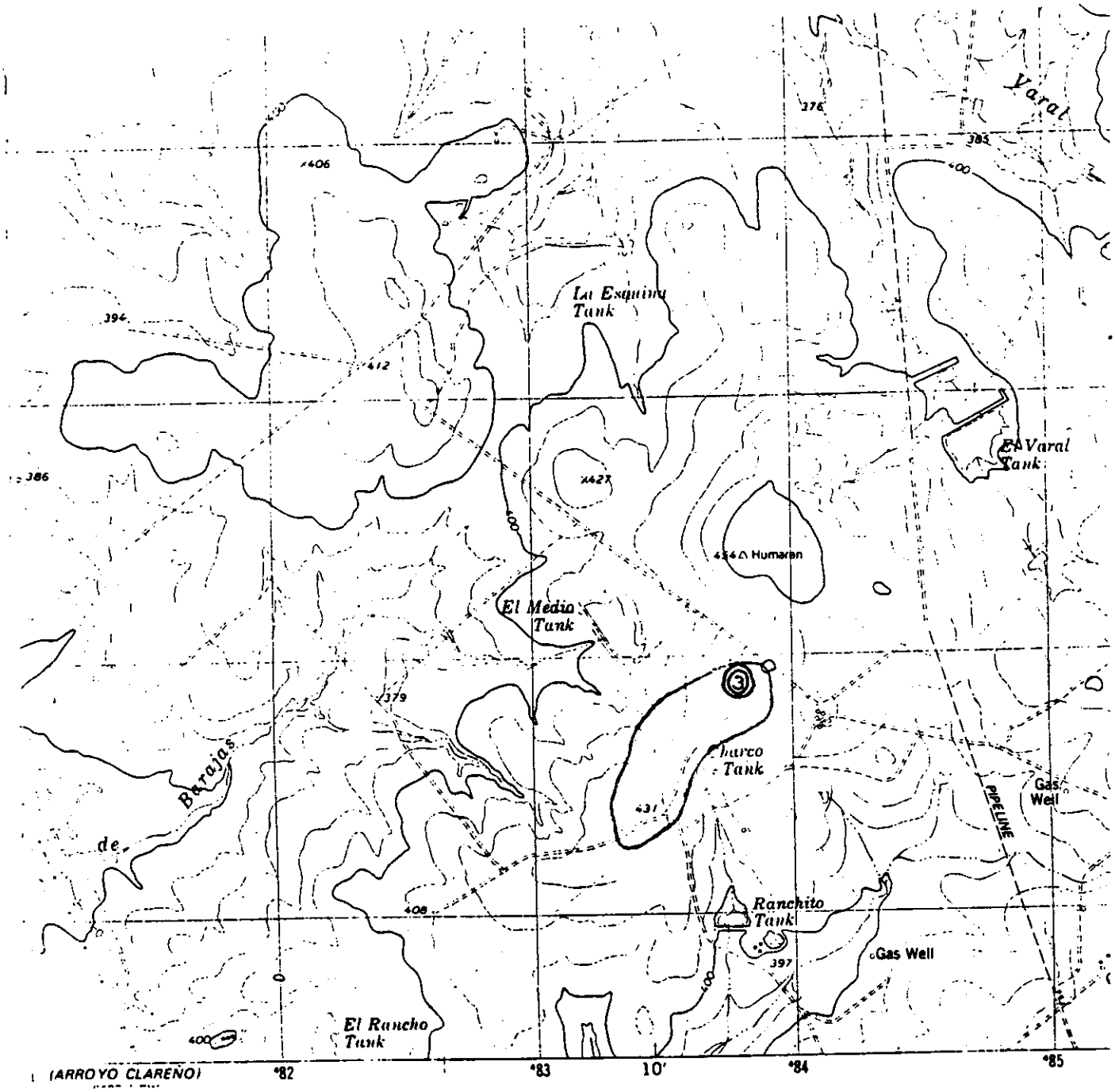

Figure 36. Population 36: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Veleño 7.5 minute topographic quadrangle.

Population 37: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Site Name:	The Lopez Hwy. 83 Cluster
Ownership:	J. W. Lopez and TxDOT
Voucher:	D. S. Correll # 35458; M. Whalen # 506; Janssen & Williamson # 0681 & # 0682.
Number of individuals:	~ 2,886
Area Covered:	~ 90 to 95 acres
Soils:	Zapata-Maverick
Geology:	Laredo and Yegua
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

Sub-population (a)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
7.7 mildly alkaline	7 ppm very low	11865 ppm very high	435 ppm high	4550 ppm very high	2160 ppm high	Clay Loam

Sub-population (j)

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.8 strongly alkaline	3 ppm very low	18808 ppm very high	338 ppm high	2470 ppm high	3363 ppm very high	Sandy Clay

Population 37 occurs on a private ranch in western Zapata County just south of the town of Zapata (see Figure 37). According to specimen records, this site was first visited in December of 1967 by D. S. Correll. Molly Whalen also visited this site in 1978 during her Ph.D. dissertation research on the genus *Frankenia* (Whalen 1980). However, I must say that Mr. Lopez had never heard of either of these two people and had no idea that he had the species on his property. Nearly 33 years since its discovery, this site remains extant and thriving.

This population is 1.8 air miles long and is composed of 13 sub-populations labeled (*a*) through (*m*), north to south. This ranch in divided by Highway 83, and sub-populations (*a*) through (*g*) occur north of 83 while sub-populations (*h*) through (*m*) occur south of 83. It could be argued that this is two populations separated by a major man-made structure that possibly interrupts gene/pollinator flow. However, since all sub-populations occur less than a mile apart from one another, for the sake of consistency it is considered one population.

Sub-population (*a*) wraps around a small hill and is composed of approximately 400 individuals. Sub-population (*b*) is a population like no other: a narrow band .5 mile long with very patchy, scattered plants at the base of the hills throughout the brush (I think this is the site/sub-population that Molly Whalen described in her visit here). Sub-population (*b*) contains approximately 200 plants. Sub-population (*c*) is located on a previously disturbed (natural gas activity) saline flat and contains approximately 100 individuals. Sub-population (*d*) is along the road to sub-population (*a*), occurs upon a rocky hillside

and contains approximately 100 individuals. Sub-populations (*e*) and (*f*) are both on a relatively flat, rocky, saline opening within the brush and contain approximately 1,000 individuals combined. Sub-population (*g*) covers the sides of an eroding, rocky hill and contains approximately 200 plants.

Sub-population (*h*) occurs along the private fence line and within the highway right-of-way owned and managed by Texas Department of Transportation (TxDOT). This little site was discovered only after TxDOT removed their large gravel pile from this right-of-way. Only 36 plants are left on this little remnant rocky hill. TxDOT has redeemed itself, however, and marked the sight with reflector posts to prevent any future harm to the sight. Sub-population (*i*) occurs along a highly dissected rocky hillside with approximately 350 plants. Sub-populations (*j*), (*k*), and (*l*) occur upon saline flat openings within the brush and each contain approximately 100 plants. Sub-population (*m*) wraps around a rocky hillside and contains approximately 200 individuals.

All the individuals within this population appear in excellent to good condition and occupy an area of approximately 90 to 95 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), dog cholla (*Opuntia schottii*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), calderona (*Krameria ramosissima*), coyotillo (*Karwinskia humboldtiana*), leatherstem (*Jatropha dioica*), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Mr. Lopez is a high school history teacher in Zapata, and lives in a nice house on a hill just northwest of his property on Highway 83. Mr. Lopez has always been very generous with access. He was one of the first landowners to share with me that these rocky *F. johnstonii* hills are just too salty to root-plow, and that his father learned this by mistake when nothing would ever grow there except the plants that were there in the first place. Mr. Lopez is committed to keeping his populations conserved and has signed a voluntary Conservation Agreement with Texas Parks and Wildlife.

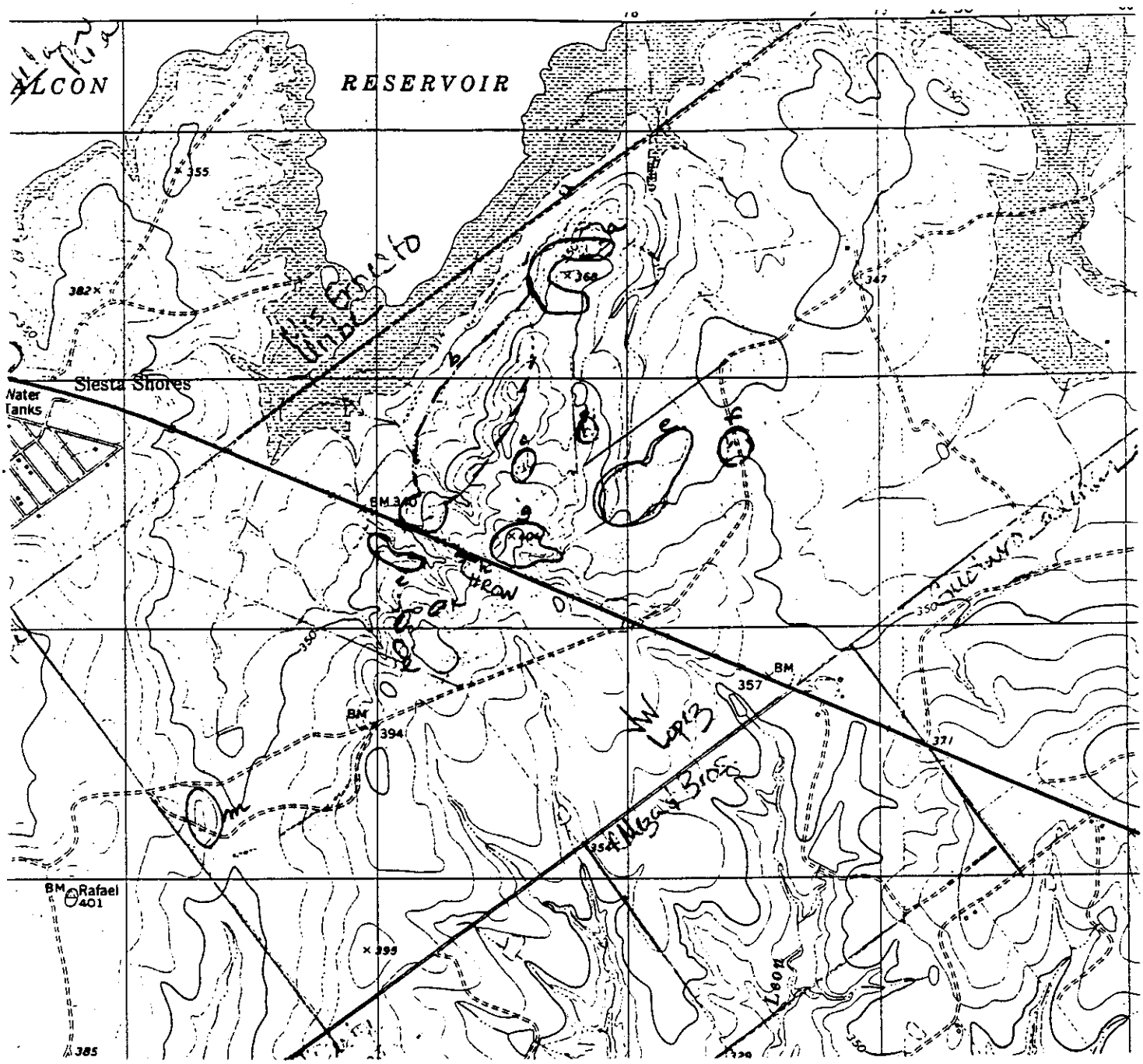

Figure 37. Population 37: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Population 38: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 900
Area Covered:	~ 16 to 17 acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Unknown, but probably secure
Soil Sample Results:	Not collected

Population 38 is located on two private ranches in western Zapata County (see Figure 38). This population is composed of three small sub-populations encompassing a narrow .8 mile long stretch. The northern most sub-population (a) is at the base of a small rocky hill and is composed of approximately 200 individuals. The sub-population to the south (b) is situated on a rocky eroding hillside and is composed of approximately 200 individuals. The third sub-population (c) occurs within a previously root-plowed pasture. Plants are scattered and number approximately 500. Plants in sub-populations (a) and (b) are in good condition while the plants in sub-population (c) are in fair condition. The total area covered by *F. johnstonii* individuals is approximately 16 to 17 acres.

Associated species not recorded.

Each sub-population of Population 38 is owned by a different landowner. All landowners are absentee, and I was never really able to establish a relationship with any of them. They all prefer confidentiality.

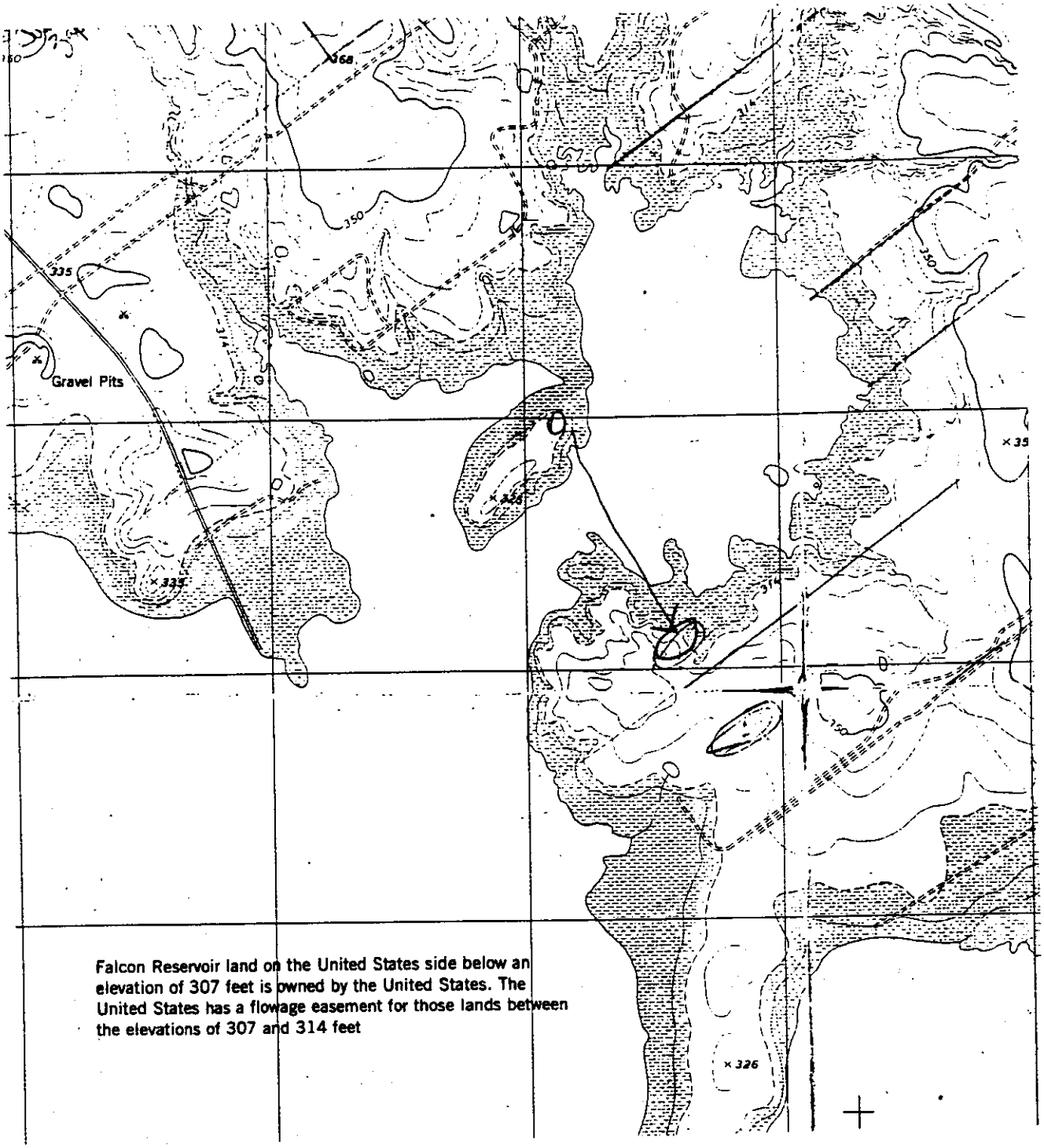

Figure 38. Population 38: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Population 39: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 10 acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Secure
Soil Sample Results:	Not collected

Population 39 occurs on a private ranch in western Zapata County (see Figure 39). This site is wrapped around a rocky hillside and contains approximately 500 individuals. The plants are in excellent to good condition and cover an area of approximately 10 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), Turner's sida (*Billieturnera helleri*), mesquite (*Prosopis glandulosa*), guapilla (*Hechtia glomerata*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), calderona (*Krameria ramosissima*), leatherstem (*Jatropha dioica*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

This family prefers that the exact locality of this site not be revealed, and that their identity remain confidential.

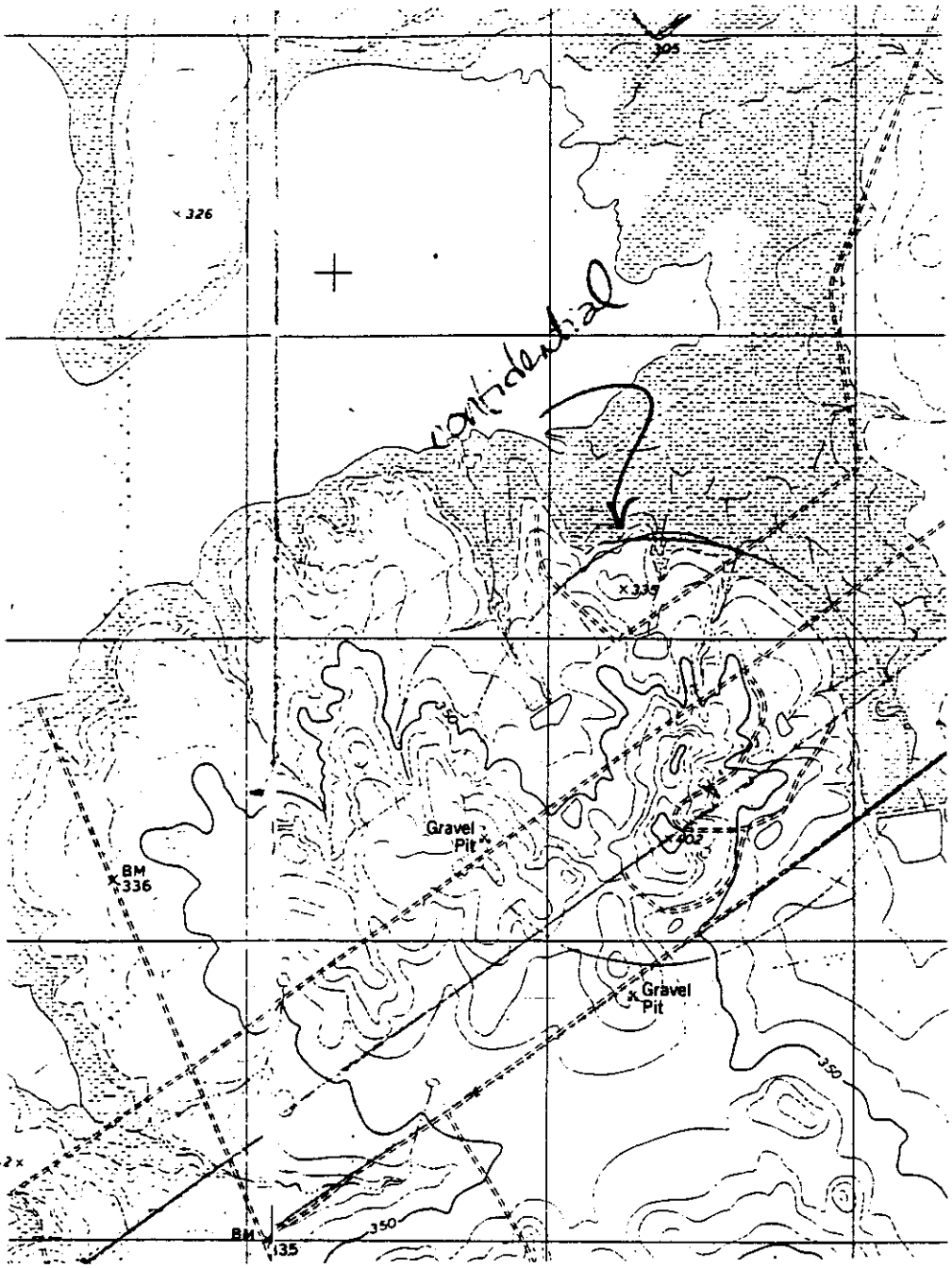

Figure 39. Population 39: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Arroyo Clareño 7.5 minute topographic quadrangle.

Population 40: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Arroyo Clareño and the Beckwith Arm 7.5 minute topographic quadrangles.

Site Name:	Maurice Alexander
Ownership:	Maurice Alexander (primarily), two smaller confidential tracts, and the IBWC
Voucher:	Janssen & Williamson # 0666
Number of individuals:	~ 1,000,000
Area Covered:	~ 500 acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	Yes
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	11 ppm low	30044 ppm very high	897 ppm high	7800 ppm very high	5949 ppm very high	Clay

Population 40 occurs on three private ranches in western Zapata County (see Figure 40). This is one large, continuous population occurring upon a series on eroding rocky hills and saline flats. Plants easily number one million. The area covered by the extensive site is approximately 500 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), broomrape (*Orobanche multiflora*), screw bean mesquite (*Prosopis reptans*), Turner's sida (*Billieturnera helleri*), guapilla (*Hechtia glomerata*), *Sueada* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), shoregrass (*Monanthochloe littoralis*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), calliandra (*Calliandra conferta*), ephedra (*Ephedra antisyphilitica*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), orange zexmenia (*Wedelia hispida*), desert lantana (*Lantana macropoda*), calderona (*Krameria ramosissima*), coyotillo (Karwinskia humboldtiana), leatherstem (*Jatropha dioica*), jicamilla (Jatropha cathartica), cenizo (Leucophyllum frutescens), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Maurice Alexander lives in Laredo, and is proud of the fact that he is a Republican AND a conservationist. Mr. Alexander has promised to protect his endangered species and has signed a voluntary Conservation Agreement with Texas Parks and Wildlife. Additionally, there are portions of this population that occur below the 307 elevation marker (Kierce and Warren 1995). All property below the 307 belongs to the federal

agency, International Boundary and Water Commission (IBWC). Theoretically, those plants below the 307 should be protected by virtue of federal ownership.

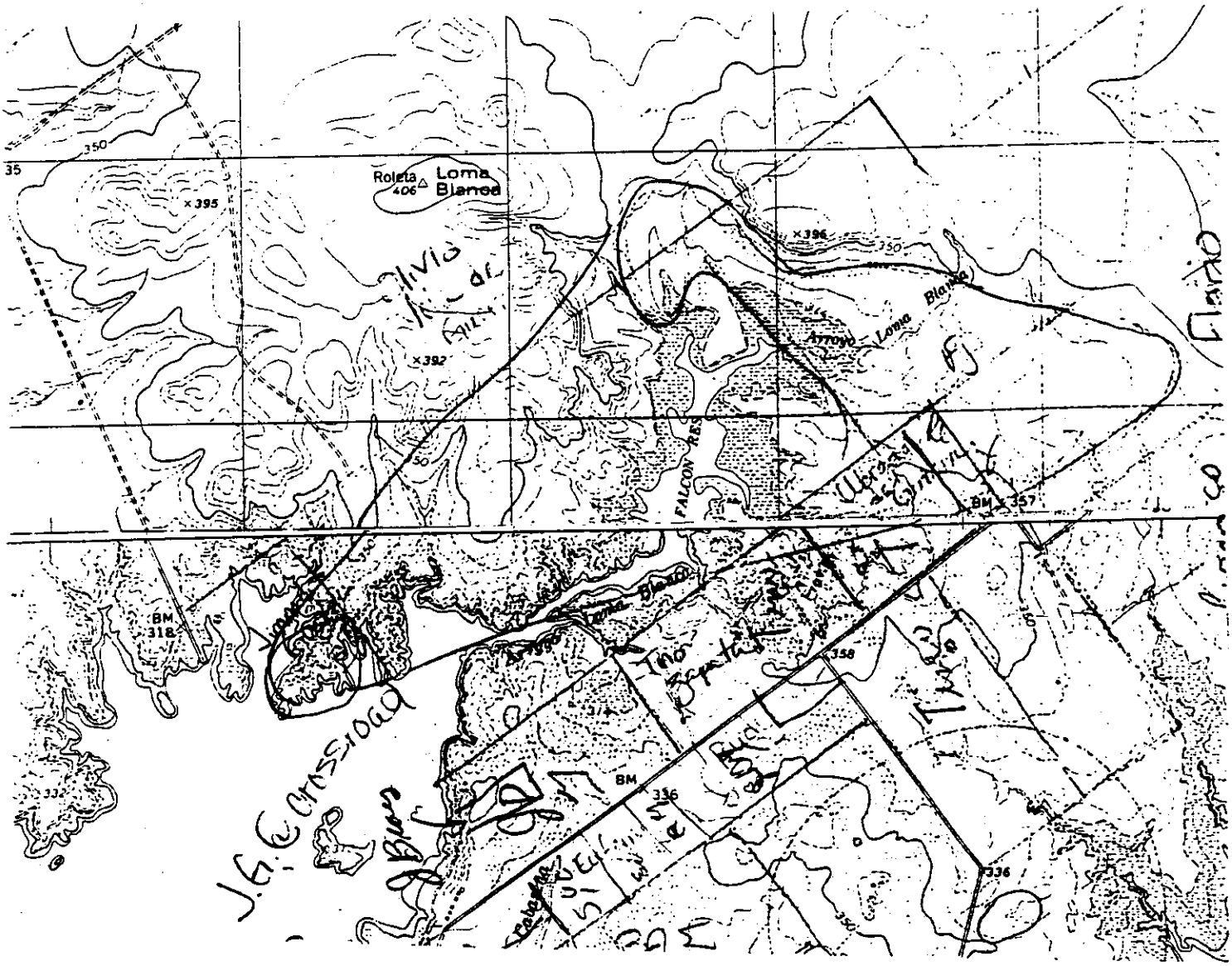

Figure 40. Population 40: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on both the Arroyo Clareño and the Beckwith Arm 7.5 minute topographic quadrangles.

Population 41: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Beckwith Arm 7.5 minute topographic quadrangle.

Site Name:	School Bus
Ownership:	Unknown, possibly IBWC
Voucher:	Janssen & Williamson # 0677
Number of individuals:	~ 300
Area Covered:	~ 3 acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Probably Secure
Soil Sample Results:	Not collected

Population 41 occurs on a small parcel of private land in western Zapata County (see Figure 41). When I first discovered this site back in 1994 or so, the water from Falcon Reservoir came right up to the edge of it. This is not so today. The plants wrap around the rocky hills and number approximately 300 on an area of approximately 3 acres. There is an old school bus on this tract, hence the site name. I could never pin down the actual ownership of this site, but maybe that's because this population actually occurs below the 307 elevation line and actually belongs to the federal agency, IBWC (Kierce and Warren 1995).

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), broomrape (*Orobanche multiflora*), screw bean mesquite (*Prosopis reptans*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), guapilla (*Hechtia glomerata*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), calderona (*Krameria ramosissima*), leatherstem (*Jatropha dioica*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Figure 41. Population 41: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Beckwith Arm 7.5 minute topographic quadrangle.

Population 42: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Beckwith Arm 7.5 minute topographic quadrangle.

Site Name:	On the Knob
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 5 acres
Soils:	Zapata-Maverick
Geology:	Laredo
Conservation Agreement:	No
Population Future:	Probably Secure
Soil Sample Results:	Not collected

Population 42 occurs on a private ranch in western Zapata County (see Figure 42). This site is composed of both rocky hills and a saline flat. There are approximately 500 individuals in an area of approximately 5 acres.

Associated species not recorded.

The owners of this site prefer confidentiality of both their name and the exact site location.

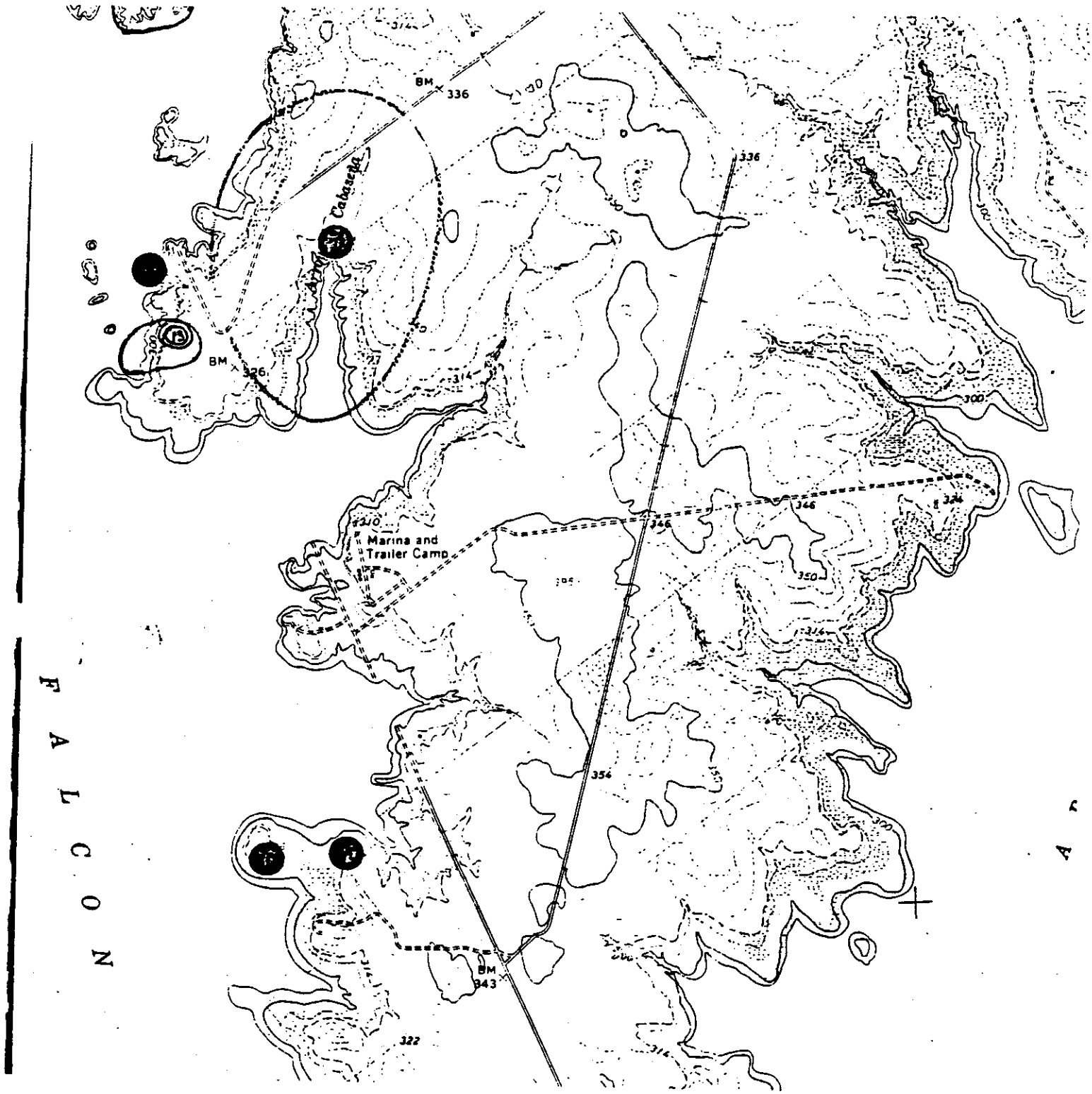

Figure 42. Population 42: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Zapata County, on the Beckwith Arm 7.5 minute topographic quadrangle.

Starr County, Texas

There are sixteen known populations of Johnston's frankenia in Starr County, Texas. All populations occur on private property; however, a portion of one is owned by the U. S. Fish and Wildlife Service. One population is protected by a voluntary Conservation Agreement, while a portion of one is protected by virtue of federal ownership.

There are two Starr County herbarium specimens for which the localities have not been relocated. A. D. Wood's 1968 specimen # 835 stated: *Hills northeast of Roma; bare open areas of no tall shrubs; apparently on salty soil that becomes very wet during rain, but at other times is very dry and hard.* Wood's specimen simply did not include the detail in the directions that is needed to relocate an occurrence. Molly Whalen (Whalen 1980; USFWS 1988) searched for this site in the late 70's during her dissertation research but could not relocate it. I also looked for this site in 1993 and 1994 but could find no *F. johnstonii* in the accessible areas northeast of Roma. R. J. Fleetwood's 1974 specimen # 10995 stated: *12 miles northwest of Roma; side of Highway 83, ca. 500 yards off road near bottom of hillside.* This locality record was simply overlooked during this project, and its relocation was not attempted.

Seven of the populations are underlain by Catarina soils (Table 3). Additionally, two sites are underlain by Maverick soils; two sites are underlain by Copita fine sandy loam; one site is underlain by a combination of both Maverick soils and Catarina soils; one site is underlain by Montell clay; one is underlain by Ramadero loam; and, one site is underlain by a combination of Montell clay, Ramadero loam, and Copita fine sandy loam. Ten populations are underlain by the Jackson Group geologic formation, and one site is underlain by both the Jackson Group and Yegua formations. The four remaining sites are mapped as Alluvium on Catahoula and Frio Formations undivided.

Table 3. Soils and Geology for the verified Starr County *Frankenia johnstonii* populations.

Starr County Population #	Topographic Quadrangle	Soil Name	Geologic Formation
43	Las Escobas Ranch	Copita fine sandy loam	Jackson Group
44	Las Escobas Ranch	Montell clay	Jackson Group
45	Las Escobas Ranch & Lopeño	Maverick soils, eroded & Catarina soils	Jackson Group
46	Lopeño	Catarina soils	Jackson Group
47	Lopeño	Catarina soils	Jackson Group
48	Salineño & El Chapote Creek	Maverick soils, eroded	Jackson Group
49	El Chapote Creek	Copita fine sandy loam	Catahoula & Frio Formations undivided
50	El Chapote Creek	Catarina soils	Jackson Group

51	El Chapote Creek	Catarina soils	Jackson Group
52	El Chapote Creek	Ramadero loam	Alluvium on Catahoula & Frio Formations undivided
53	El Sauz	Montell clay, Ramadero loam, & Copita fine sandy loam (from E to W)	Alluvium on Catahoula & Frio Formations undivided
54	Salineño	Maverick soils, eroded	Jackson Group & Yegua
55	El Chapote Creek and Roma Los Saenz East	Catarina soils	Jackson Group
56	Roma Los Saenz East	Catarina soils	Jackson Group
57	Rio Grande City North	Catarina soils	Alluvium on Catahoula & Frio Formations undivided
58	Salineño	Catarina soils	Jackson Group

Starr County Soils

Catarina soils (Thompson et al., 1972) consists of deep, undulating, clayey soils on uplands. These soils developed in calcareous, gypsiferous, saline clay and shaly clay. The surface layer is a grayish-brown clay that is about 21 inches thick and contains broken snail shells and chert fragments. The underlying material within the profile contains calcium carbonate concretions and gypsum crystals. The available water capacity is low to high depending upon the salinity. Areas containing these soils are irregularly shaped or elongated and are as much as several hundred acres in size. They are dissected by many drainageways and by a few shallow gullies and rills. In most areas the gullies and rills are small and crossable, but there are a few large gullies kept active by runoff. Sheet and gully erosion have been active in most places. Catarina soils are used for range. They are not cultivated, because they have a high content of salt and because the climate is dry.

Maverick soils (Thompson et al., 1972) are moderately deep, somewhat excessively drained, undulating olive-brown, saline clay soils on uplands. The surface layer is olive brown, platy structure, and contains a few earthworm casts and a broken marine shells. Salt threads, cemented concretions, soft lumps of calcium carbonate, weathered shale and gypsum crystals are common throughout the profile. Maverick soils, eroded (Mu2), occupy the low ridges and valley walls and are dissected by many rills and gullies. The gullies are two to six feet deep and 20 to 50 feet wide, and some cannot be crossed with ordinary machinery. The original surface layer has been removed from about half the

acreage, and the present surface layer is a mixture of materials from the subsoils and the substratum. The entire acreage is used for range. The control of erosion and revegetation to grasses are problems. The soil is droughty and hard to manage because it is clayey and saline and because water runs off rapidly.

Copita soils (Thompson et al., 1972) are moderately deep, well-drained, nearly level to gently undulating fine sandy loam soils of the uplands. The soils are droughty as a result of high lime content. The surface layer is mainly grayish-brown fine sandy loam containing a few shell fragments. Internal drainage is medium, permeability is moderate, and the available water capacity is high. Copita soils are used mainly for range, but a few are dry-farmed. Dryfarming is risky because the low erratic rainfall and the droughtiness of the soils caused by the high content of lime are unfavorable. Revegetation can take place, and the potential for grass production is good. Some areas that were formerly cultivated have been seeded to grasses and used for pasture.

Montell soils (Thompson et al., 1972) consists of deep, moderately well drained, nearly level, clayey soils on uplands. These soils developed in calcareous, gypsiferous, saline, clayey old alluvium or outwash. The surface layer is gray clay with a few broken snails shells and about 5% of the surface covered with rounded pebbles. Montell clays (Mt) occupy broad valley floors along drainageways of the uplands. This soil is used for range. This soil is droughty and difficult to manage because it is clayey and highly saline.

Ramadero soils (Thompson et al., 1972) consists of deep, well-drained, nearly level soils on uplands. These soils occupy long, narrow, shallow valley that serve as drainageways. In most years they receive extra water and some fresh sediments because of their position on the landscape. The surface layer is a dark grayish-brown loam and sandy clay loam. Ramadero loam (Ra) occur mainly as long, narrow areas in drainageways or on valley floors. They occur on low parts of the landscape throughout most of the uplands in the county. Most of the acreage is used for range, but a dew small fields have been cleared and used for cultivated crops. This soil is well suited to crop production in years when rainfall is normal.

Starr County Geology

The Jackson Group formation (Brown et al., 1976) is Eocene Age, and is composed of sandstone and clay (mostly sandstone). The sandstone is fine to coarse grained, friable to quartzitic, commonly laminated and crossbedded. The color is white, gray, greenish brown, or light brownish yellow, and fossiliferous. The clay is sandy and calcareous. The color is greenish gray, pink, or red. Silicified wood is abundant. Some beds of white volcanic ash, and large dark limestone concretions composed of calcite crystals are common.

The Yegua formation (Brown et al., 1976) is Eocene Age, and is composed of clay and sandstone (mostly clay). The clay portion is lignitic, sandy, bentonitic, and mostly well

laminated. It is chocolate brown to reddish brown in color with lighter colors upward, producing dark gray soil. The sandstone is mostly quartz and some chert described as fine grained, friable, calcareous, glauconitic, and weathering to loose, ferruginous, yellow orange and reddish brown soil. There is some fossil wood.

The Catahoula and Frio Formations undivided (Brown et al., 1976) are Miocene Age, and are composed of mudstone, claystone, sandstone, tuff and clay. The mudstone and claystone are silty, pale olive, brown or light gray to pink. The sandstone has varicolored grains that are in part interlaminated with pale-brown clay. The tuff is grayish white, massively bedded, and moderately well indurated, with a lumpy pisolitic texture. The clay is dark greenish gray, and massive.

Starr County Site Descriptions

Population 43: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Las Escobas Ranch 7.5 minute topographic quadrangle.

Site Name:	Number 43
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 23 acres
Soils:	Copita fine sandy loam
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 43 occurs on private property in northwestern Starr County (see Figure 43). This site occurs on both sides of Loma Blanca Road and covers approximately 23 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

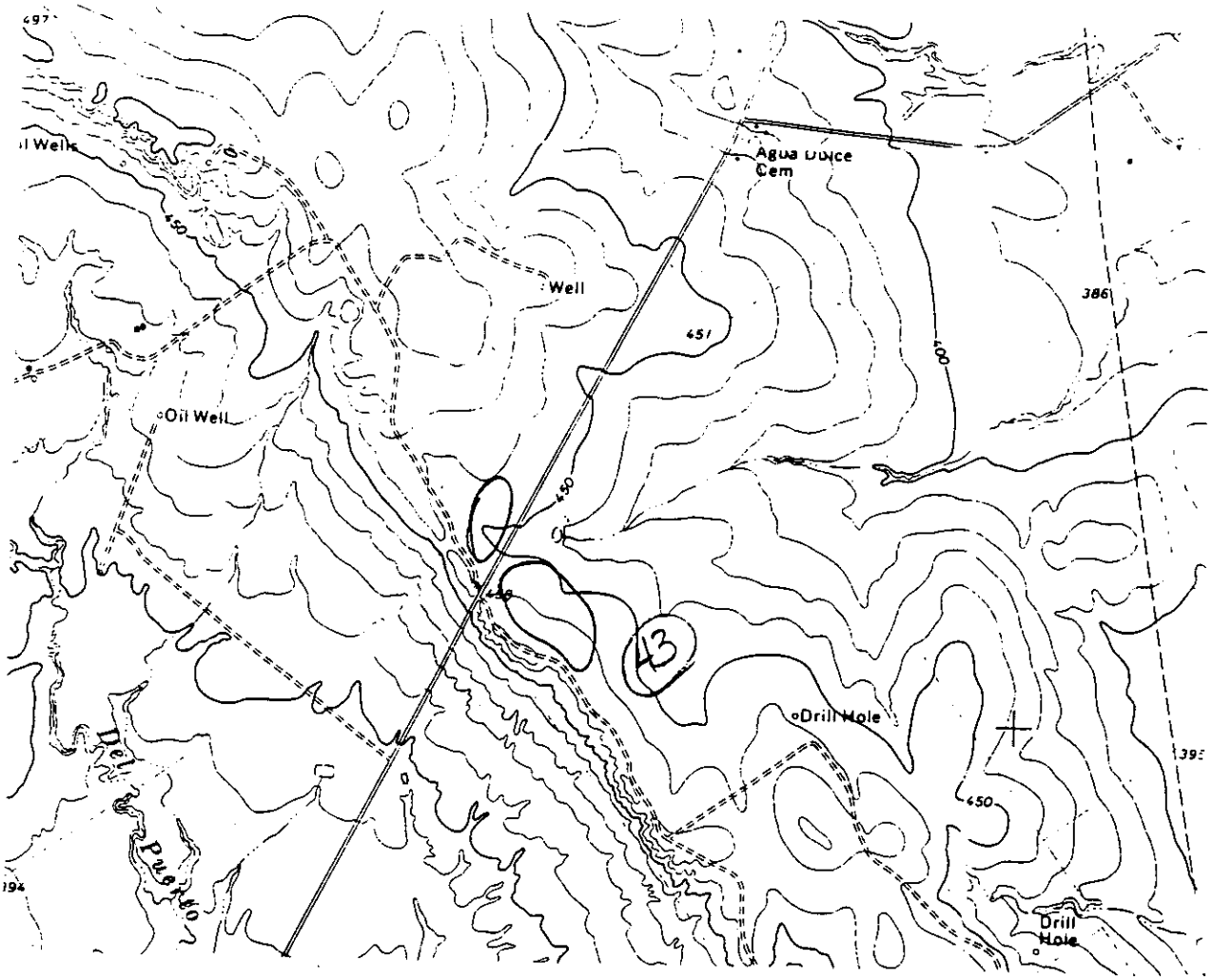

Figure 43. Population 43: Occurrence form a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Las Escobas Ranch 7.5 minute topographic quadrangle.

Population 44: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Las Escobas Ranch 7.5 minute topographic quadrangle.

Site Name:	Berryman Gate
Ownership:	Mr. Phil Berryman
Voucher:	Janssen & Williamson # 0680
Number of individuals:	~ 100
Area Covered:	~ 15 acres
Soils:	Montell Clay
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 44 occurs on a private ranch in northwester Starr County (see Figure 44). The plants are sparse and scattered at this site occurring mainly around the gate and along the fence lines. There are approximately 100 individuals in fair condition on approximately 15 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *Suaeda* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), whorled dropseed (*Sporobolus pyramidatus*), and curly mesquite (*Hilaria berlangeri*).

Mr. Berryman lives in San Antonio and runs Berryman Investments. Since he is an absentee landowner, I was never able to establish a relationship with him. And, since this site is so anemic, I didn't even ask him if he wanted to sign a Conservation Agreement.

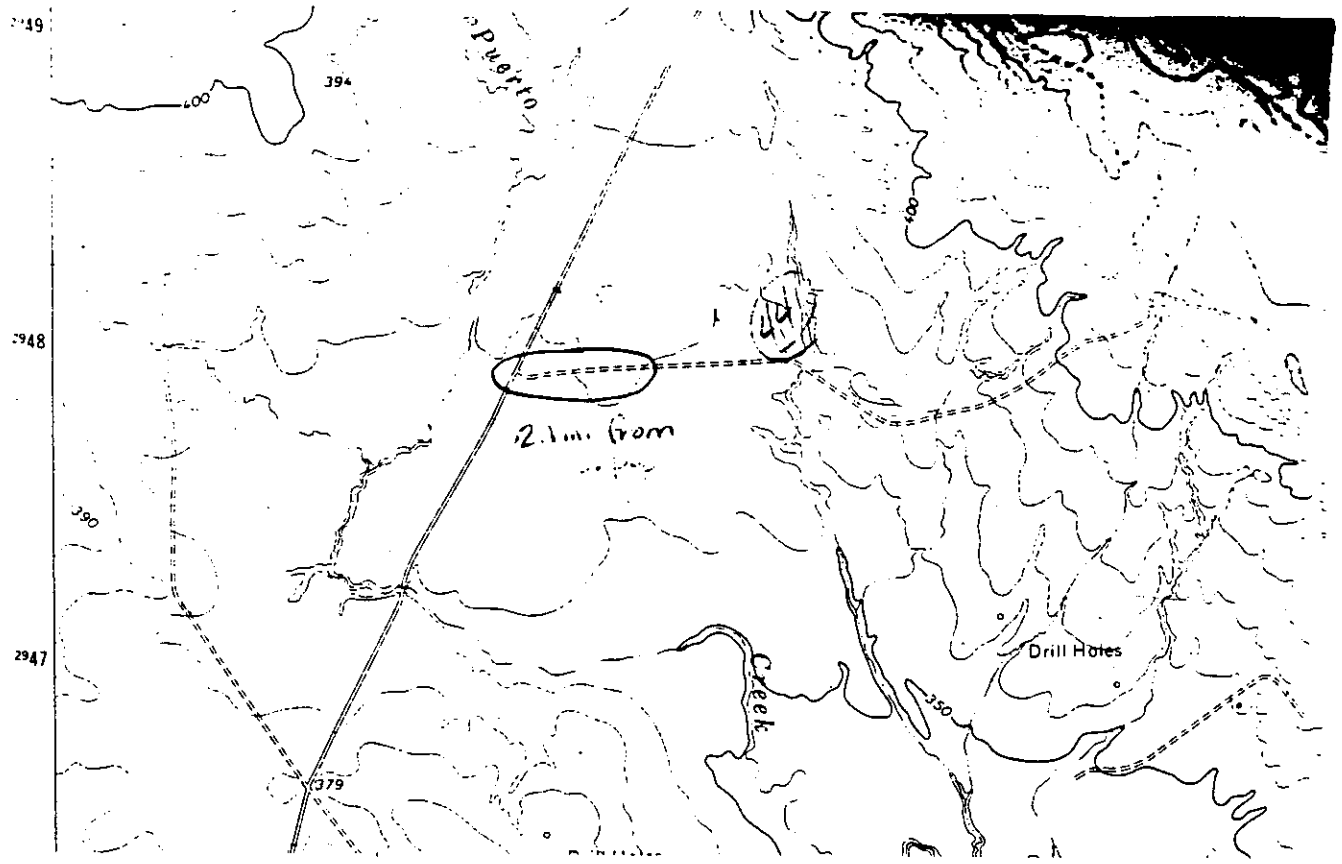

Figure 44. Population 44: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Las Escobas Ranch 7.5 minute topographic quadrangle.

Population 45: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on both the Las Escobas Ranch and the Lopeño 7.5 minute topographic quadrangles.

Site Name:	Number 45
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 40 acres
Soils:	Maverick soils, eroded & Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 45 occurs on private property in northwestern Starr County (see Figure 45). This site occurs on both sides of Loma Blanca Road and is made up of four sub-populations. The plants cover an area of approximately 40 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

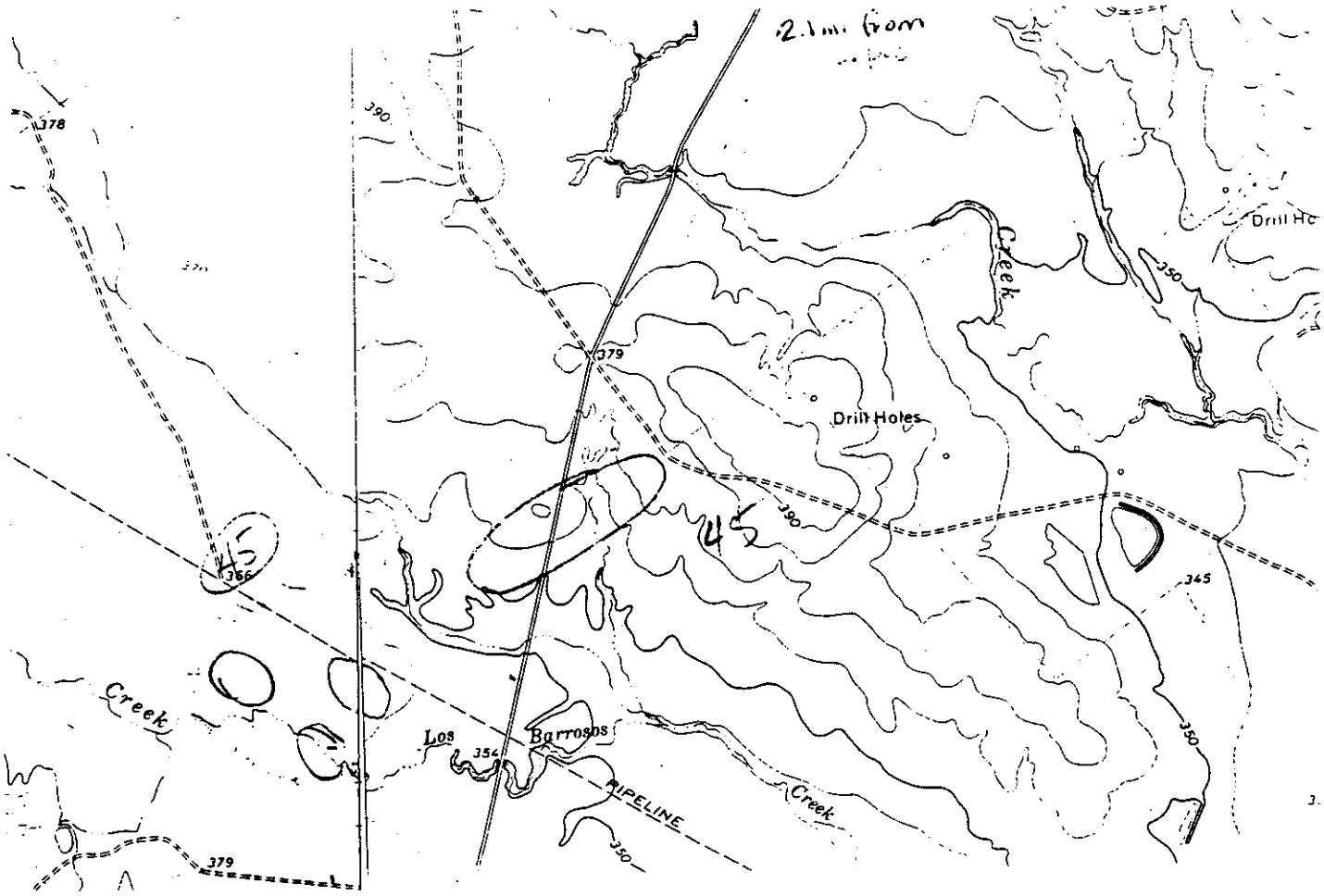

Figure 45. Population 45: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on both the Las Escobas Ranch and the Lopeño 7.5 minute topographic quadrangles.

Population 46: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Site Name:	Number 46
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 8 to 9 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 46 occurs on private property in western Starr County (see Figure 45). The plants cover an area of approximately eight to nine acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

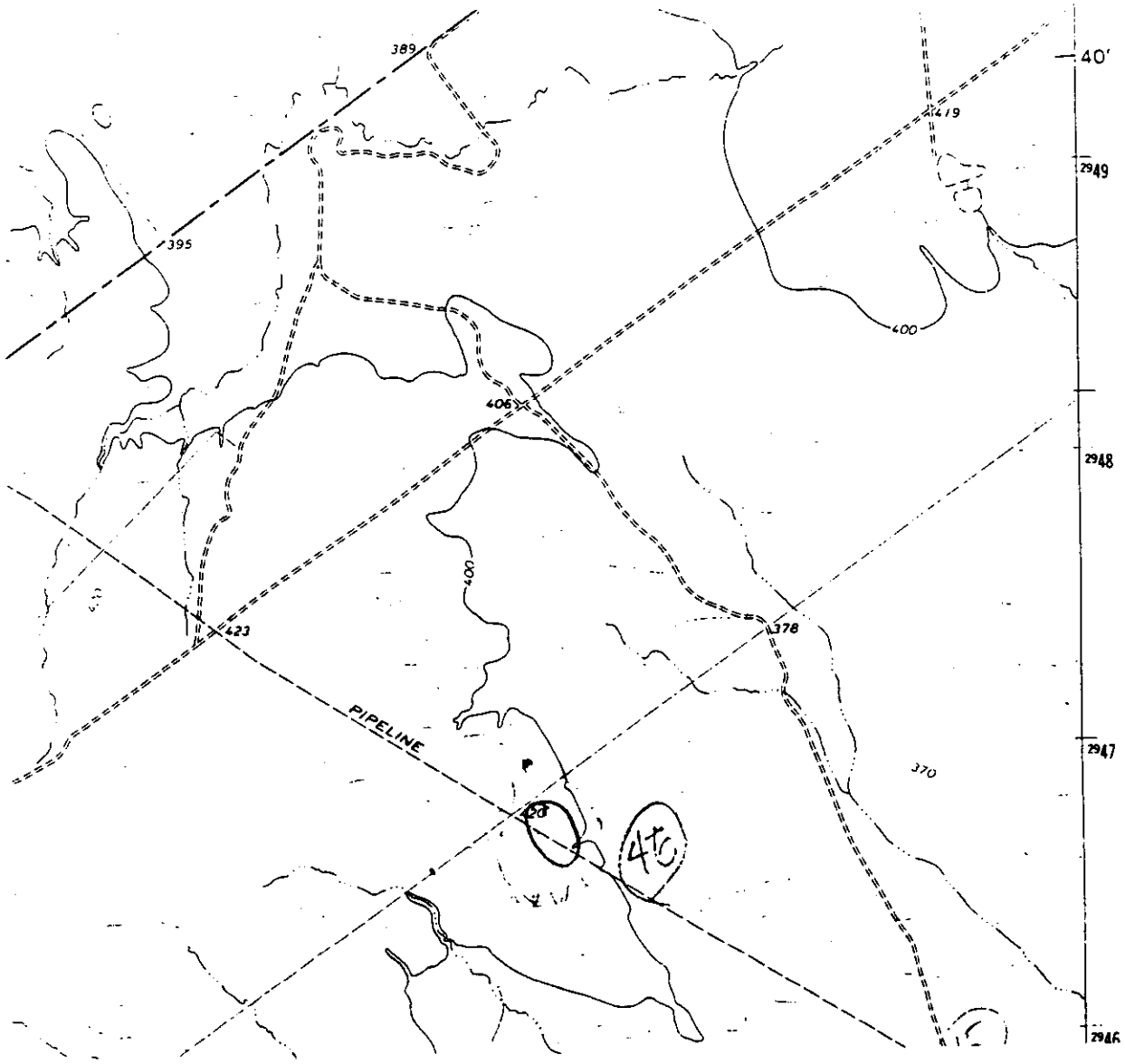

Figure 46. Population 46: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Population 47: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Site Name:	Number 47
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 17 to 18 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 47 occurs on private property in western Starr County (see Figure 47). The plants cover an area of approximately 17 to 18 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

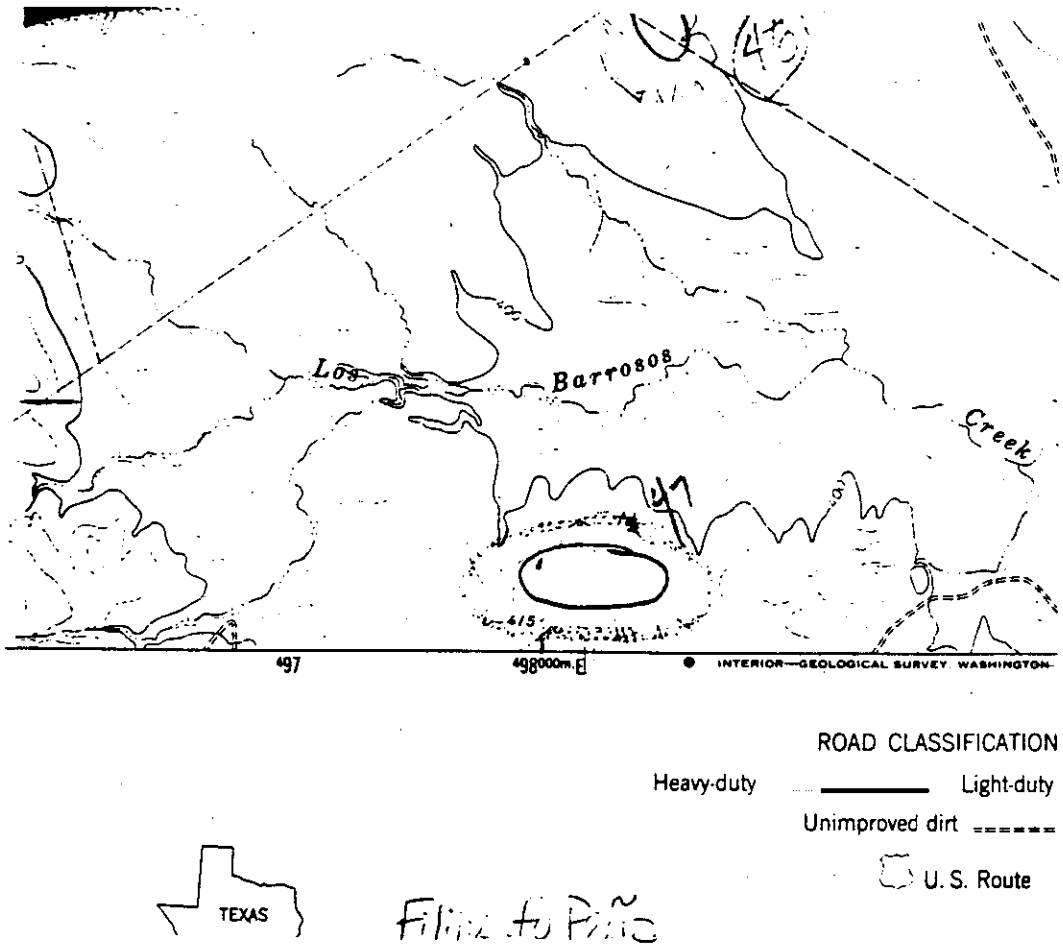

Figure 47. Population 47: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Population 48: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on both the Salineño and the El Chapote Creek 7.5 minute topographic quadrangles.

Site Name:	Loma Blanca Road # 48
Ownership:	Currently Unknown
Voucher:	Janssen & Williamson # 0679
Number of individuals:	Unknown
Area Covered:	~ 65 to 70 acres
Soils:	Maverick soils, eroded
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.2 moderately alkaline	1 ppm very low	12138 ppm very high	506 ppm high	3900 ppm very high	1225 ppm very high	Clay

Population 48 occurs on various private ranches in western Starr County (see Figure 45). A portion of this site was first discovered in 1974 by Mr. James Everitt with the USDA. Approximately 25 years since its discovery, this site remains extant.

This site occurs on both sides of Loma Blanca Road and is made up of five sub-populations. The plants cover an area of approximately 65 to 70 acres. Although one of these sub-populations is visible from Loma Blanca Road and has been known for some time, Chuck has found four more areas nearby. I received this new information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded because land ownership could not be verified.

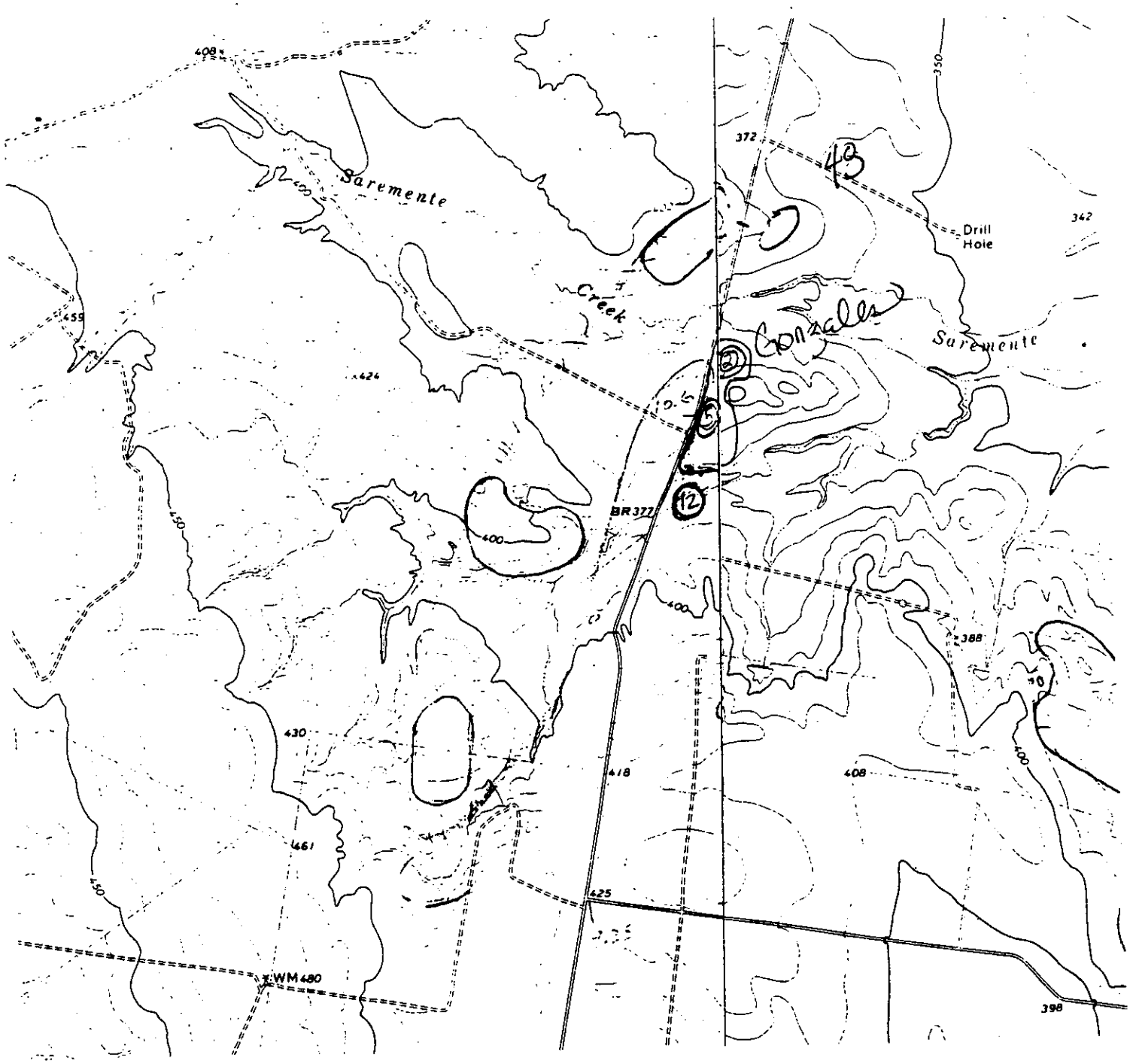

Figure 48. Population 48: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the both the Salineño and the El Chapote Creek 7.5 minute topographic quadrangles.

Population 49: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Site Name:	Confidential
Ownership:	Confidential
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 2 acres
Soils:	Copita fine sandy loam
Geology:	Catahoula & Frio Formations undivided
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 49 occurs on a private ranch in western Starr County (see Figure 49). This site appears to have been disturbed during the construction of the tank that it is next to. Plants are scattered and spindly, and number approximately 500. The area covered by this site is only about two acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *Suaeda* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

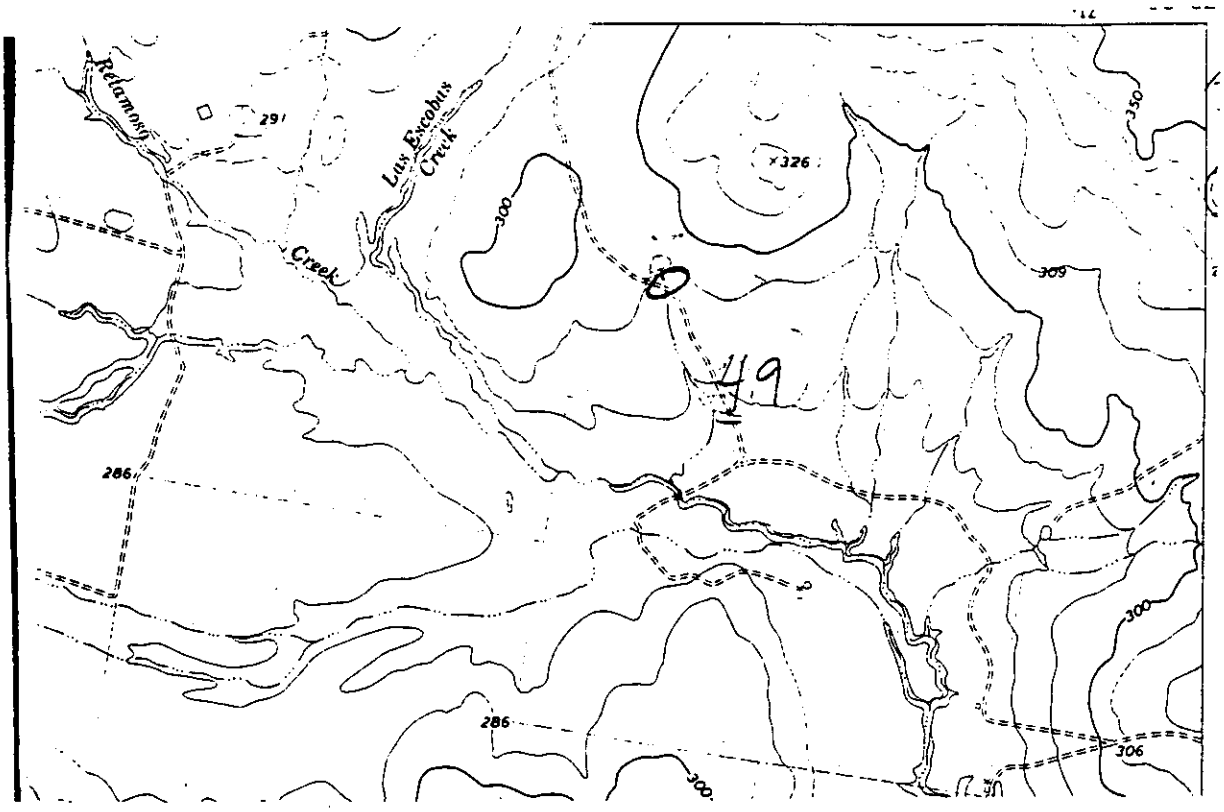

Figure 49. Population 49: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Population 50: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Site Name:	Number 50
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 30 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 50 occurs on private property in western Starr County (see Figure 50). This site occurs on both sides of the Sanchez Ranch Road and is made up of four sub-populations. The plants cover an area of approximately 30 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

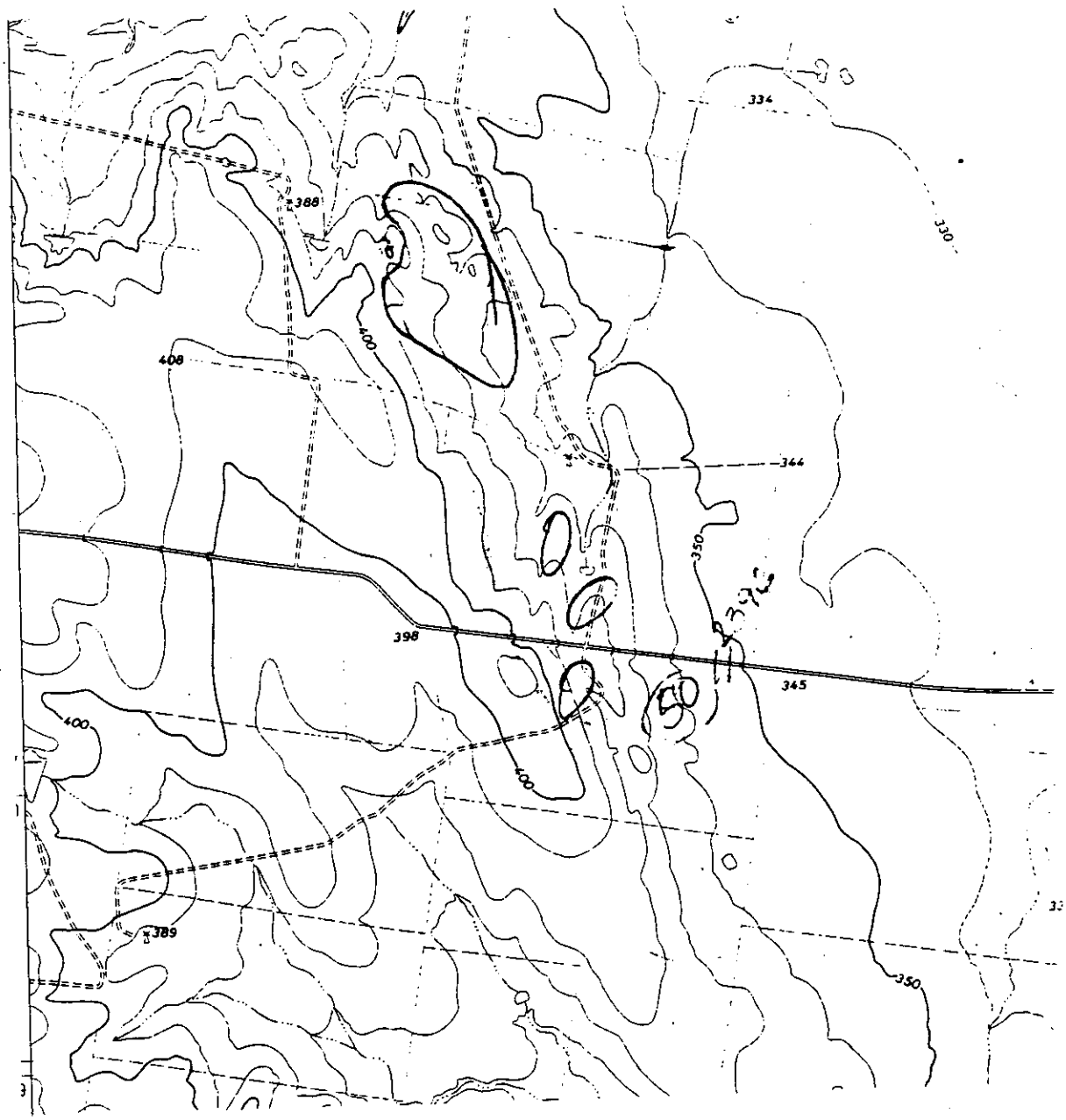

Figure 50. Population 50: Occurrence from a secondary source for Johnston's frankenia (Frankenia johnstonii) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Population 51: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Site Name:	Number 51
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 20 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 51 occurs on private property in western Starr County (see Figure 51). This site occurs on both sides of the Sanchez Ranch Road and is made up of four sub-populations. The plants cover an area of approximately 20 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

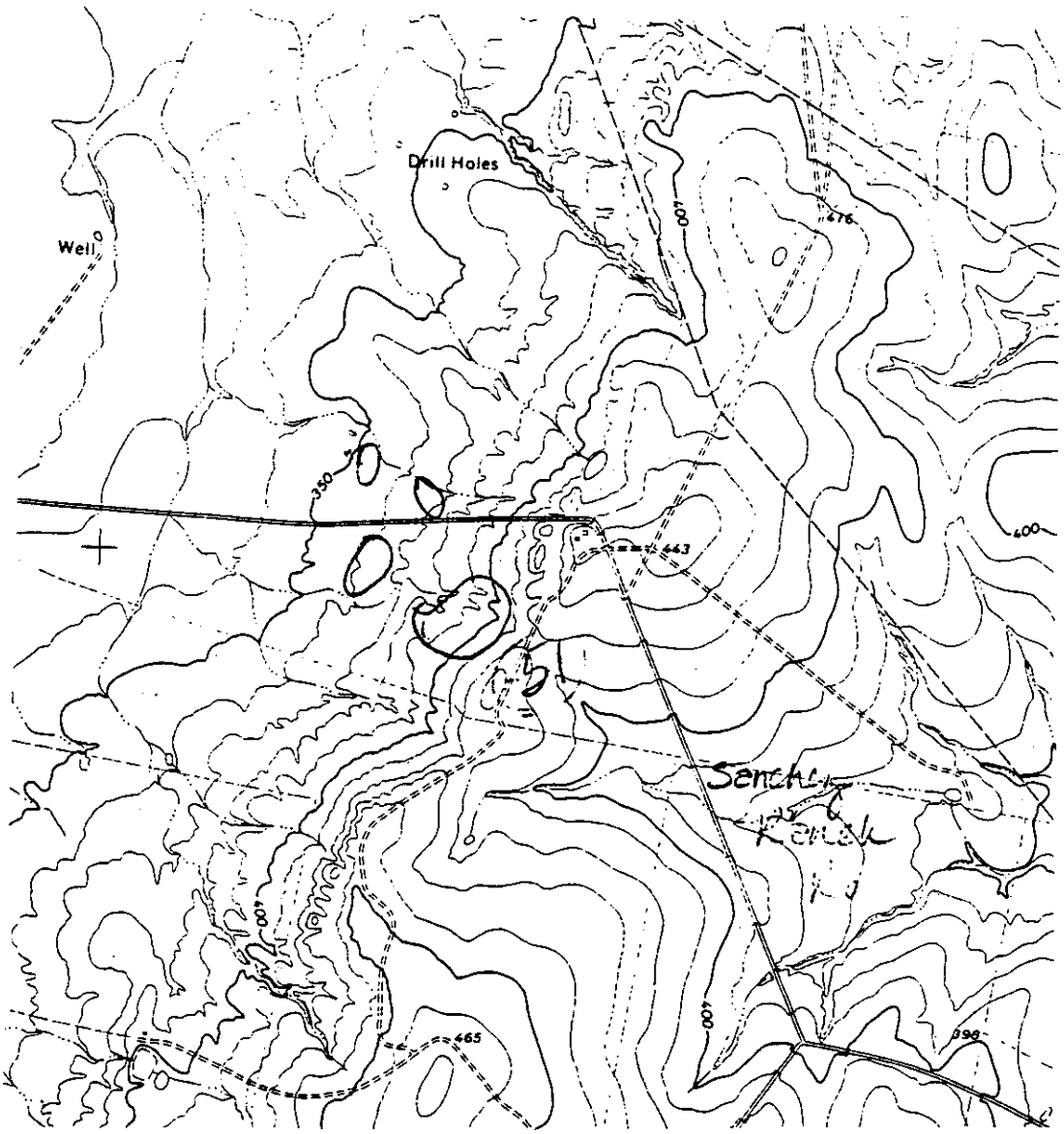

Figure 51. Population 51: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Lopeño 7.5 minute topographic quadrangle.

Population 52: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Site Name:	Ricardo Berrera
Ownership:	Ricardo Berrera
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 3 to 4 acres
Soils:	Ramadero loam
Geology:	Alluvium on Catahoula & Frio Formations undivided
Conservation Agreement:	No
Population Future:	Unknown, probably secure
Soil Sample Results:	Not collected

Population 52 occurs on a private ranch in western Starr County (see Figure 52). The plants occur on what appears to be a previously disturbed site and are scattered about. There are approximately 500 plants in an area of approximately 3 to 4 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *Suaeda* sp., mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

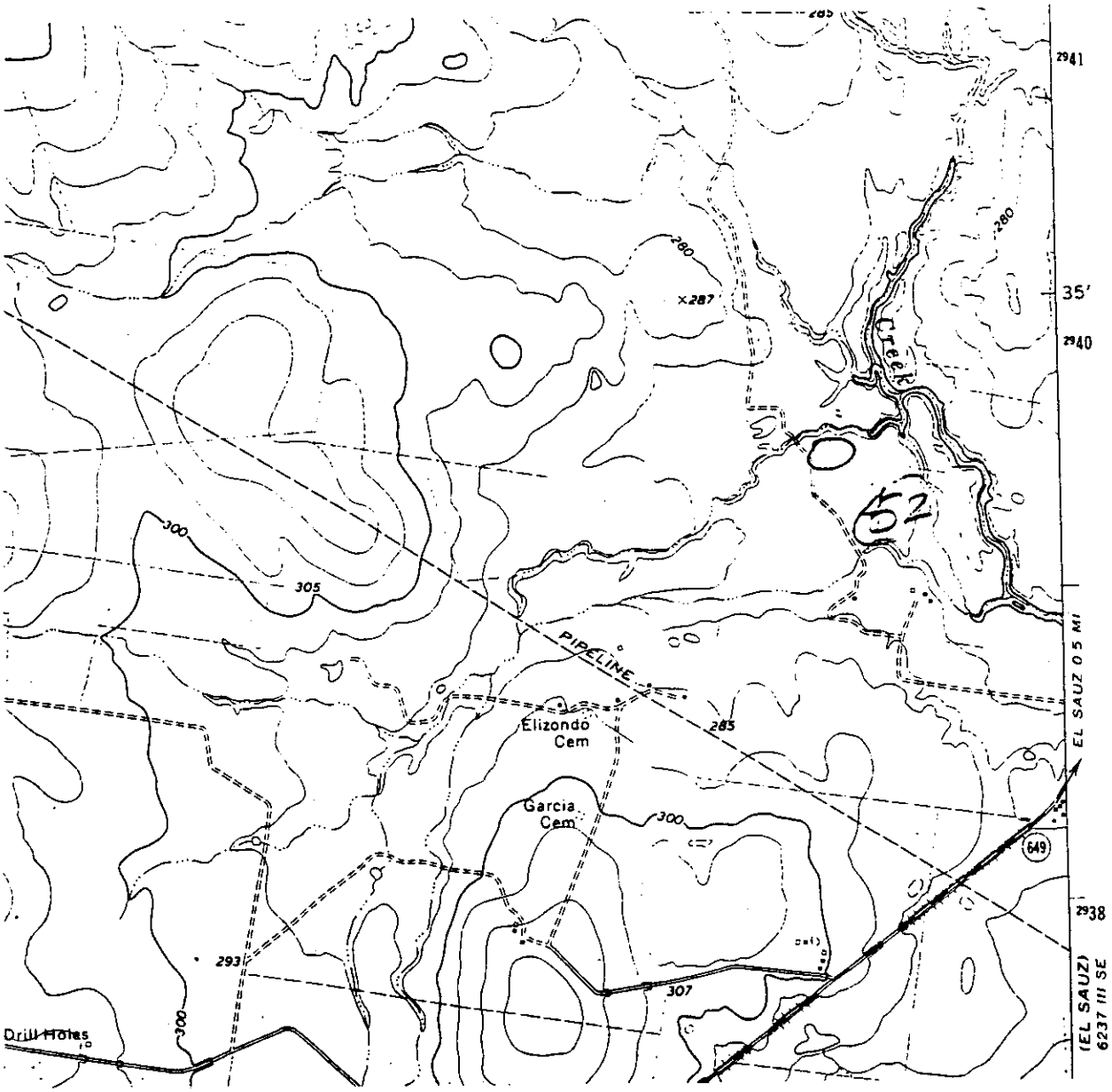

Figure 52. Population 52: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Chapote Creek 7.5 minute topographic quadrangle.

Population 53: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Sauz 7.5 minute topographic quadrangle.

Site Name:	El Sauz
Ownership:	Confidential and Gilberto Resendez
Voucher:	D. S. Correll # 32308; Janssen & Williamson # 0678
Number of individuals:	~ 10,000
Area Covered:	~ 28 to 30 acres
Soils:	Montell clay, Ramadero loam, & Copita fine sandy loam
Geology:	Alluvium on Catahoula & Frio Formations undivided
Conservation Agreement:	Yes, on eastern portion
Population Future:	Secure to Grim, depending on flood control project outcome

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.2 moderately alkaline	7 ppm very low	11680 ppm very high	337 ppm high	3250 ppm very high	1920 ppm high	Sandy Clay Loam

Population 53 occurs on two private ranches just east of El Sauz in Starr County (see Figure 53). This site is a long narrow strip approximately 4/10th to one half mile in length. There are approximately 10,000 or more individuals within this site that covers approximately 28 to 30 acres. I believe it was D. S. Correll who discovered this site in 1966 since he references this site in his article in which he named and described this species (Correll 1966).

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), screw bean mesquite (*Prosopis reptans*), *Suaeda* sp., mesquite (*Prosopis glandulosa*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), rat-tail cactus (*Wilcoxia poselgeri*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), desert yaupon (*Schaefferia cuneifolia*), desert hackberry (*Celtis pallida*), leatherstem (*Jatropha dioica*), squaw bush (*Condalia spathulata*), snake-eyes (*Phaulothamnus spinescens*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

This site is owned by two different landowners. Mr. Resendez owns the eastern portion of this site and has agreed to protect it by signing a voluntary Conservation Agreement. However, as part of a grand flood control project all along the Los Olmos, there are plans to build a dike on the western portion of this site. Only time will tell what will become of this site.

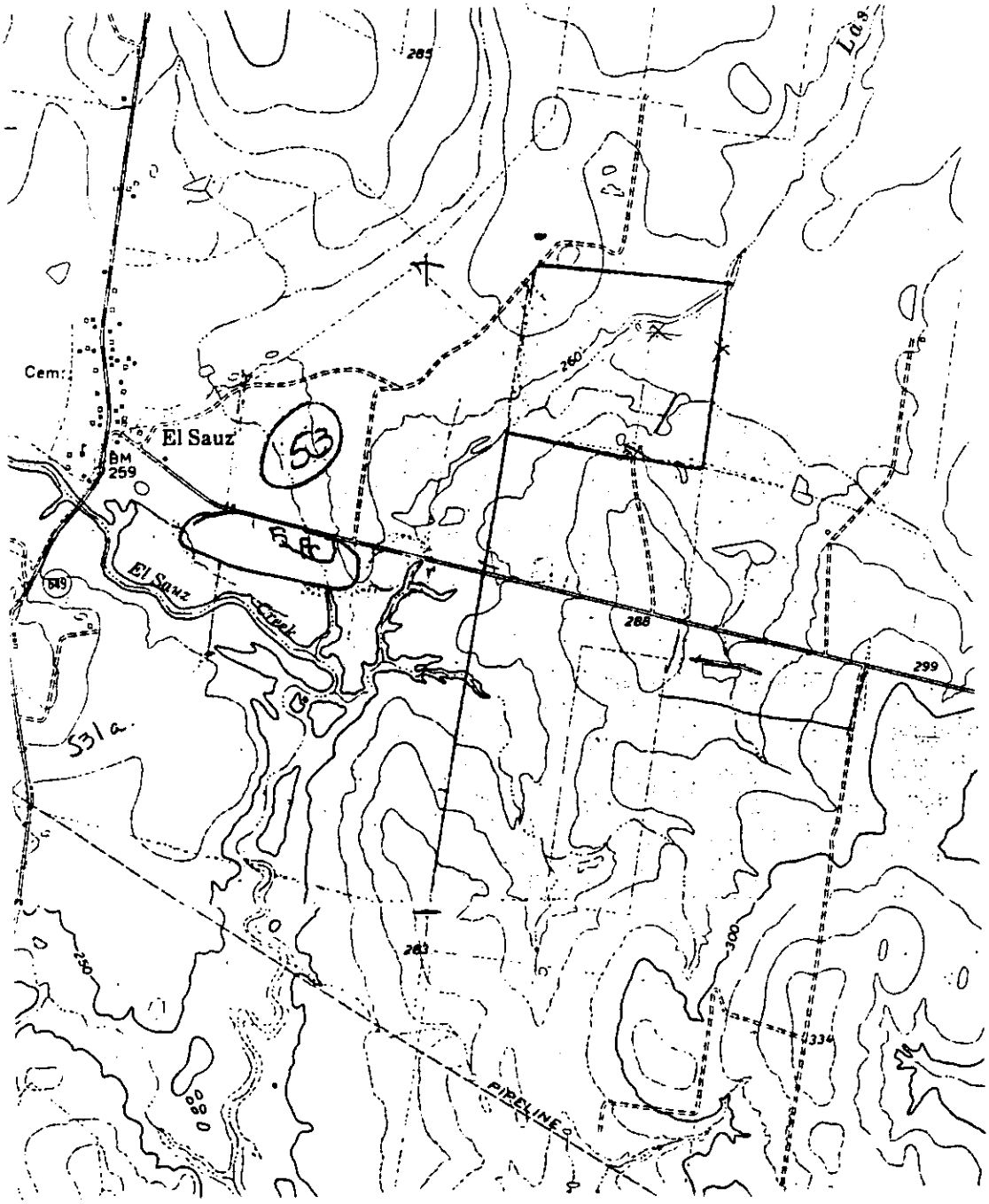

Figure 53. Population 53: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the El Sauz 7.5 minute topographic quadrangle.

Population 54: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Salineño 7.5 minute topographic quadrangle.

Site Name:	The Chapeño Tract and Confidential
Ownership:	USFWS and Private/Confidential
Voucher:	Janssen & Williamson # 0558
Number of individuals:	~ 2,000
Area Covered:	~ 19 to 20 acres
Soils:	Maverick soils, eroded
Geology:	Jackson Group & Yegua
Conservation Agreement:	No, but a portion is federally protected
Population Future:	Secure

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.6 strongly alkaline	16 ppm moderate	18310 ppm very high	777 ppm high	2015 ppm high	2088 ppm high	Sandy Clay

Population 54 occurs on the Lower Rio Grande Wildlife Refuge Chapeño Tract and neighboring private lands (see Figure 54). This site is composed of five sub-populations and contains approximately 2,000 individuals total. The area covered by the plants is approximately 19 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), broomrape (*Orobanche multiflora*), screw bean mesquite (*Prosopis reptans*), Turner's sida (*Billieturnera helleri*), *Sueada* sp., mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), *Euphorbia* sp., fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), guapilla (*Hechtia glomerata*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), nipple cactus (*Mammalaria heyderi*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), coyotillo (*Karwinskia humboldtiana*), calderona (*Krameria ramosissima*), leatherstem (*Jatropha dioica*), Texas kidneywood (*Eysenhardtia texana*), squaw bush (*Condalia spathulata*), cenizo (*Leucophyllum frutescens*), orange zexmenia (*Wedelia hispida*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

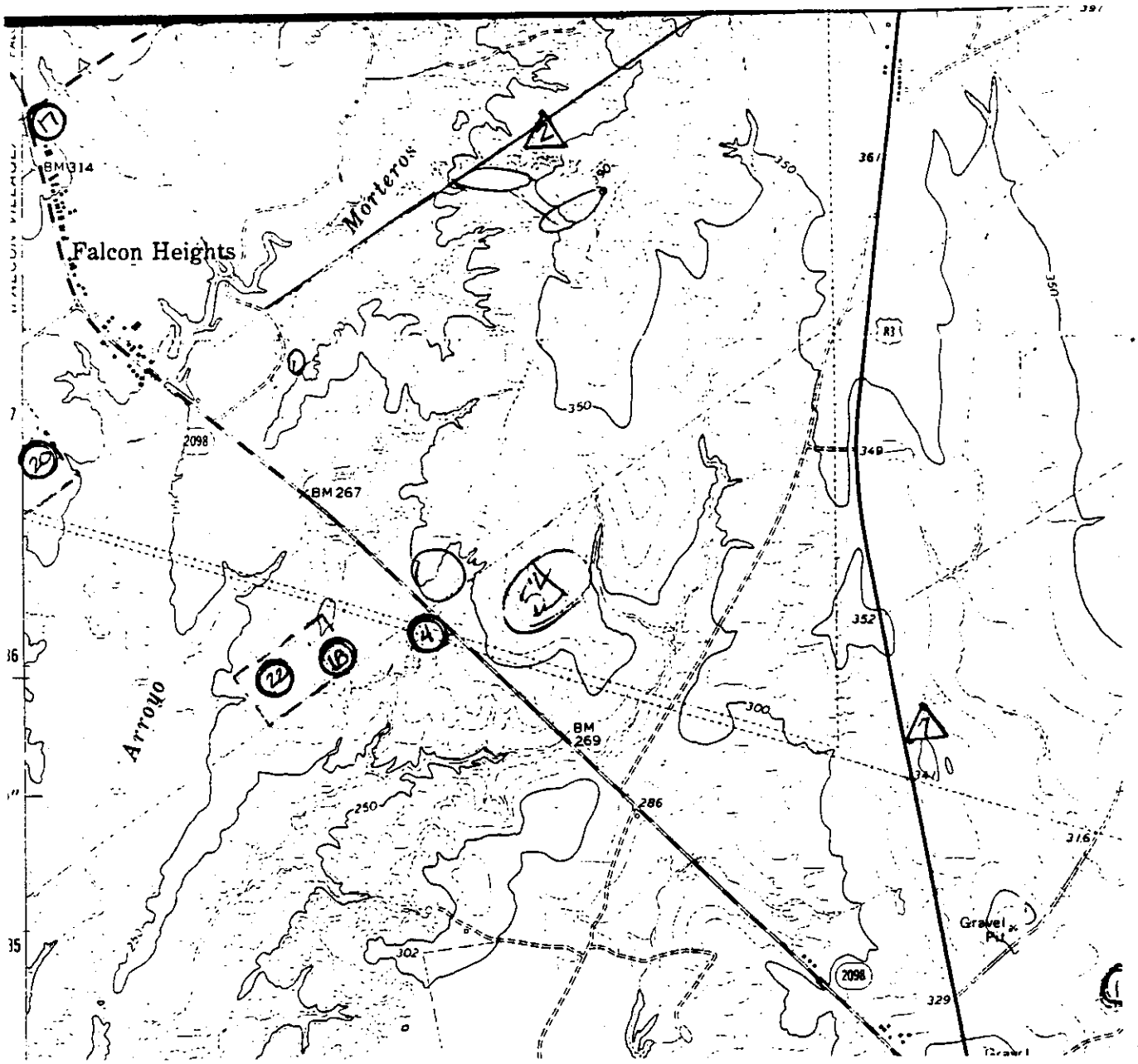

Figure 54. Population 54: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Salineño 7.5 minute topographic quadrangle.

Population 55: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on both the El Chapote Creek and Roma Los Saenz East 7.5 minute topographic quadrangles.

Site Name:	Number 55
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 11 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 55 occurs on private property in western Starr County (see Figure 51). The plants cover an area of approximately 11 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species were not recorded.

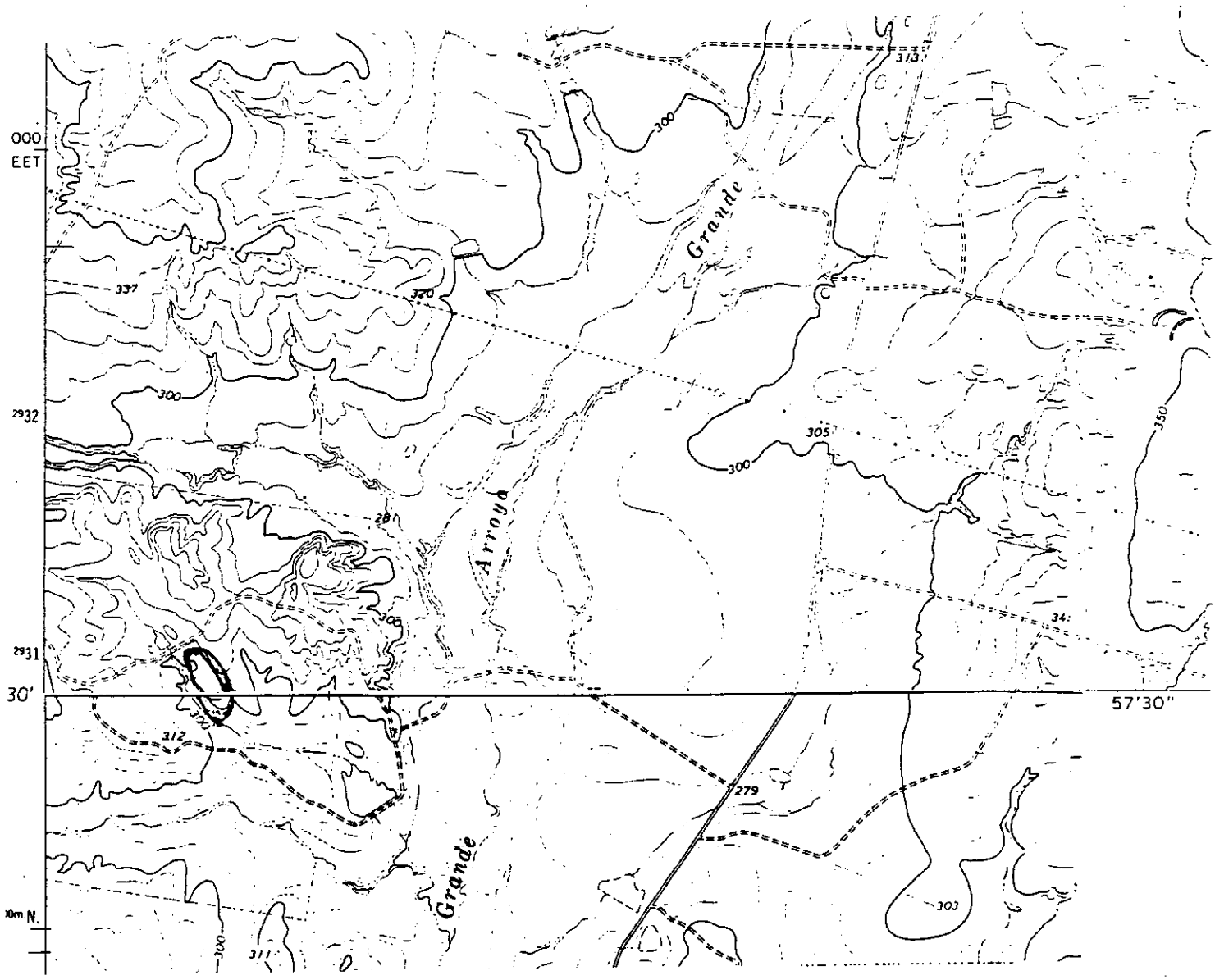

Figure 55. Population 55: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on both the El Chapote Creek and Roma Los Saenz East 7.5 minute topographic quadrangles.

Population 56: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Roma Los Saenz East 7.5 minute topographic quadrangle.

Site Name:	Number 56
Ownership:	Unknown
Voucher:	Not collected
Number of individuals:	Unknown
Area Covered:	~ 15 to 16 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	No
Population Future:	Unknown
Soil Sample Results:	Not collected

Population 56 occurs on private property in western Starr County (see Figure 56). The plants cover an area of approximately 15 to 16 acres.

I received this information in November 1999 from Chuck Kierce, a Private Consultant who just finished up walking a big seismic line project in western Starr County. Chuck always makes sure the seismic lines avoid the *F. johnstonii* sites. Although he did not record the number of plants, I know that he maps the area covered by the populations very accurately.

Associated species not recorded.

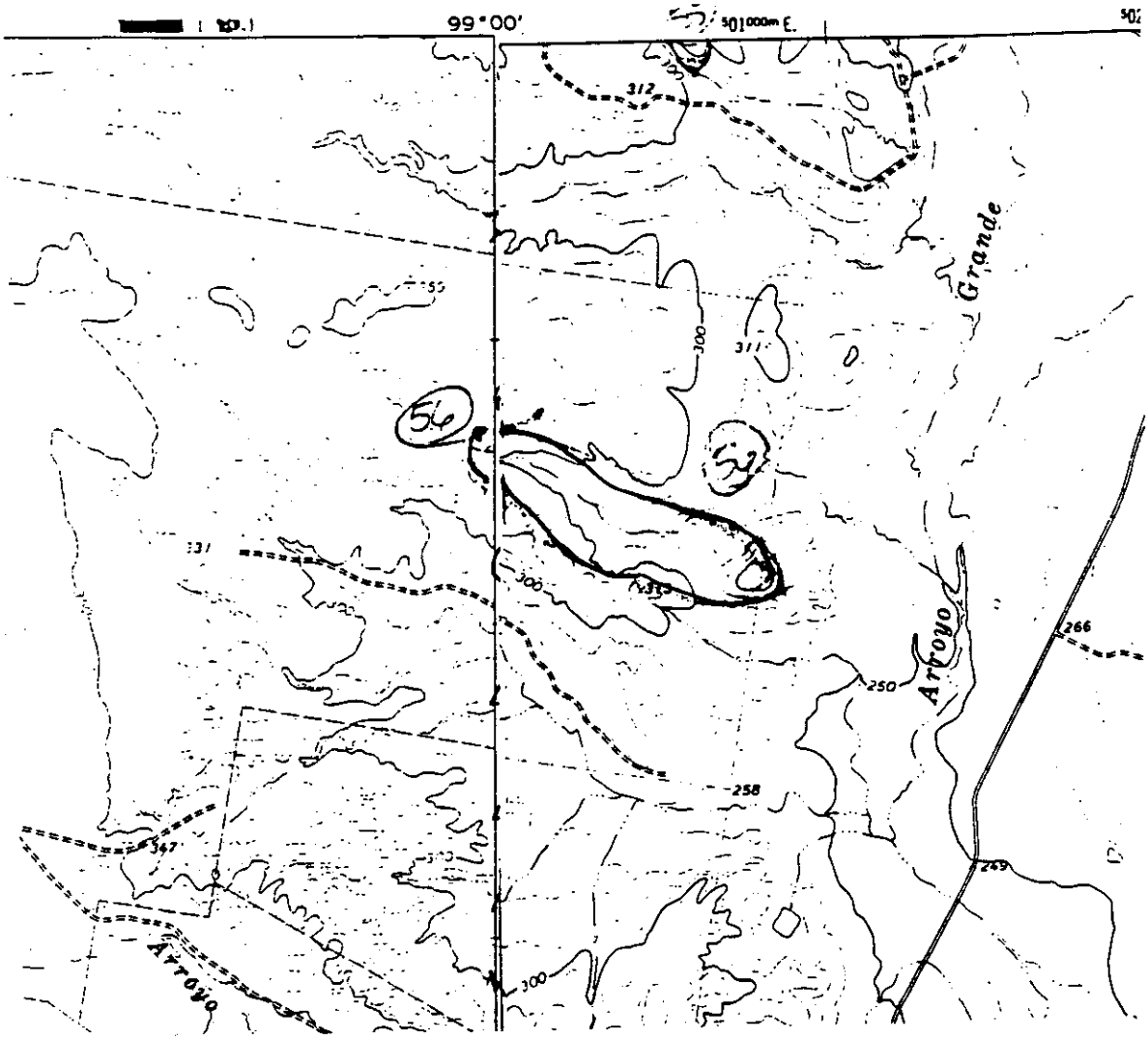

Figure 56. Population 56: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Roma Los Saenz East 7.5 minute topographic quadrangle.

Population 57: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Rio Grande City North 7.5 minute topographic quadrangle.

Site Name:	South of El Sauz
Ownership:	Lupe Castañada and Confidential
Voucher:	Not collected
Number of individuals:	~ 500
Area Covered:	~ 10 acres
Soils:	Catarina soils
Geology:	Alluvium on Catahoula & Frio Formations undivided
Conservation Agreement:	No
Population Future:	Unknown

Soil Sample Results:

pH	Nitrate	Calcium	Magnesium	Salinity	Sodium	Texture
8.7 strongly alkaline	1 ppm very low	29998 ppm very high	214 ppm high	1488 ppm moderate	1263 ppm high	Clay Loam

Population 57 occurs on two private ranches in western Starr County (see Figure 57). The plants are scattered, and number approximately 500. The area covered by the population is approximately 10 acres.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), *Sueada* sp., mesquite (*Prosopis glandulosa*), armed saltbush (*Atriplex acanthocarpa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), curly mesquite (*Hilaria berlangeri*), whorled dropseed (*Sporobolus pyramidatus*), fishhook cactus (*Ferocactus setispinus*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), prickly pear cactus (*Opuntia engelmanii*), horse crippler (*Ferocactus texensis*), goat bush (*Castela texana*), Fitch's hedgehog cactus (*Echinocereus fitchii*), Pitaya (*Echinocereus enneacanthus*), leatherstem (*Jatropha dioica*), squaw bush (*Condalia spathulata*), blackbrush (*Acacia rigidula*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

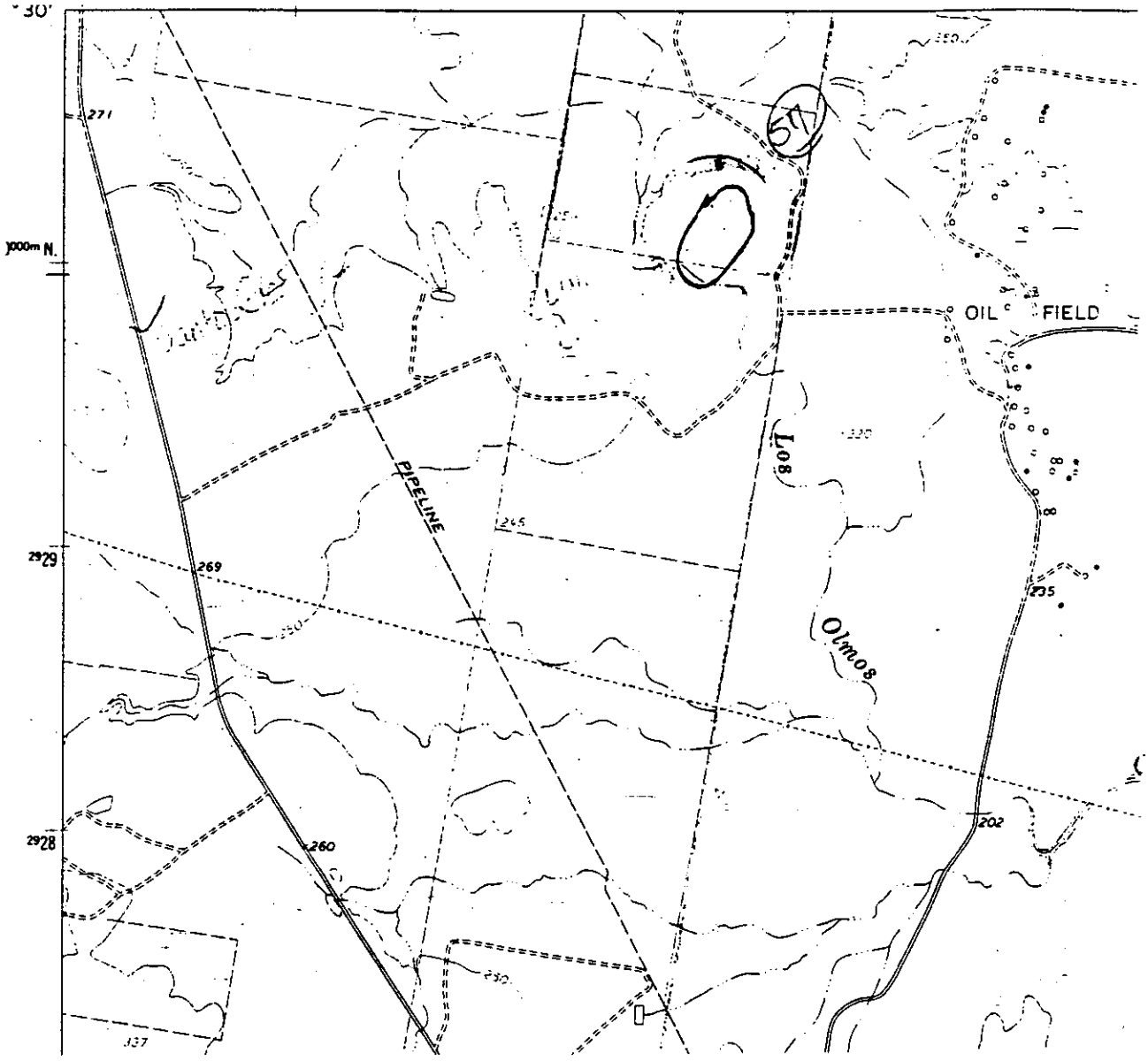

Figure 57. Population 57: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Rio Grande City North 7.5 minute topographic quadrangle.

Population 58: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Salineño 7.5 minute topographic quadrangle.

Site Name:	Number 58
Ownership:	Noel Benavides
Voucher:	Not collected
Number of individuals:	~ 400
Area Covered:	~ 10 to 20 acres
Soils:	Catarina soils
Geology:	Jackson Group
Conservation Agreement:	Pending
Population Future:	Secure
Soil Sample Results:	Not collected

Population 58 occurs on a private ranch in western Starr County (see Figure 58). This site is composed of two sub-populations and numbers approximately 400. The area covered by the plants is approximately 10 to 20 acres.

This information came from Chris Best, Biologist for the U. S. Fish and Wildlife Service. According to Chris, Noel Benavides is dedicated to conservation and would be happy to sign a voluntary Conservation Agreement.

Associated species not given.

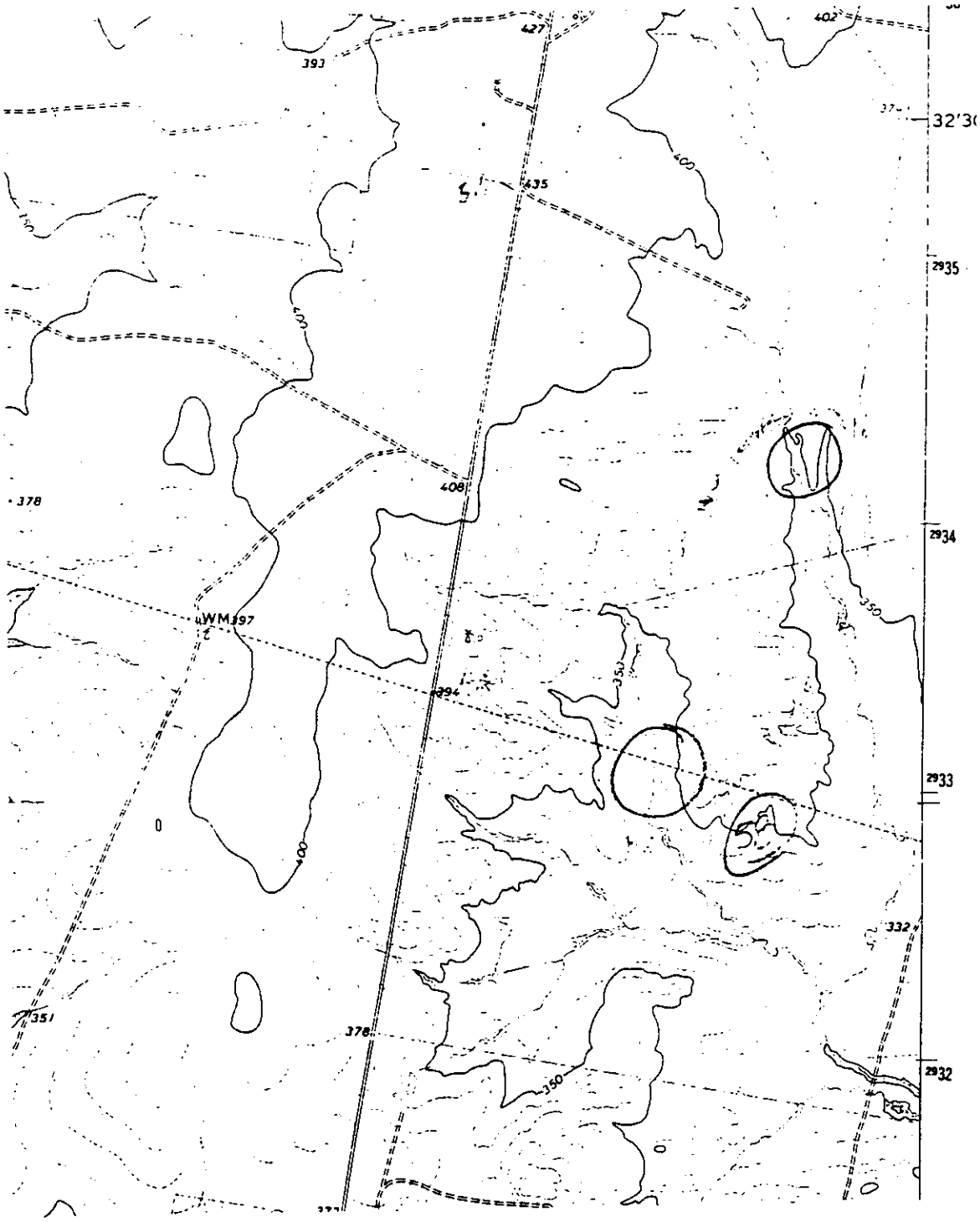

Figure 58. Population 58: Occurrence from a secondary source for Johnston's frankenia (*Frankenia johnstonii*) located in Starr County, on the Salineño 7.5 minute topographic quadrangle.

To date, there are four verified populations of Johnston's frankenia in Mexico. Soils are mapped as Regosols and Xerosols according to Instituto Nacional de Estadistica Geografia e Information (1979). I have been unable to get the soil descriptions interpreted into English; however, they are included in Appendix E. One site is underlain by Eocene Age geologic formations, while the remaining three sites occur on Cretaceous Age geology.

Table 4. Soils and Geology for the verified Mexico *Frankenia johnstonii* populations.

Mexico Population #	**Site Description**	**Soil Name**	**Geologic Formation**
M1	Tamaulipas, on Hwy 2	Regosol/calcareous & Xerosols/simple (gravelly)	Eocene (gravelly shale)
M2	Coahuila/Nuevo Leon Border, on Hwy 53	Xerosols/simple (gravelly)	Upper Cretaceous (calcareous shale)
M3	Nuevo Leon, on the road to Rancho Lechuguilla	Regosol/eutrico, moderate salinity, (petrogypsica)	Upper Cretaceous
M4	Mina, Nuevo Leon	Xerosols/simple	Upper Cretaceous (calcareous shale)

Mexico Site Descriptions

Population M1: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Tamaulipas, Mexico, on the San Ygnacio 7.5 minute topographic quadrangle and the Tamaulipas, Mexico, Guia Roji, Escala: 1:800,000.

Site Name:	The junction of Hwy. 2 and the road to San Ignacio
Ownership:	Unknown
Voucher:	Janssen & Williamson # 0683
Number of individuals:	~ 5,000
Area Covered:	~ 30 acres
Soils:	Regosols and Xerosols
Geology:	Eocene
Soil Sample Results:	Not collected

Population M1 occurs along the junction of Highway 2 and the road that leads to San Ignacio, Mexico [see Figures M1(a) and M1(b)]. I first discovered this site in the summer of 1995 while my husband and I were on our way to Guerrero Viejo. This population occurs upon a series of very gravelly hills that are nearly denuded of all vegetation with the exception of *Frankenia johnstonii* and *Varilla texana*. The site is completely fenced so access was not attempted. There are approximately 5,000 individuals on an area of approximately 30 acres. Since some grazing/browsing pressure was evident at the site, the plants should be considered in fair to poor condition.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), saladillo (*Varilla texana*), screw bean mesquite (*Prosopis reptans*), mesquite (*Prosopis glandulosa*), dog's ear (*Tiquilia canescens*), parralena (*Thymophylla pentachaeta*), common goldenweed (*Isocoma coronopifolia*), pencil cactus (*Opuntia leptocaulis*), and prickly pear cactus (*Opuntia engelmanii*).

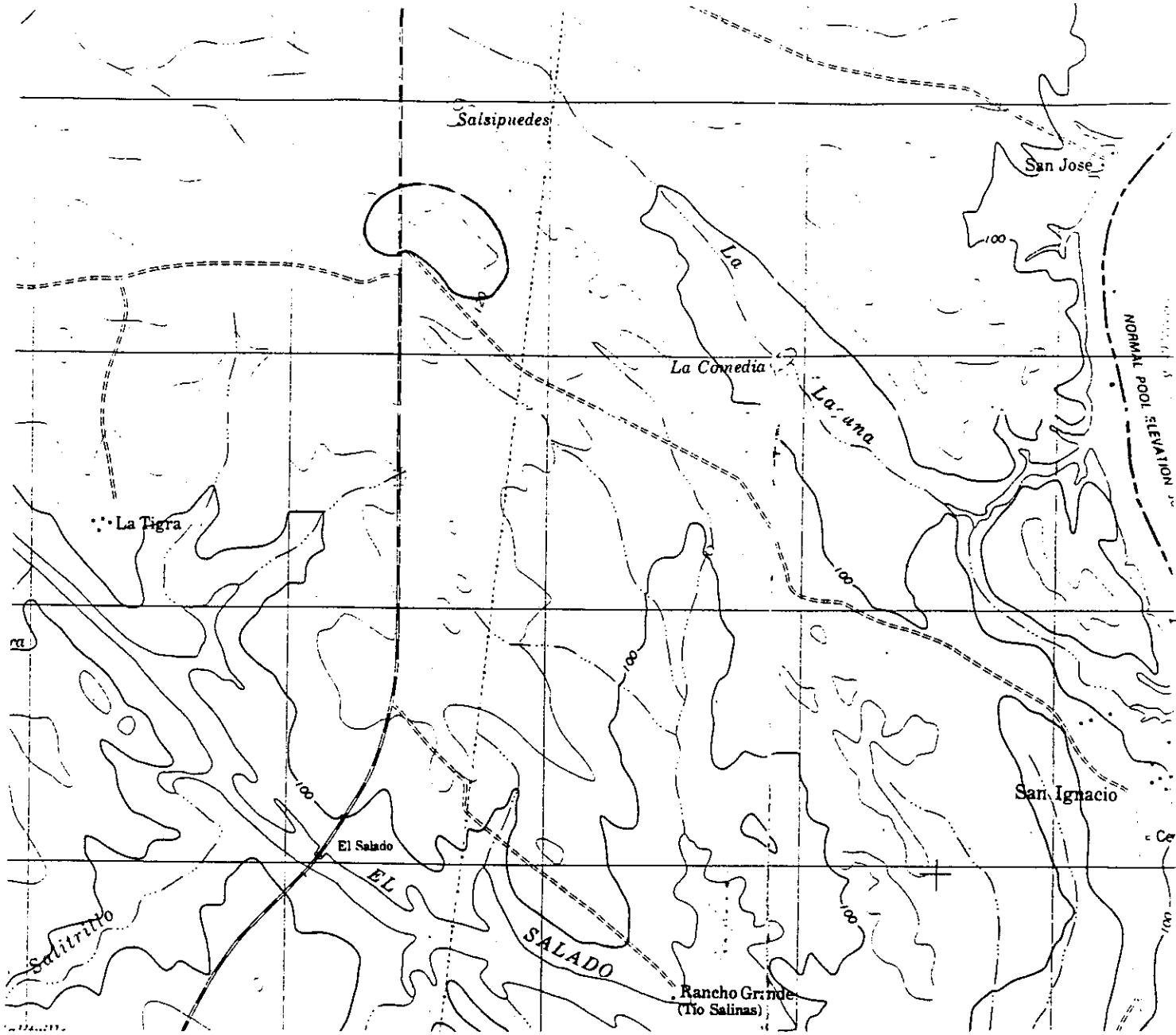

Figure M1(a). Population M1: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Tamaulipas, Mexico, on the San Ygnacio 7.5 minute topographic quadrangle.

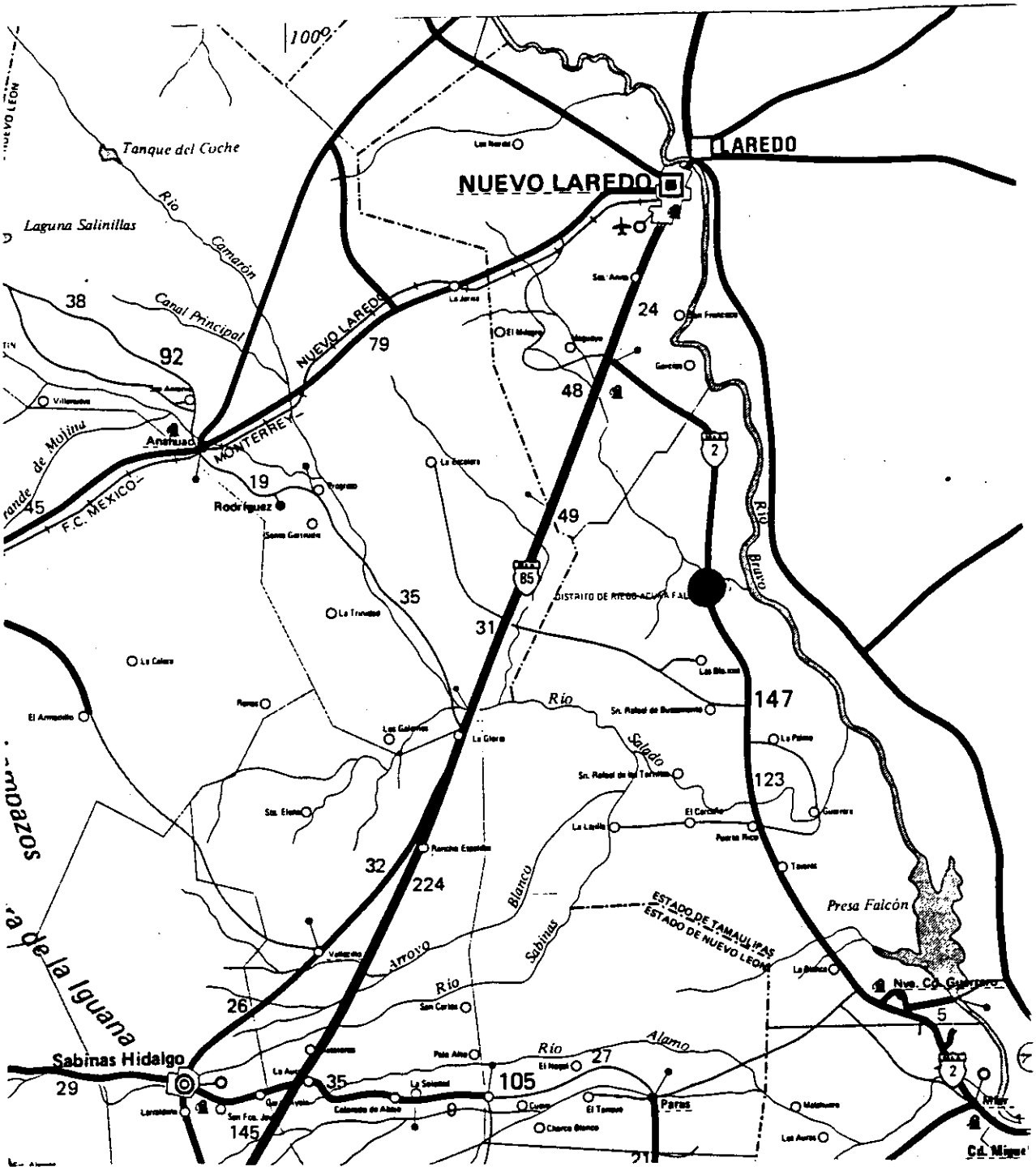

Figure M1(b). Population M1: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Tamaulipas, Mexico the Tamaulipas, Mexico, Guia Roji, Escala: 1:800,000

Population M2: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located at the Coahuila/Nuevo Leon border, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

Site Name:	Coahuila/Nuevo Leon border on Hwy. 53
Ownership:	Unknown
Voucher:	J. D. Bacon, W. R. Leverich, & B. L. Turner # 1076; Powell & Turner # 2311; M. Whalen #'s 449, 451, 524r
Number of individuals:	~ 600
Area Covered:	not given
Soils:	Xerosols
Geology:	Upper Cretaceous

Soil Sample Results:
From Whalen (1980)

pH	SAR	Calcium	Magnesium	Gypsum	Sodium	Texture
7.2 alkaline	4.2 (a ratio)	20.2 meq/l	4.6 meq/l	39 (percent)	2.6 meq/l	Silt Loam

Population M2 occurs along Highway 53 at the border of Coahuila and Nuevo Leon (see Figure M2). The directions state: 100 km. Northwest of Monterrey near the 100 km. Marker on Highway 53 between Monterrey and Monclova.

The collection history at this site is quite interesting. The site was first discovered in September 1971 by Dr. Billy Turner who was accompanied by a few graduate students. Turner, thinking that he had uncovered a new *Frankenia* species, named it for W. R. Leverich (*F. leverichii*) the "quasi-hippie" who had accompanied him on his 1971 trip (Turner 1973). Powell and Turner returned in May of 1972 to collect. Molly Whalen traveled to the site in July 1977 and October 1978 while working on her Ph.D. dissertation on the genus *Frankenia*. Unfortunately for Turner, Molly sunk *F. leverichii* into *F. johnstonii* in her dissertation, A Systematic Revision of the New World Species of Frankenia (FRANKENIACEAE) (Whalen 1980). According to a phone conversation with botanist Dr. Tom Patterson (pers. com. October 1999) and e-mail from Mexican biologist M. C. Julian Trevino-Villareal (pers. com. October 1999), after 28 years this site remains extant.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), Johnston's machaeranthera (*Machaeranthera johnstonii*), winged sesuvium (*Sesuvium verrucosum*), pickleweed (*Allenrolfea* sp.), sartwellia (*Sartwellia* sp.), 4-wing salt bush (*Atriplex canescens*), *Sueada* sp., bahia (*Bahia* sp.), greggia (*Nerisyrenia gracilis.*), pitchfork (*Dicranocarpus* sp.), and moonpod (*Selinocarpus* sp.).

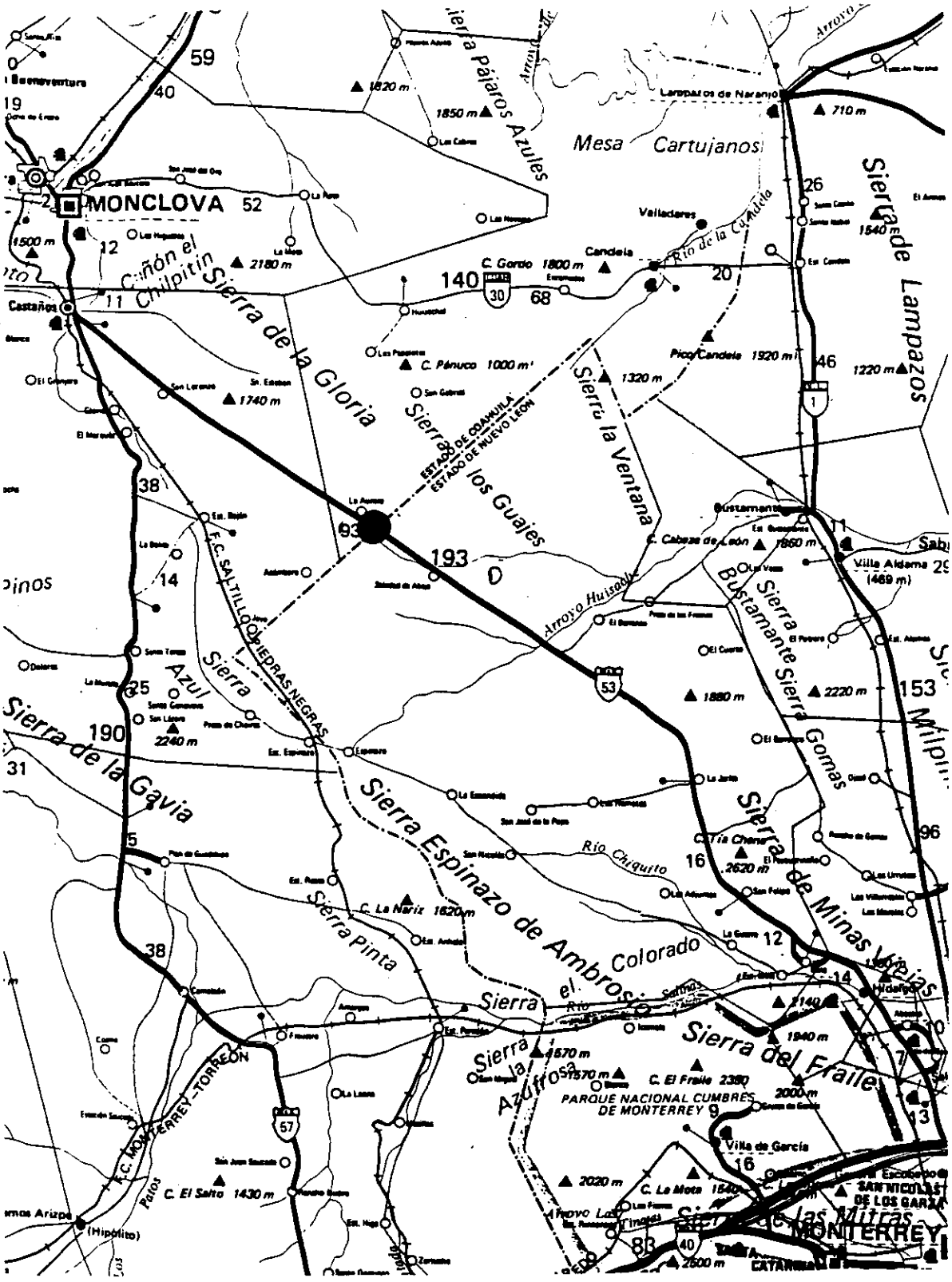

Figure M2. Population M2: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located at the Coahuila/Nuevo Leon border, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

Population M3: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Nuevo Leon, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

Site Name:	On the road to Rancho Lechuguilla
Ownership:	Unknown
Voucher:	M. C. Johnston et al. # 10215; T. F. Patterson # 7433
Number of individuals:	not given
Area Covered:	not given
Soils:	Regosol
Geology:	Upper Cretaceous
Soil Sample Results:	Not collected

Population M3 occurs north of Highway 53 on the road to Rancho Lechuguilla (see Figure M3). On 1973 specimen # 10215, M. C. Johnston states: Nuevo Leon—16 km. North of Rancho Estacas, on the road to Rancho Lechuguilla; 26 30'N, 100 48'30"W; 650m; matorral desertico inerme; gypsum flat, gypsiferous loam. On 1993 specimen # 7433, T. F. Patterson states: Nuevo Leon—North of Monterrey/Monclova Highway 53, 7 miles north of Rancho Las Estacas on one of several roads leading north from headquarters- this road passes two watering holes and ends here. Plants growing on gypsum loam, 650m, ca. 26 25'N; 100 50'W. Mexican biologist M. C. Julian Trevino-Villarreal also describe this site as: Northwest on Highway 53 from Monterrey, ~ 100 km. to Rancho Las Estacas, go north ~ 18-19 km. (Mr. Trevino-Villarreal is not sure where his specimens have been deposited.) Approximately 27 years after its discovery, this site remains extant.

Associated species include: Johnston's frankenia (*Frankenia johnstonii*), creosote bush (*Larrea tridentata*), *Opuntia* sp., ocotillo (*Fouquieria splendens*)., *Suaeda* sp., greggia (*Nerisyrenia gracilis*), moonpod (*Selinocarpus* sp.), wolfberry (*Lycium* sp.), and *Sporobolus* sp.

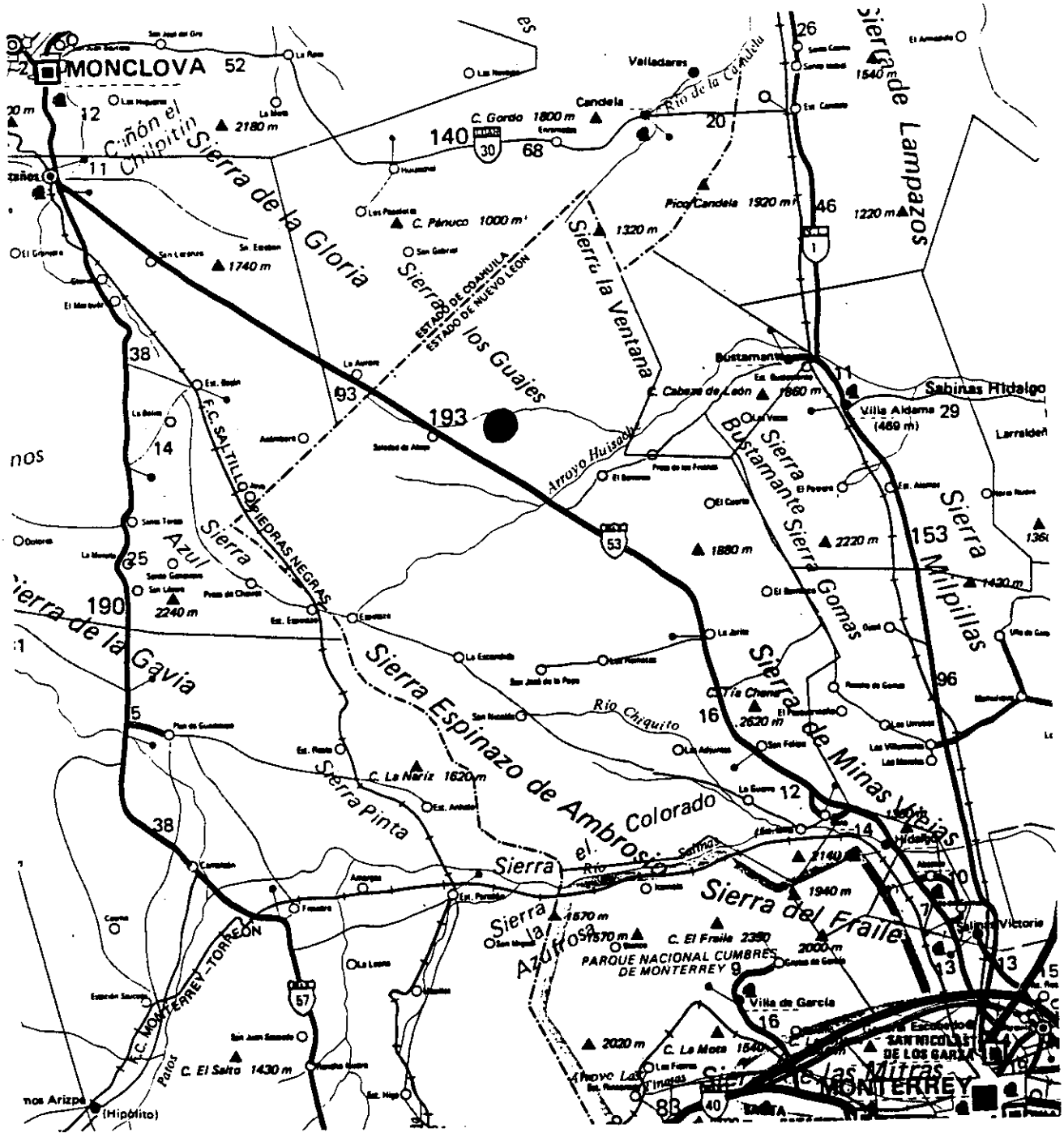

Figure M3. Population M3: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Nuevo Leon, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

Population M4: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Nuevo Leon, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

Site Name:	La Soledad, Mina, Nuevo Leon
Ownership:	Unknown
Voucher:	M. C. Herrera #'s 012013, 012014, 015233, 015234
Number of individuals:	abundante!
Area Covered:	not given
Soils:	Xerosols
Geology:	Upper Cretaceous
Soil Sample Results:	Not collected

Population M4 occurs within the town of Mina, Nuevo Leon, Mexico (see Figure M4). I found the above specimens in the Falcutad de Ciencias Biologicas Herbario at Universidad Autonoma de Nuevo Leon (Monterrey) during a 1999 visit. They were labeled as *Frankenia leverichii.* Mexican biologist M. C. Julian Trevino-Villarreal also described this site to me via e-mail in October 1999 (Mr. Trevino-Villarreal does not know where his specimens have been deposited). Nearly 20 years since its discovery, this site remains extant.

The labels of specimen #'s 012013 and 012014 collected in 1980 read: Atitude 710 met. Ascociacion de halofitas. Planta con cristales del sal en el enves de las hojas y flores de color rosa.

The labels of specimen #'s 015233 and 015234 collected in 1981 read: Asociacion de halofitas. Hierba abundante. Espcie en demica del area, flores rosa palido, casi blancas, con cristales de sal en el enves. Suelo salino (costroso).

Although Herrera described the flowers as pink and pink to almost white, the specimens were definitely those of *Frankenia johnstonii.*

Associated species not given.

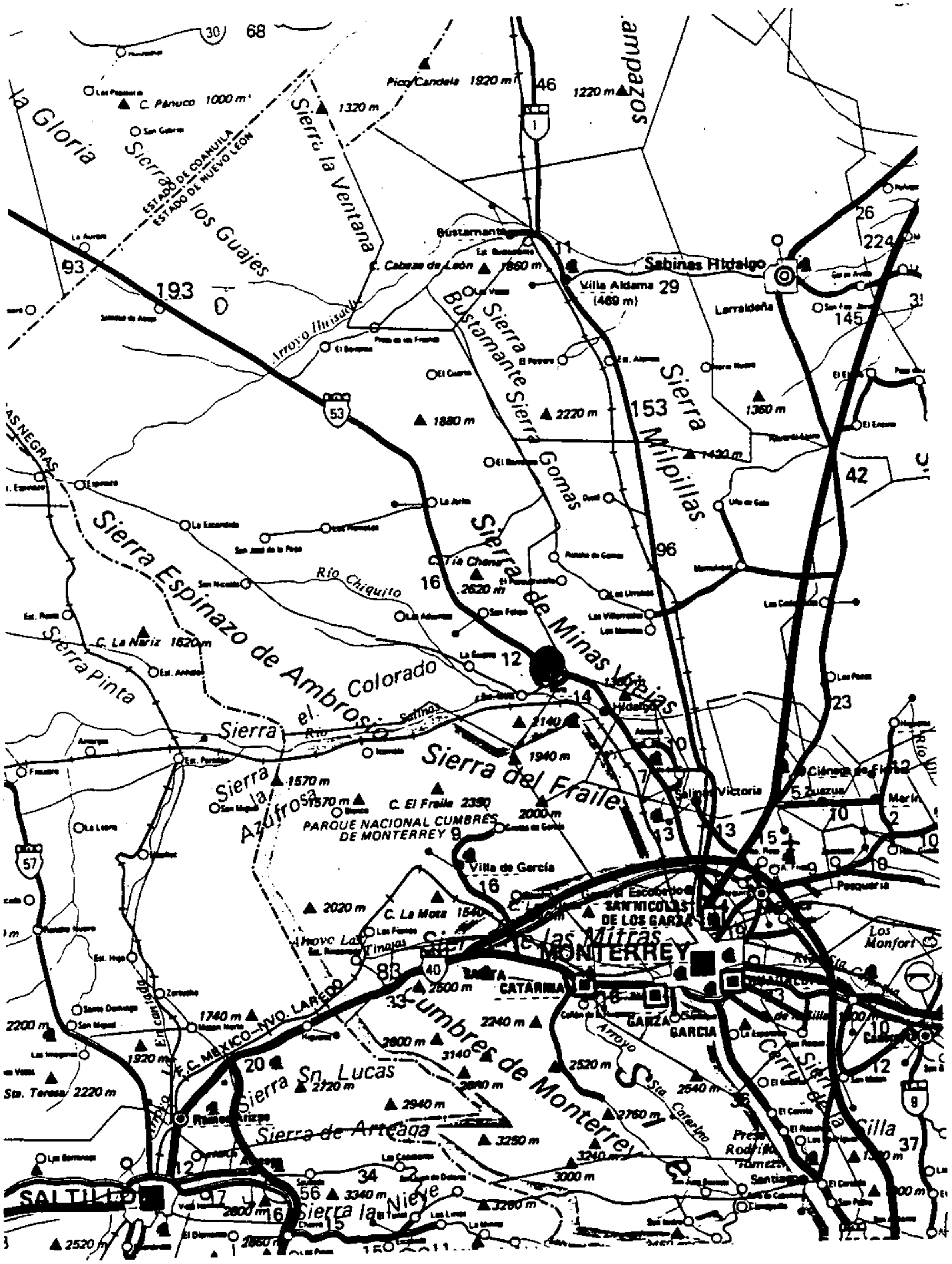

Figure M4. Population M4: Confirmed occurrence for Johnston's frankenia (*Frankenia johnstonii*) located in Nuevo Leon, Mexico, on the Nuevo Leon, Mexico, Guia Roji, Escala: 1:800,000.

PART 2: SOIL ANALYSIS

INTRODUCTION

Edaphic characteristics are a major factor affecting the distribution of plant species (Barbour, et al. 1987). Members of the genus *Frankenia* have unusual distributional patterns and are restricted to specialized habitats (Whalen 1980). All members of the genus are woody perennials that are restricted to saline and gypseous soils. Range fragmentation is particularly prominent for the members of *Frankenia* that occur within the inland desertic regions where saline lakes and gypsum outcrops which these species occupy are often widely isolated (Whalen 1980). *Frankenia johnstonii* is a highly restricted endemic of the Tamaulipan Thorn scrub. Although saline soils are relatively widespread in Webb, Zapata and Starr Counties in Texas, the distribution of *F. johnstonii* is further restricted to what appeared to be an even more specialized habitat within those saline areas. *Frankenia johnstonii* always occurs in very well defined clumps within well delineated salt flats or saline openings of the brush. Based on the assumption that this distinctive pattern was caused by edaphic characteristics, a study was initiated to determine if there were soil differences within population boundaries and outside of population boundaries.

METHODS AND MATERIALS

Composite soil samples were collected according to guidelines outlined in the Texas Agricultural Extension Service form D-494 entitled: *Procedures For Taking Soil Samples*. Composite soil samples were taken at 38 *F. johnstonii* Texas populations (or sub-populations). A composite sample was obtained by taking five separate six inch deep samples per site, mixing them together in a clean container or bucket, and taking one sample from the mixture within the container. A second composite sample was taken 50 meters from the edge of 30 Texas populations (or sub-populations) in an area where the plants did not occur.

All soil samples were sent to the Texas A & M Soil Testing Laboratories in College Station, Texas, for complete elemental analysis, soil texture analysis, and detailed salinity reports. Gypsum analysis was requested, but Texas A & M Soil Testing Laboratories does not perform that test.

RESULTS AND DISCUSSION

Soil texture results for the 38 *F. johnstonii* populations sampled were: 21 clay; 6 sandy clay; 5 clay loam; 3 sandy clay loam; 2 silty clay; and 1 loam. Soil texture results for the 30 areas sampled outside of *F. johnstonii* sites were: 11 sandy clay loam; 10 clay; 4 sandy clay; 2 clay loam; 1 silty loam; 1 loamy sand; and, 1 loam.

Average Soil pH was 8.6 within *F. johnstonii* populations, and 8.4 50 meters from *F. johnstonii* populations.

Nitrogen was consistently low within and outside of population boundaries while potassium, calcium, and magnesium were consistently high (see Part 1—Soil Sample Results for each site).

Differences in soil salinity, soil sodium, and soil absorption ratios (SAR's) from within and outside of population boundaries were striking (see Table 5). Soil salinity results from within *F. johnstonii* populations averaged 4444 parts per million (ppm), ranging from 949 ppm to 10400 ppm. Soil salinity results taken 50 meters from *F. johnstonii* averaged 423 ppm, ranging from 123 ppm to 1430 ppm. Soil sodium results from within *F. johnstonii* populations averaged 4429 ppm, ranging from 1011 ppm to 112404 ppm. Soil sodium results taken 50 meters from *F. johnstonii* sites averaged 383 ppm, ranging from 21 ppm to 2983 ppm. SAR results from within *F. johnstonii* populations averaged 19.02, ranging from 5.84 to 55.52. SAR results taken 50 meters from *F. johnstonii* sites averaged 3.38, ranging from 0.34 to 10.05.

Soil salinity is an average of 10 times greater within *F. johnstonii* populations than that of the surrounding soils. Soil sodium is an average of 11 times greater within *F. johnstonii* populations than that of the surrounding soil. SAR's average five times greater than those of the surrounding soil.

The results indicate that *F. johnstonii* grows within highly alkaline, hyper-saline pockets of clayey soil found within the South Texas Brush Country. These pockets are not detectable in the county soil survey books, but they can be located within the broad areas mapped as saline soils (described in Part 1 of this Chapter) in Webb, Zapata and Starr County.

According to Rabinowitz (1981), competitive abilities are more critical to persistence than to the regulation of abundance. It is apparent that *F. johnstonii* has adapted to these hyper-saline habitats, thus explaining why this taxon is restricted in distribution. *Frankenia johnstonii* is actually a dominant species where occurs (see Part 4--vegetation sampling results and importance values) suggesting that *F. johnstonii* can successfully compete within these hyper-saline soils.

Table 5. Soil sampling results, as reported by Texas A & M Soil Testing Laboratory, for salinity, sodium, SAR, and texture analysis for 30 samples collected within *Frankenia johnstonii* populations and 30 samples collected 50 meters from that given population.

Soil Sample #	*Frankenia johnstonii* Pop. #	Salinity (ppm) IN	Salinity (ppm) OUT	Sodium (ppm) IN	Sodium (ppm) OUT	SAR IN	SAR OUT	Textural Analysis IN	Textural Analysis OUT
1	1	9100	650	3520	224	10.82	2.01	Clay	Clay
2	3	5850	455	3438	251	10.44	4.12	Clay	Clay
3	4	2470	546	3808	938	55.52	6.69	Sandy Clay	Clay
4	8	10400	325	3829	559	32.88	10.05	Silty Clay	Clay loam
5	9 (N)	1560	468	1011	196	16.66	1.44	Sandy Clay loam	Sandy Clay
6	9 (SE)	3900	780	1833	600	17.10	7.63	Clay	Clay
7	10	6500	169	7901	61	11.13	0.76	Clay	Sandy Clay loam
8	11	2405	260	2292	90	15.52	0.84	Clay	Clay loam
9	12	2535	218	5218	91	13.19	0.91	Clay	Clay
10	13	2080	299	7872	517	11.82	2.39	Clay	Clay
11	14	1300	819	2618	338	22.70	6.82	Clay	Sandy Clay loam
12	15	5525	351	6526	412	9.79	5.70	Silty Clay	Sandy Clay loam
13	16	1690	184	2920	193	21.84	2.65	Clay	Sandy Clay
14	21	8450	260	6245	220	9.65	2.27	Loam	Sandy Clay loam
15	22	1716	175	5297	68	17.56	1.19	Clay	Loam
16	23	1235	455	1605	393	17.86	8.12	Sandy Clay loam	Clay

Soil Sample #	*Frankenia johnstonii* Pop. #	Salinity (ppm) IN	Salinity (ppm) OUT	Sodium (ppm) IN	Sodium (ppm) OUT	SAR IN	SAR OUT	Textural Analysis IN	Textural Analysis OUT
17	24	7800	231	11121	69	11.11	1.17	Clay	Clay
18	27 (N)	1560	585	1497	639	10.29	1.12	Clay	Sandy Clay
19	27 (C)	8450	123	3346	21	42.03	0.87	Sandy Clay	Loamy Sand
20	27 (S)	2340	806	4891	613	8.31	6.30	Sandy Clay	Sandy Clay
21	28	9100	260	3395	44	37.73	0.87	Clay	Silty Loam
22	29	8450	195	12404	110	5.84	0.87	Clay	Sandy Clay loam
23	31	1170	198	2324	228	21.86	4.12	Clay	Sandy Clay loam
24	32	2470	910	3897	409	9.58	6.07	Clay	Clay
25	33	10400	1430	3987	2983	8.19	1.12	Clay	Clay
26	34	949	183	7431	100	9.89	2.35	Clay	Sandy Clay loam
27	35	1560	292	1243	261	30.27	4.09	Sandy Loam	Sandy Clay Loam
28	37	2470	585	3363	90	48.21	1.12	Sandy Clay	Sandy Clay Loam
29	40	7800	214	5949	552	8.63	7.63	Clay	Sandy Clay Loam
30	54	2015	260	2088	217	24.31	0.34	Sandy Clay	Sandy Clay Loam
Average		**4442**	**423**	**4429**	**383**	**19.02**	**3.38**		
Low		949	123	1011	21	5.84	0.34		
High		10400	1430	12404	2983	55.52	10.05		

PART 3: ANATOMICAL ADAPTATIONS

INTRODUCTION

Plants that are capable of growing in soil with more than 0.2% salt concentration (some authors place the limit at 0.25% to 0.5% salt concentration) are classified as halophytes (Barbour, 1970). Analysis of soils from within populations of *Frankenia johnstonii* and from 50 meters outside the boundary of a given population revealed significant differences in salinity and soil sodium. Analytical parameters are described in this chapter. The results indicate that *F. johnstonii* grows under edaphic conditions suitable to classify the plant as a halophyte.

Halophytes (salt plants) exhibit structural features, such as salt glands, thought to be adaptations related to saline or alkali environments (Thomson, 1975). Other members of the Frankeniaceae are known to possess halophytic characteristics including salt glands (Thomson, 1975). A study of leaf anatomy was undertaken to determine if *F. johnstonii* exhibits specialized structural features that would correlate with edaphic conditions of high salinity. Such specializations could provide a competitive edge in a saline environment and help to explain why this taxon is restricted in distribution.

METHODS AND MATERIALS

Specimens of *F. johnstonii* were prepared for examination with light microscopy. Leaves were collected from Population 53 (Starr County), Population 47 (Zapata County) and Population 9 (Zapata County). The material was fixed in 70% ethanol. Following fixation the material was washed then dehydrated in a tertiary-butyl alcohol series (Johansen, 1940) and then infiltrated with, and embedded in, paraplast-plus (Johansen, 1940). The material was sectioned using a Spencer 820 rotary microtome, mounted on microscope slides and stained with safranin and fast green (Johansen, 1940). Five leaves per population were examined.

RESULTS AND DISCUSSION

Leaves of *F. johnstonii* are small with inrolled margins. The epidermal cells of the adaxial (upper) surface are large; those in the lower surface are much smaller. The cuticle is thick, especially on the adaxial (upper) surface. In addition to the cuticle, the epidermal cell walls are cutinized. Stomata occur in both leaf surfaces, but are more abundant in the abaxial (lower) surface. Trichomes occur on both surfaces, but are especially abundant on the lower surface, imparting a grayish color. Salt glands occur in both epidermal surfaces. Each salt gland consists of six secretory cells and two collecting cells. The leaf is unifacial. One to two layers of palisade parenchyma occur beneath both the adaxial and abaxial surface. The spongy mesophyll is greatly reduced. Druse crystals occur in the spongy parenchyma cells. Elongated sclereids are common in the mesophyll, often extending from the upper to the lower surface. These cells are thick

walled and heavily cutinized. Sclerenchyma tissue also occurs along the inrolled portions of the leaf. The vascular system consists of a midrib and several marginal veins. The phloem is quantitatively reduced.

Frankenia johnstonii grows in an arid, saline and gypseous habitat. The plants occur in open areas and are subjected to high light intensities. A number of structural features characteristic of both halophytic and xerophytic plants (Esau, 1977; Sen and Rajpurohit, 1982; Barbour, Burk and Pitts, 1987) occur in the leaves of this species. The thick cuticle and cutinization of epidermal cell walls function to slow cuticular transpiration. The dense covering of trichomes traps water vapor as it evaporates from the stomata. This effectively maintains a boundary shell layer, lessening the steepness of the water vapor gradient, thus slowing stomatal transpiration. Curvature of the leaf also prevents wind from removing the boundary shell layer. The grayish color of the leaves helps reflect light, cooling the leaf and reducing the rate of transpiration. Halophytic plants absorb and accumulate salt. The salt contributes to the osmotic potential of the root cells, lowering the water potential and allowing the plants to absorb water from the soil solution. The salt glands function in salt extrusion. The glands exude excess salt on the surface of the leaf helping to maintain a constant salt concentration within the tissue.

Some plant species can tolerate environmental extremes that others cannot. *Frankenia johnstonii* exhibits many structural adaptations that enable the plant to tolerate the extreme saline soils in which the plant is found. The plant does not occur in the adjacent soils that are not as saline. Plants may be restricted to severe habitats because they are poor competitors on less extreme sites (Barbour, Burk and Pitts, 1987). The plant cover of such extreme sites is often low, so plants growing there are subjected to less competition (Barbour, Burk and Pitts, 1987). Few other species occur within *F. johnstonii* population sites (see vegetation survey results and importance values). This suggests that *F. johnstonii* can successfully compete within the saline soil, but not outside the pockets of saline soil. This may explain the specific edaphic association noted in the distributional pattern of this taxon.

PART 4: VEGETATION SAMPLING AND COMMUNITY COMPOSITION

INTRODUCTION

The importance of biological diversity has received much attention in recent years. Maintaining biodiversity requires an understanding of the biology of the species to be conserved and protection of existing habitat. *Frankenia johnstonii*, an endangered halophytic subshrub, occurs in three South Texas counties and three adjacent States in Mexico. Until recently, little was known about the habitat of this taxon. *Frankenia johnstonii* always occurs in very well defined clumps within well delineated salt flats or saline openings of the brush. These areas are bordered by Tamaulipan brush communities that are composed of different species assemblages than those within the populations of *F. johnstonii*. Studies were undertaken in an attempt to classify the vegetative communities occurring at these sites. Classification of the vegetative assemblage of the populations of *F. johnstonii*, in combination with abiotic parameters, will assist conservation biologists and private landowners with the identification and conservation of these unique habitats.

METHODS AND MATERIALS

Vegetation sampling using the line-intercept method (Brower, et al. 1990; Cox 1990) was conducted at 29 *F. johnstonii* sites. Two transects were run at each site: one within the *F. johnstonii* population; and, one within the surrounding brush at least 50 meters from the edge of the *F. johnstonii* population. Each transect was 100 meters. The transects were laid out using the following stratified-random design: 1) A 50 meter tape was situated within and outside of each population using a Random Numbers table. If the random number was even, the tape would be place on the ground from North to South. If the number was odd, the tape would be placed from East to West; 2) A 25 meter tape was then placed perpendicularly atop of the 50 meter tape. A Random Numbers table was used to establish placement of the 25 meter tape (for example, if the number chosen was 10, the 25 meter tape would be situated atop the 10 meter point of the 50 meter tape). If the number was greater than 50, a decimal was inserted (for example, if 75 was chosen, the 25 meter tape would be placed at 7.5 meters on the 50 meter tape.); 3) The 25 meter tape was placed randomly atop the 50 meter tape four different times, totaling 100 meters; 4) In addition to intercept length, the height of every woody species encountered was recorded; and finally, 5) the intercept length of bare ground was also recorded.

Field data was entered into Microsoft Excel 97 and formulas were created to calculate relative density, relative coverage, frequency, relative frequency and importance values for each species encountered within the transects. Additionally, total coverage for each site was calculated using the total bare ground recorded (Cox 1990).

RESULTS AND DISCUSSION

Line-intercept data shows that *Frankenia johnstonii* is indeed the woody dominant in those areas that it is found (see Table 6). *Frankenia johnstonii* had the highest relative dominance, frequency, density, and coverage values compared to other woody species encountered within this hyper-saline habitat. *Frankenia johnstonii* also had the highest Importance Value. *Frankenia* was followed in Importance by *Varilla texana*, *Prosopis reptans*, *Thymophylla pentachaeta*, and *Opuntia leptocaulis* respectively. These five species are consistently found at each *Frankenia johnstonii* population.

Table 6. Top 10 woody species encountered using the line-intercept vegetation sampling technique within population boundaries of *Frankenia johnstonii*, in order of Importance Value.

Species	Relative Dominance	Relative Frequency	Relative Density	Relative Coverage	Importance Value
Frankenia johnstonii	27.1	.12	.16	.27	.56
Varilla texana	13.7	.07	.05	.13	.27
Prosopis reptans	5.6	.08	.12	.05	.26
Thymophylla pentachaeta	3.4	.10	.10	.03	.23
Opuntia leptocaulis	5.8	.07	.03	.05	.16
Prosopis glandulosa	4.6	.03	.006	.04	.08
Suaeda sp.	2.9	.02	.02	.02	.07
Opuntia engelmanii	3.1	.03	.009	.03	.07
Isocoma coronopifolia	1.9	.03	.01	.01	.06
Billiturnera helleri	.67	.03	.01	.006	.05

During data entry, all grasses encountered were lumped into one category, Grass. When the data were generated, the grass category actually had a slightly higher Importance Value (.67) than *Frankenia johnstonii*. Curly mesquite (*Hilaria berlangeri*) and Whorled dropseed (*Sporobolus pyramidatus*) were the two grasses encountered most often. In retrospect, we should have separated the grasses by species while entering the data. However, it is interesting that the category of Grass turned out to be such an important community component. The category of Grass had a relative dominance of 17.4, relative frequency of .13, relative density of .37, and, relative coverage of .17. For purposes of publication, the grass data will be reentered by species.

The average height of woody species encountered within *F. johnstonii* populations was 29.08 cm. The average total amount of bare ground at each population was 50% (average total coverage 50%).

Line-intercept data show that *Acacia rigidula* dominates the shrublands bordering populations of *F. johnstonii* (see Table 7). *Acacia rigidula* had an Importance Value of .37, followed by *Ziziphus obtusifolia* (.19), *Prosopis glandulosa* (.18), and *Guaiacum angustifolium* (.14). *Opuntia leptocaulis*, *Castela texana* and *Tiquilia canescens* were also important components of the bordering community.

Table 7. Top 10 species encountered using the line-intercept vegetation sampling technique 50 meters from population boundaries of *Frankenia johnstonii*, in order of Importance Value.

Species	Relative Dominance	Relative Frequency	Relative Density	Relative Coverage	Importance Value
Acacia rigidula	18.2	.07	.10	.18	.37
Ziziphus obtusifolia	8.3	.06	.04	.08	.19
Prosopis glandulosa	11.0	.04	.03	.11	.18
Guaiacum angustifolium	3.7	.06	.04	.03	.14
Opuntia leptocaulis	4.0	.04	.04	.04	.13
Castela texana	5.8	.04	.02	.05	.13
Tiquilia canescens	1.7	.04	.07	.01	.13
Opuntia engelmanii	5.0	.04	.02	.05	.12
Forestiera angustifolia	3.9	.04	.02	.03	.10
Larrea tridentata	4.1	.03	.02	.04	.10

The average height of the woody species encountered outside of *F. johnstonii* populations was 95.96 cm. The average total amount of bare ground outside of each population was 25% (average total coverage 75%).

According to Diamond et al. (1987), a Dwarf Shrubland is a community with 26 percent or more canopy cover of shrubs less than half a meter tall. Diamond et al. (1987) also went on to state that "none are described for Texas". Data presented in this report show that the community in which *F. johnstonii* occurs is indeed a Dwarf Shrubland (average plant height 29.08 cm/.2908 m). Additionally, data presented here contributes to our ever-growing knowledge of plant associations found in Texas. According to Weakley, et al. (1996), "association" is defined the following way:

> The association is the finest level of the classification system. For the terrestrial system, the association is defined as an individual plant association or a repeating complex of plant associations. These associations have definite floristic composition and uniform physiognomy, and represent uniform habitat conditions (see Flahaut and Schroter 1910). This basis concept has been used by most schools of floristic classification (Braun-Blanquet 1932, Westhoff & van der Maarel 1978). The plant association concept applies to existing vegetation regardless of successional status. The definition of the association can be clarified with following points: 1) "Habitat" refers to the combination of environmental conditions and ecological processes influencing the community; 2) Uniformity of physiognomy and habitat conditions may include patterned heterogeneity; 3) As a rule, associations recur over the landscape; 4) The scale of the association varies. Among other factors, the variation is determined by the size and apparent homogeneity of the occurrence across the landscape, the amount of data that has been collected, and the interpretation of these data; 5) The association may be composed of a complex of plant associations that constitutes a functioning ecological unit if the plant association always occur together (e.g. cedar glades). The association is different from the alliance level by inclusion in the name of additional plant species, found in any stratum, that indicate finer scale environmental patterns or disturbance regimes. Concepts at this level are derived from analyzing complete floristic composition of the vegetation unit when plot data are available. In the absence

of a complete data set, approximation of this level is reached by using available information on the dominant species, or environmental modifiers and their hypothesized indicator species.

Line-intercept sampling data show that a distinct, recurring, assemblage of plants are found at each *F. johnstonii* population. This new plant association, the *Frankenia-Varilla-Prosopis reptans* Dwarf Shrubland, should be added to the list of Texas plant communities.

The *Frankenia-Varilla-Prosopis reptans* Dwarf Shrubland Association is a specialized plant association found on areas of hyper-saline soils. These unique associations are enclosed within the broader *Acacia rigidula* Shrubland Alliance, or possibly even more specifically (based on the data presented here), the *Acacia rigidula-Ziziphus obtusifolia* Shrubland Association.

The *Frankenia-Varilla-Prosopis reptans* Dwarf Shrubland Association is characterized by its openness and low species composition/competition. Average total coverage is approximately 50% while the remaining bare ground is usually covered with multi-colored cherty rocks and gravel and/or distinctive fossilized oyster shells. *Frankenia johnstonii* is the dominant woody subshrub creating a striking, unmistakable, landscape vista. While *Varilla texana* is also very prominent on the landscape, only careful inspection reveals the multitude of *Prosopis reptans*. Grasses commonly found are curly mesquite (*Hilaria berlangeri*) and whorled dropseed (*Sporobolus pyramidatus*). Shoregrass (*Monanthochloe littoralis*) is also occasionally found. Cacti are abundant and often dangerous (beware of the dog cholla camouflaged along the ground and the tasajillo that grows within *F. johnstonii* individuals). This dwarf shrubland association develops on strongly alkaline, hyper-saline, sometimes gypseous, clay soils that are underlain by mostly Eocene Age formations. This unique association should be considered restricted and somewhat rare. Efforts to conserve these areas should be relatively easy since the hyper-saline soils make these areas useful for little else but looking for neat plants and nighthawk eggs.

A complete list of the species recorded within the *Frankenia-Varilla-Prosopis reptans* Dwarf Shrubland Association can be found in Table 8 on the following page.

Table 8. Species assemblage of the *Frankenia-Varilla-Prosopis reptans* Dwarf-Shrubland Association. Each species represents a line-intercept record. However, each species does not necessarily occur at every population site.

FAMILY *Species*	**Common Name**	**Spanish Name**
AMARYLLIDACEAE		
Manfreda variegata	Texas tuberose	Huaco
BORAGINACEAE		
Tiquilia canescens	Dog's ear	Oreja de perro
BROMELIACEAE		
Hechtia glomerata	Guapilla	Guapilla
CACTACEAE		
Ancistrocactus sheeri	South Texas fishhook	South Texas fishhook
Opuntia engelmanii	Prickly pear cactus	Nopal
Opuntia leptocaulis	Pencil cactus	Tasajillo
Opuntia schottii	Dog cholla	Clavellina
Echinocereus enneacanthus	Strawberry cactus	Pitaya
Echinocereus fitchii	Fitch's hedgehog cactus	Fitch's hedgehog cactus
Echinocereus sp.	Alicoche	Alicoche
Ferocactus setispinus	Fishhook cactus	Fishhook cactus
Ferocactus texensis	Horse crippler	Manca caballo
Lophophora williamsii	Peyote	Peyote
Mammalaria heyderi	Nipple cactus	Biznaga de chilitos
Mammalaria sphaerica	Yellow dumpling cactus	Yellow dumpling cactus
Wilcoxia poselgeri	Rat-tail cactus	Rat-tail cactus
CELASTRACEAE		
Schaefferia cuneifolia	Desert yaupon	Capul/panalero
CHENOPODIACEAE		
Atriplex acanthocarpa	Armed saltbush	Huaha
Atriplex canescens	Four-wing saltbush	Four-wing saltbush
Salsola australis	Russian thistle	Russian thistle
Suaeda sp.	Seepweed	Seepweed
COCHLOSPERMACEAE		
Amoreuxia wrightii	Yellow show	Yellow show
COMPOSITAE		
Helenium microcephalum	Sneezeweed	Sneezeweed
Isocoma coronopifolia	Common goldenweed	Common goldenweed
Thymophylla pentachaeta	Parralena	Parralena
Varilla texana	Saladillo	Saladillo
EPHEDRACEAE		
Ephedra antisyphilitica	Ephedra/Mormon tea	Popote/Canatilla
EUPHOBIACEAE		
Euphorbia sp.	Euphorbia	Euphorbia
Jatropha cathartica	Jicamilla	Jicamilla
Jatropha dioica	Leatherstem	Sangre de drago
FABACEAE		

(LEGUMINOSAE)		
Acacia rigidula	Blackbrush	Chaparro prieto
Calliandra conferta	False-mesquite	Calliandra
Eysenhardtia texana	Texas kidneywood	Vara dulce
Pithecellobium pallens	Tenaza	Tenaza
Prosopis glandulosa	Mesquite	Mesquite
Prosopis reptans	Screw bean mesquite	Tornillo
FRANKENIACEAE		
Frankenia johnstonii	Johnston's frankenia	Johnston's frankenia
KRAMERIACEAE		
Krameria ramosissima	Ratany/calderona	Calderona
LILIACEAE		
Yucca treculeana	Spanish dagger	Palma pita
MALVACEAE		
Billiturnera helleri	Formerly Copper Sida	Locoman's sida
OLEACEAE		
Forestiera angustifolia	Desert olive	Panalero
OROBANCHACEAE		
Orobanche multiflora	Broomrape	Broomrape
PHYTOLACCACEAE		
Phaulothamnus spinescens	Snake-eyes	Ojo de vibora
POACEAE		
Hilaria berlangeri	Curly mesquite	Curly mesquite
Sporobolus pyramidatus	Whorled dropseed	Whorled dropseed
Monanthochloe littoralis	Shoregrass	Shoregrass
RHAMNACEAE		
Condalia spathulata	Squaw-bush	Costilla
Karwinskia humboldtiana	Coyotillo	Coyotillo
Ziziphus obtusifolia	Lotebush	Clepe
RUTACEAE		
Thamnosma texana	Dutchman's breeches	Dutchman's breeches
SCROPHULARIACEAE		
Leucophyllum frutescens	Purple sage	Cenizo
SIMAROUBACEAE		
Castela texana	Goat-bush	Amargosa
SOLANACEAE		
Physalis lobata	Purple ground cherry	Purple ground cherry
VERBENACEAE		
Aloysia gratissima	Whitebrush	Jazminillo
Lantana macropoda	Desert lantana	Yerba de cristo
ZYGOPHYLLACEAE		
Larrea tridentata	Creosote bush	Gobernadora
Guaiacum angustifolium	Soap bush	Guayacan

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May 20, 199

Botanist seeks to protect endangered plant species in Zapata

By Ma. Eugenia Guerra
Zapata Express Editor

"The extinction rate today is greater than any time in fossil record," Gena K. Janssen, Endangered Species Botanist with Texas Parks and Wildlife, said to a handful of Zapatans who met with her at a recent visit at the Zapata Public Library.

Janssen was in Zapata recently to talk about endangered plant species in Jim Hogg, Webb, Zapata and Starr Counties and what willing land owners can do to assist the state in locating endangered such species and trying to reverse their extinction.

Janssen met with district conservationist Adolfo Perez, county executive director of the Agricultural Stabilization and Conservation Service Cris Perez, Rio Bravo Rural Conservation Program Coordinator Zaragoza Rodriguez III, county extension agent Edmundo Martinez, Jim Hogg district conservationist Ernest Haner, and Webb County district conservationist Tony Garcia.

Janssen seeks to find landowners with a conservation ethic who wish to protect endangered plant species. Determining the existence of a plant on a landowner's property would entail a visit to the property and documentation of the location of the plant.

"There is a myth," Janssen said, "That having an endangered plant species on your land can shut your property and your operation down. We'd like to dispel that myth," she said. "There are also ways on our documentation and log sheets to be less specific about location so as to protect the land owner's privacy," she stressed.

According to the botanist, the two plants of concern in Zapata County are Johnston's frankenia (Frankenia johnstonii) and Ashy Dogweed (Thymophylla tephroleuca). Both plants have "LE" federally endangered status.

"Extinction means it's over and never coming back," she stressed. "And that's why it is important to get out all the information we can at this point," Janssen said.

Encroachment on wildlife and plants, Janssen said, is entire populations, towns, cities.

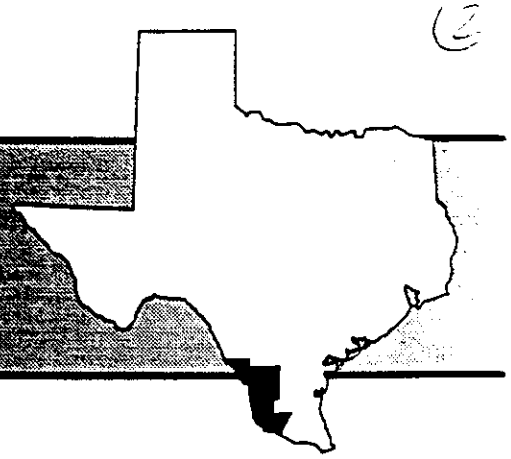
"We want to get the word out on how to protect a threatened species and how to proliferate it," Janssen said.

Land owners who are interested in participating in Janssen's queries to establish populations of threatened plants, may call her at (512) 448-4311.

Federally and State Endangered

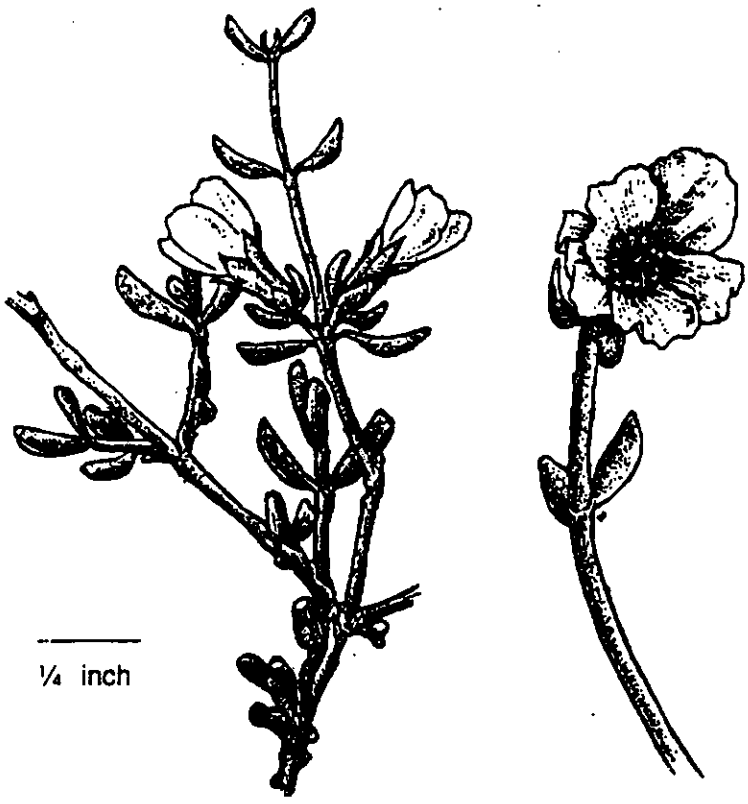
Johnston's frankenia

Frankenia johnstonii



Johnston's frankenia (*Frankenia johnstonii*) was listed as endangered by the U. S. Fish and Wildlife Service (USFWS) in August 1984, and listed endangered by the State of Texas soon afterwards. At the time of its listing, only 5 populations were known: two in Zapata County; two in Starr County; and, one in Mexico. Recently, however, many more populations have been discovered in Zapata County, and also one in Webb County.

Johnston's frankenia is a grayish-green, or sometimes bluish-green, spineless, halophytic (or salt-loving) subshrub that occurs in Webb, Zapata and Starr Counties of the South Texas brush country, and on the Coahuila-Nuevo Leon border of Mexico. At maturity, this species is usually one foot high, and one to two feet wide forming a convex-shaped, almost perfectly spherical subshrub. The majority of this subshrub is woody; however, the delicate, slender, curving stems that extend from the woody branches remain herbaceous. The very tiny, oblong leaves (1/4th to 1/2 inch long and 1/8th of an inch wide) have margins that curl under. The underside of the leaf is lighter in color due to the small, dense, grayish-white hairs that are barely visible with the naked eye. Often salt crystals are visible and tasteable on the underside of the leaves as well. The flowers, which are smaller than a dime when open, are white with five slightly fringed or toothed petals, and a distinct yellow center. Johnston's frankenia usually flowers from April to November, especially after rainfall. From November through February Johnston's frankenia turns from grayish-green to its autumn color, crimson red. During this red phase, when many other south Texas shrubs have lost their leaves, these endangered plants are very easy to detect.



Leaves and flower of Johnston's frankenia

by Patrick Stark

Habitat

This species does not occur singularly, or scattered throughout the brush. Populations of Johnston's frankenia are clumped, and tend to occur within openings of the Tamaulipan thorn-scrub on hyper-saline pockets of soil. According to soil analysis, soil salinity and sodium content are approximately 10 times greater within these populations of Johnston's frankenia as compared with the soils of the surrounding brush just 150 feet away. The majority of the known populations occur on reddish-colored rocky, sometimes eroding, hillsides on Maverick-Catarina soils primarily in Zapata County. This species can also be found on salt flats, and flat rocky openings within the brush. Other sites are located on Zapata Maverick soils in Zapata County and Eroded Maverick soils, which contain very distinctive fossilized oyster shells, in Starr County. A good species to look for when searching for Johnston's frankenia is saladillo (*Varilla texana*), which is also a salt-loving plant. The saladillo and the Johnston's frankenia often (but not always) occur together, and are frequently the dominant species in these areas since the high salinities make it difficult for other plants to colonize this type of terrain.

These areas that contain populations of Johnston's frankenia are not good range sites. Preliminary observations on private ranches indicate that root-plowing and seeding these specific areas result in no grass growth (or only a small amount of grass for a short time) because of the very high salinities, and increased erosion because regrowth is sparse and slow. Populations of Johnston's frankenia are a good indicator of areas to be incorporated into wildlife habitat, since any type of mechanical improvement will not create good rangeland, and will undoubtedly result in increased erosion.

How Can You Help?

When Johnston's frankenia was listed as endangered by the USFWS in 1984, there were only 5 known populations. Because of the commitment and cooperation of private land owners and the Texas Parks and Wildlife Department, today we know of many more populations, and we may be well on the way to downlisting this species to threatened or possibly even delisting this species. If you have populations of Johnston's frankenia on your ranch, we would like to know. With each new population of Johnston's frankenia that we can verify, the closer we are to full recovery of this endangered species.

For Further Assistance:

Please contact:

Gena K. Janssen, Endangered Species Botanist
Texas Parks and Wildlife Department
3000 IH 35 South, Suite 100
Austin, Texas 78704
1 (800) 792-1112 (Press Ext. 71 anytime during the recording.)
1 (512) 912-7011
or your local Soil Conservationist

PWD LF R3000-019 (3/95)

Zapata County News

Thursday
May 11,
1995

Zapata's Oldest Award Winning Locally Owned & Operated Newspaper

All that is necessary for the forces of evil to win the world is for enough good men to do nothing.
Edmund Burke

TEXAS PRESS ASSOCIATION AWARD WINNER

Vol. 16, No. 19 *Serving the Peoples and Communities of Zapata County – Viva Zapata* 50¢

Guest editorial

by Gena K. Janssen, Endangered Species Specialist, TPWD

Let's talk endangered plants

There will be a meeting May 17th, 1995, at 7 p.m. at the Zapata County Library to discuss local endangered species issues. The meeting is open to all interested persons from the local area. The topics of discussion will be:

- The current status of the Endangered Species Act (briefly).
- The law as it stands today, specifically the difference between endangerd plant laws and endangered animal laws (briefly).
- The current status of the endangered species in Webb, Jim Hogg, Zapata, and Starr Counties (especially the plants).
- Non-regulatory conservation options – the use of conservation agreements with private landowners in lieu of listing and also to delist or downlist species from the endangered species list.

I want to focus the majority of the meeting on the issue of using a conservation agreement to downlist or delist the plant Johnston's frankenia. It is now known from approximately 25-30 populations, and is now a good candidate for a status change. I *especially* would like all of the landowners of the area who have Johnston's frankenia (or other endangered species) ***on their ranches to attend.***

We have a great opportunity to really make a difference in endangered species conservation in Texas if the community comes together to work for a positive change.

This meeting is not meant to be an anti-government or anti-endangered species debate. This meeting is focused on community outreach, education, and letting landowners know that they can make a difference when it comes to endangered species.

There will be a free fajita dinner after the meeting at approximately 8:30 p.m. for all who attend.

Johnston's frankenia

Zapata County News

Thursday
May 25,
1995

apata's Oldest Award Winning Locally Owned & Operated Newspaper

Vol. 16, No. 21 *Serving the Peoples and Communities of Zapata County – Viva Zapata* 50¢

All that is necessary for the forces of e › win the world is for enough good men to do nothing.
Edmund Burke

TEXAS PRESS ASSOCIATION AWARD WINNER

Endangered Ranchers hear talk about local plants

A "gentleman's agreement." That's what Texas Parks and Wildlife Dept. botanist Gena K. Janssen asked from more than a dozen ranchers last Wednesday night as she met with them for an Endangered Species Update at the Zapata County Library. If one is reached, Zapata County ranchers and property owners will be the first to institute a new program for plant species conservation.

Starting promptly at 7 p.m., Janssen introduced the program by emphasizing that the Endangered Species Act (ESA) differs significantly when dealing with plants and animals. She noted that the ESA requires all federal agencies to conserve and protect endangered and threatened species, and that where plants are concerned, the protection and enforcement efforts start and end only on federal lands, not private property.

"You can do what you want on your own land with your own money," when it comes to plants, she said. She touched briefly on the difference when endangered and threatened animals are concerned, noting that the ESA includes taking, or changing or destroying, habitat of the endangered animals as well as the animals themselves. That's where protection of endangered animals can affect private property.

When it comes to plants, though, Janssen specified repeatedly that private landowners maintained total control

(See **Plants**, Page 8A)

Plants

Continued from Page 1

of what grew on their property.

She pointed out, too, that in Texas 97% of all land is privately owned. "And that's why we need your voluntary cooperation," she said.

She praised the landowners' past and continuing conservation efforts, noting that a number of once-thought endangered plants exist thanks to ranchers and farmers. "You have allowed us on your property and we have found these species, many more plants than we thought at first still flourished. It's with your foresight and efforts that we're now looking at de-listing some species."

She cited the example of the plant Johnston's frankenia, a subshrub that grows in hypersaline soil. When first listed as endangered in 1984 by the U.S. Fish and Wildlife Service, it was believed that only five stands of the plant existed, two in Zapata County, two in Starr County, and one in Mexico.

Janssen has been visiting ranches and senderos in the listed counties for nearly two years, researching the growth of this and other plants. To date, more than 25 stands of the once-thought-endangered plant have been found.

"With your help, we may soon be able to take this plant to the threatened category, or possibly take it off, or de-list from, the ESA entirely," she said.

Janssen then outlined a totally voluntary program proposed for agreement between private landowners and the state agency for plant specie protecti[on] [t]entatively titled Conserva[tion] Agreement, pro perty owners would acknow ledge the existence of threatened or endangered plan on their land and woul voluntarily agree to protect i from destruction. There woul be no penalty, Janssen explained if destruction occurred, whethe by accident or deliberate outsid act. "All that would happen, she explained, "would be possible return to the list o endangered or threatened statu for the plant if enough of them disappeared. There would be n official actions taken."

In response to question from the gathered ranchers, sh also explained that landowner could end the agreement at any time for any reason. "Thi would be totally voluntary o your part."

She cautioned, however, tha "It will only work if we all agre to it. We need all, or at leas most, of the ranchers and property owners to enter into these agreements. At that point the chances would be excellen for us to remove Johnston's frankenia from the protected list.

"We won't have to protect it, because you will. That's why the agreements work," she concluded.

Local rancher Joe Dodier, Jr. agreed to begin work on a draft of a Conservation Agreement that local ranchers could review and use as the basis for the project. The nearly two-hour meeting ended with a free fajita dinner served behind the library.

Zapata County News

Thursday
August 17,
1995

Zapata's Oldest Award Winning Locally Owned & Operated Newspaper

All that is necessary for the forces of evil to win the world is for enough good men to do nothing.
Edmund Burke

TEXAS PRESS ASSOCIATION AWARD WINNER

Vol. 16, No. 33 *Serving the Peoples and Communities of Zapata County – Viva Zapata* 50¢

Photo by Frank Barlett

Summer learning, summer fun

Youngsters of all ages spent one of their three days of the Conservation Learning Camp finding out more about proper diet, how to take care of themselves in an emergency (such as a house fire), and endangered animals, birds, and plants in the local area. The camp took place at the Zapata County Library and was sponsored by theTexas Agricultural Extension Service, Texas Parks and Wildlife, and the AmeriCorps volunteers.

LareDOS
A JOURNAL OF THE BORDERLANDS
Vol. 1, No. 7 AUGUST 1995 56 PAGES

OP-ED

No Easy Answers

By Pamela L. Holz

Upon discovering I majored in environmental studies, an ex-logger from Oregon attempted to instigate a "discussion" on the spotted owl with me. I firmly refused to argue, much to his disappointment. I wished I could have said that the endangered owl was more important than any other consideration, but I know it is not so.

My own father works in a paper mill in Wisconsin. It is the only job he ever had. When NAFTA was proposed, he was strongly against it. I had read strong arguments for the act, yet how could I say that NAFTA was worth my father losing his job? If new jobs opened up, they would not be available to a 50-year-old man with no sellable skills.

Too many who should know better forget that not only is an ecosystem at stake but also that system's interrelationship with humanity.

NAFTA is a complex agreement, but my father chose to oppose it simply on the ground that it could potentially take away his income. Environmental conflicts are seen the same way: owls vs. loggers. Too many who should know better forget that not only is an ecosystem at stake but also that system's interrelationship with humanity. Can we forget the salmon industry, the income from tourists and backpackers, and the high price of real estate in the wilderness? We also must not forget the relationship the forest has with the surrounding ecosystems.

That is why many of today's environmental problems are not solvable in this light. My dad knew NAFTA could do a lot of good, but at his own personal cost? How can one care for a bird when one's family is starving? Unfortunately, we are too focused to see the problems in any other way. In jobs vs. the environment, jobs are almost always going to win.

So we have to look at the problem another way. Take in the entire picture. Examine innovative solutions. Can't we find solutions where no one loses? True, sacrifices have to be made on each side, but isn't that democracy? We need to stop this petty bickering where each side denies any ounce of validity to the other. We need to listen. We need to calm down and think.

I find hope in the proposed agreement between local ranchers and the Texas Parks and Wildlife Department covered in this paper's last issue. Under this agreement, ranchers would voluntarily protect Johnston's frankenia and Ashy dogweed, two endangered plant species. Through education and patience, this proposal succeeds where most have miserably failed.

The answers are out there. We just haven't been looking for them.

A R I Z O N A

Daily Sun

WEDNESDAY

Serving Flagstaff and northern Arizona since 1883

September 13, 1995

INSIDE

Suspect charged in Bear Jaw Fire

SEE PAGE 2

Plant protectors meet at NAU

Researchers trying to help populations before they hit list

By LUKAS VELUSH
Sun Staff Reporter

Our dependence on vegetation begins with the oxygen we breathe and extends to just about everything else.

Ranching, water availability and quality of life are among the things that depend on healthy plant communities, said Ken Berg, the Bureau of Land Management's national botanist.

"It's almost so basic that we take it for granted that they're going to be there," said Berg, one of the speakers at the Second Southwestern Rare and Endangered Plant Conference taking place at Northern Arizona University.

The conference, hosted by the Arboretum at Flagstaff, is intended to share research and ideas about plant protection among environmental consultants, academic researchers, land management officials and others. About 125 people are taking part in the conference, which started Monday and ends Thursday.

Plants are the foundation for all life, Berg said, which is a fact often lost in the shuffle of the everyday world. The diversity of plant life also is important, he said.

In Arizona, for example, he said the tourism industry depends greatly on different types of plant life, whether at desert level, in canyons or in the mountains.

In the name of that diversity Berg defended the Endangered Species Act. He said people often don't understand that the act's intent goes beyond protecting individual species.

"Endangered plants provide an early warning sign" of problems in the plants' ecosystems, he said.

The BLM and other land mangers need the most current information to protect at-risk plants and to keep them from becoming endangered to begin with, Berg said.

"That information comes from a lot of different sources, which is what is happening here," Berg said. Representatives of the BLM, Fish and Wildlife Service, U.S. Forest Service, National Park Service and the National Biological Survey are among those attending this week's conference.

Berg said the conference has provided several examples of how efficiency can be increased among those protecting plants.

He described how an between Fish and Wildlife, the Forest Service and Park Service has kept the Arizona willow from being listed under the Endangered Species Act.

The willow, which is found only on Mt. Baldy in Arizona's White Mountains and Utah's Brian Head Mountain, recently came extremely close to being added to the list, which would have been a costly procedure, Berg said.

See PLANT, Page 3

yesterday.

The accident occurred about eight miles west of Seligman.

The eastbound car struck a bridge abutment and did a half-turn, the

Student leaders from the state's three universities have recommended tuition hikes next year that would eclipse $1,000 per year for the first time.

CARJACK

From Page 1

employee Brenda Anderson was on her way to work when she heard the broadcast and saw the vehicle travelling westbound on Interstate 40. She followed the suspects into the Bellemont Truck Stop and called 911, Connell said.

The woman notified authorities, and they were able to stop the suspects at 8:59 a.m. with a roadblock at milepost 151, which is 9 miles west of Williams.

The Williams Police Department, the Coconino County Sheriff's Department and the Arizona Department of Public Safety helped with pursuit and apprehension of the suspects, Connell said.

The suspects were expected to be questioned by Flagstaff police this morning and booked into the Coconino County Jail.

...state, will receive $830,900 to establish three new sites and work on one other site.

NAU could begin offering classes in Tucson, Nogales and Bullhead City as early as next fall, Television Services Director Paul Neuman said.

The money allows the university to build electronic classrooms at Pima Community College in Tucson, Mohave Community College in Bullhead City and at Nogales Unified School District No. 1.

The grant also gives NAU funds to begin establishing hub sites at Window Rock and the Pima college. Hub sites receive signals from remote sites and then trans-

which could be affe... funding cuts propo... broadcasting statio...

The new station... and Prescott will... about 41,000 peo... The station curren... listeners.

Through partn... Northland Pioneer... Yavapai College, t... be built on the...

NAU and the c... leges will contr... $53,236 to the proj...

Stark said he ex... to be finished in ... broadcasting will b...

PLANT

From Page 1

Instead, the three agencies together implemented a plan that averted the need to list the species without sidestepping provisions of the act.

Working with private landowners was another method that one presenter from Texas proved works to protect at-risk plants, in this case a Texas subshrub called Frankenia johnstonii.

"By working very cooperatively with landowners, Gena Janssen was able to get their trust and get them to agree to voluntarily protect the species," Berg said. "She found 30 more populations (groups of the plant) just by getting the cooperation of the private landowners," greatly increasing the plant's chances of recovery.

"It's not an impossible task or a broken system as people say it is," he said of the Endangered Species Act.

Another presentation showed why it doesn't always pay to choose short-term studies of plants over longer, more expensive research.

Pedicocactus peeblesianus, a cactus in the Coconino, Kaibab and Prescott national forests, looked liked it was in trouble after a three- to four-year study. However, after studying the plant for 11 years, Forest Service researcher Barbara Phillips found the cactus has a cycle in which its population drops and increases naturally.

"By learning more about it, we didn't go in and mess with it when we could have hurt it," Berg said.

Ron Koss, an environmental consultant working for Utah Inter...

Sean Openshaw/Arizona Daily Sun

Mark Minton, a botanist for the Denver Botanic Garden, tries to identify a plant Monday at the Arboretum at Flagstaff, a stop for participants in the Second Southwestern Rare and Endangered Plant Conference.

ference is to find at-risk plants early and help them avoid getting on the endangered list.

In fact, Koss presents a paper today on a plant that grows in southwest Wyoming, an area that is expected to become the U.S. oil capital in 15 to 20 years. Koss said his firm is studying the plant to see what it needs to stay off the endangered list.

"We need to project the threats and how they can be avoided," he said. "We're thinking of setting aside some undisturbed areas that could be used to regenerate disturbed areas.

"It's understanding the biology so we can manage the plants better and keep them from crisis situations," Koss said.

Fantastic ticket

PHOENIX (AP) — One of the tickets sold for Tuesday night's drawing of the Arizona Lottery's "Fantasy 5" game matched all five of the numbers that were drawn. Those numbers were 1, 18, 23, 28 and 31.

TRIBE

From Page 1

kind to the already ... dian support agen... cepted.

"It would be resi... existing levels of ... said.

On Sept. 25, 3,0... 12,000 employees ... get notices telling ... will end in 60 day... of the cuts the Sena...

The BIA is the ... that sees services pr... Americans on re... Hale said. Fundin... law enforcement ar... ces come through th...

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Meetings with ... ministration officia... Congress and In... Bruce Babbitt have ... Indian leaders lobb... ly in Washington.

Hale said the Un... treaties agreeing to

TEXAS WILDLIFE

Magazine of the Texas Wildlife Association

May, 1999 Volume 15 - Number 1

Working for tomorrow's wildlife ... TODAY! *$5.95*

Setting a New Standard

article and photos by Gena K. Janssen, Endangered Species Botanist, Wildlife Diversity Program, Texas Parks and Wildlife Department

Never in the history of the Endangered Species Act in Texas has the active participation, cooperation and conservation of a community of private landowners been solely responsible for the future delisting of an endangered species. Some of the private ranchers of Webb, Zapata and Starr Counties are setting a new standard for conservation of endangered species on private property. Not only are these ranchers making a difference, they're making history.

The U. S. Fish and Wildlife Service has recommended that a little-known endangered plant, Johnston's frankenia, be removed from the endangered species list. Why? Two simple words: Cooperation and Conservation.

The private landowners of South Texas have cooperated with the Texas Parks and Wildlife Department (TPWD) by opening their gates and allowing access to survey for this endangered species. This access has led to the discovery of at least 50 confirmed population complexes of Johnston's frankenia, and all but one were on private property.

But simply a few more populations will not assure that a species gets delisted—especially a plant. So, many of the private landowners went a step further by committing to conserve this species on their ranches through voluntary conservation agreements with TPWD.

But wait. I've gotten ahead of myself. Let me start at the beginning. I've got a story to tell.

When I first came to work for Parks and Wildlife, I heard tales of an endangered plant, Johnston's frankenia (*Frankenia johnstonii*), down in South Texas that was supposed to be everywhere. From local soil conservationists to the ranchers themselves, many local residents were claiming that our current data for this species was completely inaccurate. Maybe, the community leaders stated, this species did not need to be listed at all.

Johnston's frankenia was listed as an endangered species in 1984. At that time, it was known from only four localities in Texas: two in Zapata County and two in Starr County.

Back in 1993, the former Webb, Zapata, Starr and Jim Hogg County District Conservationists and the members of the Zapata County Soil and Water Board invited me to Zapata for a friendly little meeting. They wanted someone to come to South Texas and take another look at this so-called endangered species. They said it was everywhere in Zapata County.

"Hey, no problem" I thought, "this is going to be easy."

"Where are they?" I asked. Silence filled the room. They were all on private land, and nobody was talking.

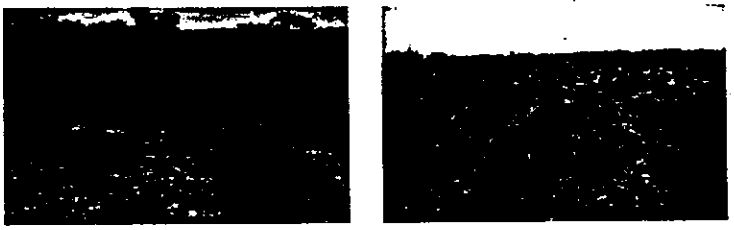
"But how can I delist this species if I cannot verify that there is actually a bunch more out there?" More silence.

Tough crowd.

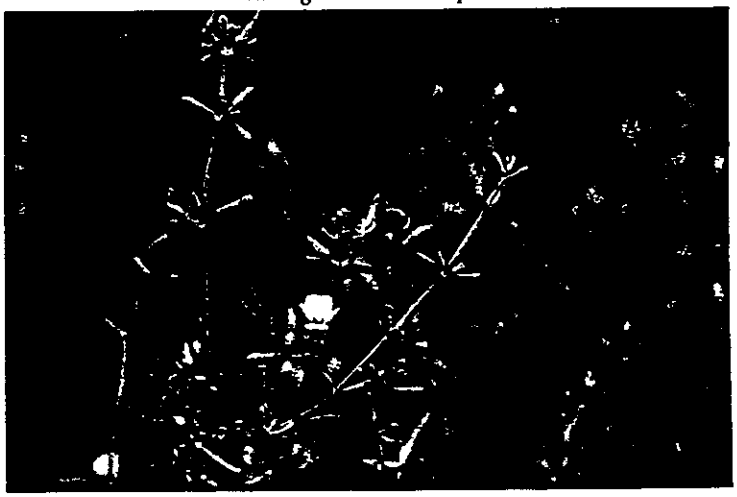
The message I got that day was: That's your job, we're just here to let you know that there is a lot of that stuff out there. By the end of that day I was faced with a challenge that I couldn't refuse. So, off I went on one of the greatest Easter egg hunts of

See STANDARD on Page 47

Jose Dodier (l) of Zapata County is one of the many South Texas landowners who aided TPWD botanist Gena Janssen (r) in her efforts to have the Johnston's frankenia removed from the federal Endangered Species List. Dodier is president of the South Texas Soil and Water Conservation Board.



The Johnston's frankenia has two color phases — green and red. For most of the year the plant is green-colored, left photo. But the plant turns red during South Texas' brief winter, right photo, making it easier to spot.



The center of all this attention is a modest little plant that usually is gray- to blue-green in color with no spines, unlike most other South Texas plants. Johnston's frankenia thrives in a salty environment and salt crystals often are visible on the underside of the leaves. Some 80 percent of all the plants are found in Zapata County.

Standard . . .

from Page 46

all time, and everyone but me knew where all the eggs were.

It took me a while before I actually gained access to the first ranch. But, one ranch turned into two, and two turned into three, and so on. Most landowners were kind and inquisitive, cautious but gracious. Over and over I would explain how the law was different for endangered plants, and that I may be able to take this species off the endangered list if they just would help me a little. And do you know what? Over and over the gates opened up; and over and over the landowners told me not to worry, that they really cared deeply about the ranch and that they would take care of their little endangered plants.

Those days would put me on top of the world. But then there were other days. . .

One of the first ranches I gained access to was split in two, with another private ranch in between. The landowner of the two-piece ranch gave me permission to access the other parcel of his property that was further to the east. In doing so, I had to drive through the ranch in the middle.

The owner of the ranch in the middle, however, saw me in my state vehicle driving on "his road," and vowed that if he ever saw me again he would shoot me. Word got back to me in no time. Threats from this man are not to be taken lightly. He had a history of escorting people off his property at gunpoint. The road through his place actually was an easement road that many ranchers used to get to their ranches, but let's not split hairs. For all practical purposes it was his road, and he did not want me on it.

The day soon came when I wanted to use that road again. I was scared. Surely he really wouldn't shoot me, would he? Maybe he'll just shoot out my tires. Hmmm. I only have one spare...plus, I hate to change tires.

That settled it. I only had one option: I gathered all my courage, took a deep breath, and I drove down that road and straight to his house. I knocked on the door, and his wife answered. I introduced myself and asked if I could speak with her and her husband for a few minutes. She looked at me, and then she looked at my truck. She looked at me again, and looked at my truck again. Then, with a look in her eyes like "girl, you're crazy," she said, "Yes, come on in. My husband is taking a nap. Let me go wake him up." "Oh, no!" I thought, "First this guy said he would shoot me, and now I'm waking him up from his nap! I'm going to be killed!"

She came from waking him from his nap and said, "It takes him a while to wake up. I'll make some coffee." It was a July afternoon in South Texas, in a house with no air conditioning, and I was about to have coffee. Finally, he slowly shuffled into the kitchen, a very old and frail man wheezing of emphysema.

The rest of the day is a blur to me now. We talked about the grandchildren, and the EPA, and the IRS, and how his mother's house is underneath Falcon Reservoir because of the government, and the drought and the heat, and the USFWS, and my project and the plant I was looking for, and if the cows don't eat your plant, then what's it good for?

About five cups of coffee later, not only had he not shot me, but he gave me permission to use his road AND access to his ranch, as well.

Today his son runs the ranch, and, yes, they have Johnston's frankenia. And, believe it or not, this man's son has become my biggest supporter in the county. He told me once, "Any girl who is brave enough to go talk to my daddy and get permission to come on the ranch is okay by me."

Approximately 30 newly located populations later, I had reached a pinnacle. I realized that no matter how many populations I located on private land, trying to down- or delist this species still was going to be difficult because the USFWS considers endangered plant populations on private land in Texas as "unprotected." These populations theoretically could meet their demise at any time because the Endangered Species Act protects listed plants on private land only during activities using federal funds or permits, and state law covers less than that. We needed something tangible that showed the threats (land-clearing, root-plowing, herbicide broadcasting) to these populations would be alleviated.

The answer was a Voluntary Conservation Agreement.

I started asking landowners what they thought about a voluntary conservation agreement. Most indicated that it sounded okay to them, so we decided to set up a meeting with as many of the landowners with the species on their property as we could get.

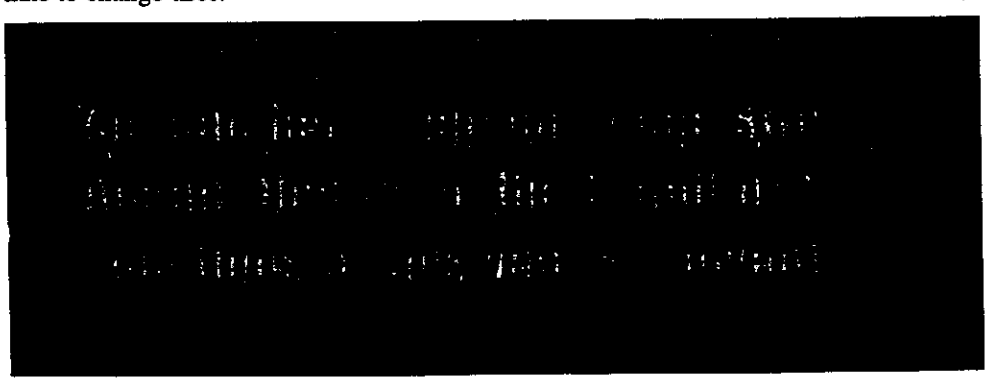
We met in May of 1995. We reviewed the legalities of the Endangered Species Act and the differences between the plant and animal laws, and the issues that faced the community. We discussed the conservation agreement, and how it would be completely voluntary, *their choice*, to conserve these plants on their ranches even when they were not using federal money or using a federal permit.

After what seemed hours of discussion, I finally asked, "Well, do you all want to do it?" There was dead silence. My stomach did a flip-flop. More silence. Then finally one landowner, the son of the landowner who'd wanted to shoot me, said, "I'll do it." Then all the other landowners in the room started shifting in their chairs, saying things like, "Well, okay maybe, but we need to see this thing in writing." At that point I promised to write it up with the help of some landowners, and I would then share it with everyone to review.

After the meeting we had a bar-b-que dinner outdoors. During the dinner, something happened that touched me so deeply that I will never, ever forget it.

I looked up and noticed one of the landowners approaching me. He had his college-age son with him. Throughout the time when I was thinking of developing the conservation agreement, I thought this very landowner probably would not sign on.

See STANDARD on Page 48



Standard . . .

from Page 47

He owned only about 300 acres, and the Johnston's frankenia practically was on every acre of his property. The family was of modest means, and those 300 acres were all they had. I told myself they probably never would do this, and I could understand why. But I was wrong.

He and his son came and stood next to me, and said "Gena, we want to ask you something. Would it be okay if, you know this conservation agreement thing, if we just did that on half of our property so that maybe we could still build a house or something on the other half?" I got a lump in my throat. I was so moved, that all I could say was, "Yes, of course you can."

"Okay then," he said, "next time you're in the neighborhood stop by, and we'll mark off which half." And they turned around, got into their truck and left.

Every time I think of that evening, my heart skips a beat. It makes me just want to scream to the world, "See! We *can* work these things out!"

Today, of the 50 thriving populations confirmed, nearly half are protected voluntarily by the private landowners with conservation agreements. And soon, this species will begin the delisting process.

I hope more than anything that people will begin to look at the endangered species on their ranches as the treasures they truly are. And conserving these endangered species is so easy. All it takes is just a little awareness and a little careful thought. That is part of the beauty of these voluntary conservation agreements—the private landowners with Johnston's frankenia are not agreeing to do anything that they were not doing already!

APPENDIX B

United States
Department of
Agriculture

Forest Service

Rocky Mountain
Forest and Range
Experiment Station

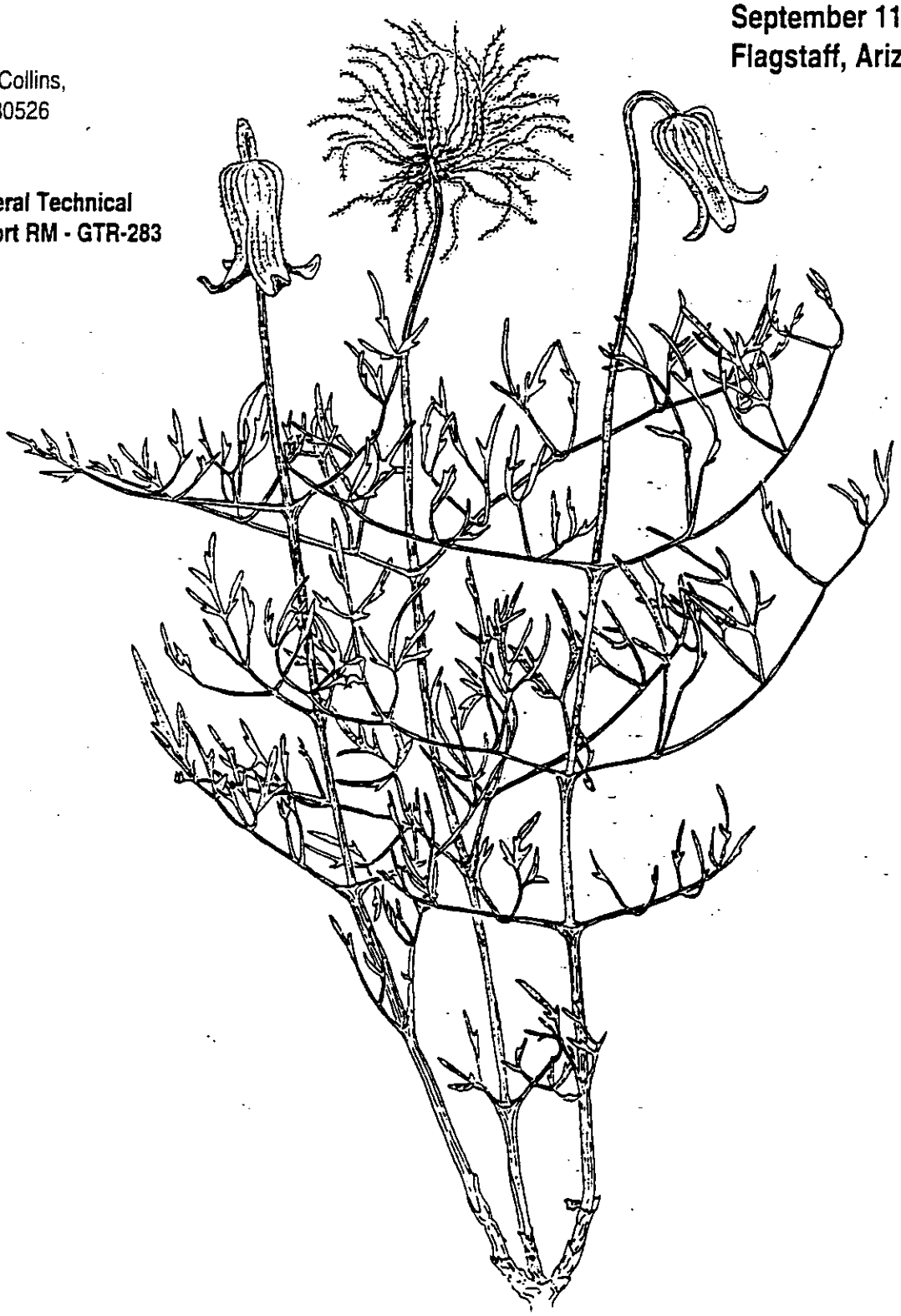
Fort Collins,
CO 80526

**General Technical
Report RM - GTR-283**

Southwestern Rare and Endangered Plants:

Proceedings of the Second Conference

**September 11-14, 1995
Flagstaff, Arizona**



Encouraging Conservation of Endangered Plants on Private Lands: A Case Study of Johnston's Frankenia (*Frankenia johnstonii*), an Endangered South Texas Subshrub

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Abstract: A study was initiated in 1993 to investigate the status and biology of *Frankenia johnstonii*, which had been reported by local South Texas ranchers and Natural Resources Conservation Service officials to be much more abundant than the original five populations known at the time of listing. In a state that is more than 90 percent privately owned, cooperation with private landowners and access to private property is essential for gathering status information and biological data on rare plants. Developing landowner confidence and working within local rural communities to gain public support were two of the primary goals of this project. This is not an easy task; it takes an abundance of time, listening, compassion, patience, and honesty. Through this initiative, over 25 new populations were located on private lands and landowners became interested in the conservation of this species. Local landowners came together and agreed to preserve this rare species on their private property and discussed options such as local conservation agreements to assure the preservation of *F. johnstonii* in South Texas.

Introduction

When I, Gena Janssen, first came to work for the Texas Parks and Wildlife Department in 1992, there were tales of an endangered plant, Johnston's frankenia (*Frankenia johnstonii*), down in South Texas that was "everywhere." From local soil conservationists to the ranchers themselves, many residents were claiming that our current data for this species was completely inaccurate. Maybe, community members stated, the species did not need to be listed as endangered at all.

The situation, at first, seemed an easy one to tackle. Just share with us these localities, let us assess the vigor of these populations, and we can then follow through with a reevaluation of the status of the species. However, the difficulty arose with the actual verification of these localities. They were all on private land and no one was willing to divulge any information. The landowners were scared (to say the least). They were fearful of the "government" finding out that they had endangered species on their property, with all the implications they perceived, such as condemnation of property, the government taking over the land, loss of money, no more cattle grazing, and many other scenarios. Herein lies the hurdle. How do you gain the trust of landowners, or an entire community for that matter, to allow for endangered species surveys and studies on their private land? In a state that is more than 90 percent privately owned, cooperation with private landowners and access to private property is essential for gathering status information and biological data on rare plants. Cooperatively, the Texas Parks and Wildlife Department and Southwest Texas State University submitted a proposal for funding under Section 6 of the Endangered Species Act to attempt to accomplish this very thing and it was funded in 1993.

Johnston's frankenia (*Frankenia johnstonii*) Frankeniaceae is a low-growing perennial subshrub known from Starr and Zapata counties of South Texas and from Nuevo Leon, Mexico. Johnston's frankenia was listed as endangered by the U.S. Fish and Wildlife Service (USFWS) on August 7, 1984 (USFWS 1984), and was listed as endangered by the state of Texas in January, 1987 (Poole and Riskind 1987). At the time of state and federal listing, there were only five verified populations: four in Texas (two in Zapata County, two in Starr County) and one from Nuevo Leon, Mexico. All five populations occurred on private property. No other members of the family Frankeniaceae are listed as threatened or endangered, nor are any members of the family considered federal candidates (USFWS 1993).

Johnston's frankenia was first collected by D.S. Correll in 1966 in Zapata County, Texas. Correll named and described the species in honor of M.C. Johnston later that same year (Correll 1966). In 1973, B.L. Turner described *Frankenia leverichii* as a new species from Mexico (Turner 1973); however,

M.A. Whalen (1987) reduced *F. leverichii* to synonymy under *Frankenia johnstonii*.

This small woody subshrub grows in open or sparsely vegetated rocky, gypseous hillsides or saline flats (USFWS 1988). The soils are usually saline clays or sands. The populations occur within the South Texas Brush Country natural region of Texas (LBJ School of Public Affairs 1978). In Mexico, the one known population of Johnston's frankenia is situated on the transition zone between the Tamaulipan Scrub and the Chihuahuan Desert (Whalen 1980), or the *matorral xerofilo* (scrub of xerophytes) (Rzedowski 1978).

According to the recovery plan for Johnston's frankenia (USFWS 1988), possible threats to the species include specialized habitat requirements, habitat modification and destruction, heavy grazing, and blading and/or bulldozing followed by seeding to buffelgrass (*Cenchrus ciliaris*). Additionally, the Recovery plan for Johnston's frankenia (USFWS 1988) stated that low numbers of the species may be detrimental since there are only about 1,500 plants with no more than a few hundred plants in any of the populations. Low reproductive potential was also cited as a potential threat. According to Turner (1980), the natural habitat seed set is approximately 50 percent and seedlings are rarely observed. Moreover, an added threat to the species is the fact that there are no protected population sites (viz., any sites occurring on federally owned property).

At the time of publication of the Johnston's frankenia recovery plan, lack of data made it impossible to quantify habitat and plant abundance with the precision needed to establish quantified downlisting and delisting criteria. According to the plan, information is needed on specific habitat requirements, population biology, and the population ecology of the species, and continued searches of potential habitat are needed to establish precise limits of the species distribution. Only through landowner outreach could we even begin to try to answer these questions.

The following is not a scientific report—it's a story about *working with people.*

Initial Landowner and Community Contact

Where do you start? We decided that we would get right to it and contact the landowners of the four known sites in Zapata and Starr counties in Texas. We contacted all by telephone and met with them at the sites. Believe it or not, the very first landowner contacted said, "You want to come onto the ranch and see my endangered species? Great! When can you come?" (If only they were all so easy.) The remaining three landowners were reluctant, but gracious and accommodating. We spent a lot of time explaining to the landowners that we simply needed access to learn more about the species and that we were also interested in surveying for additional populations to possibly downlist or delist the species in the future.

Since so little was known about the life history and phenology of Johnston's frankenia, we decided to establish monitoring plots on two of these original four known population sites. Using a belt method for perennial plant species by Lesica (1987), we recorded various measures of vigor and fecundity monthly at each site. Although we had no idea at the time, setting up monthly monitoring plots was the best thing we could have ever done. Why? First, we learned about important aspects of phenology and life history. For example, *The Manual of the Vascular Plants of Texas* by Correll and Johnston (1979) states that Johnston's frankenia blooms from November to February; however, we found that it blooms every month *except* November to February. But second, and more important, monthly monitoring put us in the community every month. We became familiar faces—folks you could count on being there at least one week of the month. We were no longer government strangers; we were regulars.

When the monitoring was completed during our weekly visits, we started surveying for new populations on private ranches. This proved to be a difficult and time-consuming task since Texas Parks and Wildlife biologists do not enter onto private land without permission of the landowner and eventually one week a month became two weeks a month. Much time was spent doing the actual legwork to confirm who owned which piece of property and how to get in touch with that person. This meant spending hours at the local tax assessor's office. Most landowners were local and lived either in town or on the ranch. Some were absentees, however, and still other lands were held in trust overseen by a group of lawyers, which made getting permission for access more difficult, but still doable. (If you think asking private landowners for permission for access to look for endangered species is difficult, try asking a group of lawyers. I'm sure the day I called became a Maalox day for them.)

Once we started gaining access to ranches, we found that another technique of determining land ownership was talking with the landowners

whose ranches we were on and asking who their neighbors were. This proved to be one of the most effective ways of verifying landowners and gaining access. Once you get access to one ranch, then you attempt to gain access to the one adjacent, and then the next one, and the next one—sort of a stepping-stone approach. Even this can be complicated at times, however. For example, when asking a landowner who owns the ranch to the west of him, he replied something like this: "Well, it used to belong to Jose Antonio Lopez, but he died and his sons inherited the place. The older son, Jose Jr. did not want anything to do with the ranch, so his brother, Juan, took it over. Jose Jr. moved to Houston and they say he has a very profitable trucking business shipping fresh seafood all over Texas from the Gulf. Juan married Maria De La Garza of San Ygnacio and they had five children, three boys and two girls. Two of the boys are in prison today—drugs or something. The other son went to Texas A & M and now he lives in Brenham, Texas. He's a jailer. One daughter, Carlotta, married Charlie Villareal, the son of the county clerk, and they live in town and have two kids (although they say one is not Charlie's, but he swears it's his). The other daughter, Ana, went to Europe and is into fashion designing now in New York or some place like that. Jose Jr. died back in 1985—heart attack. Juan died just last year. I don't know how. Old age I guess." "So," I said, "does Maria, Juan's wife, own the property?" "Maria?" he exclaimed, "No! Maria left Juan a long time ago for a hunter, who used to lease the place for deer hunting. She married the hunter and I don't know where they live. It broke his heart you know, that hunter was one of his best friends." "So, who owns the property now?" I asked. "Now? Oh, I don't know. I think the bank. I think they foreclosed on it last year after Juan died, because the family didn't pay some loan off." At this point, I did not dare ask which bank.

In rural Texas, one of the best contacts and allies that you can make is the local soil conservationist of the Natural Resources Conservation Service (NRCS). In Texas, there is usually one NRCS representative in each county and they are close to the people and the issues that concern them. However, this relationship, like any other that you are trying to establish when working with endangered species issues, did not come easily. I never gave up, though. I would visit the NRCS office every month and share what I had learned and whose ranch I had been on and whether or not I had found endangered plants. I wanted him to know that he could trust me and that I would share all my information with him. It took about a year before I felt as though we could actually call ourselves "friends." Today, we work closely concerning ideas about the conservation of endangered plants and the best approaches to use with landowners.

Getting Over the Rough Spots

It isn't always pretty. Talking with private landowners can be downright scary sometimes. They are scared of and outraged by many of these issues and by gosh they are going to tell you all about it! As I began to meet and get to know more and more landowners, I began to notice that most of them did basically the same thing when they met me: They yelled at me. And then one day it finally hit me as to why they did that. Finally, they had a person, a warm body, in front of them that represented all these endangered species issues that had been scaring them for so long. They just needed to vent, so I let them. They had no one there for them. There was no one there to say, "No, that's not true," or "Yes, that was a very difficult situation for everyone," or "Well, only part of that is true," etc., until now. As time went by, I found that if I let folks speak their peace and listened closely to their concerns, soon we would begin talking like two rational people (although this moment in time took longer for some than for others).

One of the first ranches I gained access to was broken into two pieces with another private ranch in between. The landowner of the two-piece ranch gave me permission to access the other parcel of the property, which was further to the east. In doing so, I had to drive through the ranch in the middle. The owner of the ranch in the middle, however, saw me in my state vehicle driving on "his road" and vowed that if he ever saw me again he would shoot me. Word got back to me in no time. Threats from this man were not to be taken lightly. He had a history of escorting people off his property at gunpoint. The road through his place is actually an easement road that many ranchers use to get to their ranches, which are land-locked, but let's not split hairs. For all practical purposes it was *his* road and he did not want *me* on it. Well, the day soon came when I wanted to use that road again. I was scared, I didn't know what to do. I gathered all my courage, took a deep breath, and I drove down that road and straight to that man's house. I knocked on the door and his wife answered. I introduced myself and asked if I could

speak with her and her husband for a few minutes. She looked at me, then she looked at my truck. She looked at me again and looked at my truck again. Then, with a look in her eyes like 'Girl, you're crazy', she said, "Yes, come on in. My husband is taking a nap. Let me go wake him up." "Oh, no!" I thought, "First this guy said he would shoot me and now I'm waking him up from his nap! I'm going to be killed!" She came from waking him from his nap and said, "It takes him a while to wake up. I'll make some coffee." It was a July afternoon in South Texas in a house with no air conditioning and I was about to have *coffee*. Finally, he slowly shuffled into the kitchen, a very old and frail man wheezing of emphysema. The rest of the day is kind of a blur to me now. We talked about the grandchildren and the EPA and the IRS and how his mother's house is underneath Falcon Reservoir because of the government and the drought and the heat and the USFWS and my project and the plant I was looking for and if the cows don't eat your plant, then what's it good for? About five cups of coffee later, not only had he not shot me, but he gave me permission to use his road *and* access to his ranch, as well. Today, it is actually his son who runs the ranch and, yes, they have Johnston's frankenia. And, believe it or not, it is this man's son who has become my biggest supporter in the county. He told me once, "Any girl who is brave enough to go and talk to my daddy and get permission to come on the ranch is okay by me." (Just as an aside, I have since witnessed my first "gunpoint escort victim" last summer. I walked into the NRCS office and there stood a man from the Texas Water Development Board, who was beet red, sweating bullets, wiping the sweat with a handkerchief, standing there surrounded by other people consoling him. When I asked what was wrong, I found that he had just been escorted at gunpoint off of this very ranch I speak of. I started to laugh. This poor man must have thought that I was the cruelest woman in the world. I simply smiled and said, "You should have gone and had coffee with him.")

Community Outreach and Involvement

In addition to working with local landowners, we also developed community outreach projects and programs for the local community. To reach the general public, we did a series of newspaper articles in the local paper about the project. Additionally, we set up a booth at the county fair. The booth included an extensive pictorial display of all the rare plants and animals that occur in that region of South Texas in addition to information brochures and live rare plants in pots from the San Antonio Botanical Gardens. We also set up a television that ran constantly with South Texas segments of the Texas Parks and Wildlife television show spliced together. The display was a great success and it gave us the opportunity to talk with people about all the beautiful rarities that occurred right there where they lived.

I love working with children, but I rarely get to do that. So, when a local Americorps volunteer asked me to help her put together a conservation summer program for kids, I jumped at the chance. Together, we developed a four-day summer camp. We each taught hour-long programs and we alternated throughout the day. She taught topics such as water conservation and recycling, while I taught fisheries and wildlife conservation, habitat conservation, the importance of plants and food chains, and endangered species. Each lesson had an activity. For example, after learning about fisheries and wildlife conservation, the children got to make fish prints using real (but dead) fish and tempura paints. They loved it. But not every activity after a lesson was hands on. For example, after learning about the importance of plants, we all sat on the floor while reading *The Lorax* by Dr. Seuss (yes, we are allowed to read this book in Texas). The most rewarding part of the day was always teaching the children about endangered species in Texas. They knew all about pandas, rhinos, and elephants, but they had no idea of the rare and endangered species that occurred right in their own backyard. While talking about another endangered plant in Texas, ashy dogweed (*Thymophylla tephroleuca*), I told the kids that the only place in the world that this plant grows is right here in the area where they live. Upon hearing that, one boy, who was about 10 years old, stood up, and very seriously said, *"Then we've GOT to SAVE it!"* We should all see things the way 10 year olds do.

The Landowner Meeting

Two years and approximately 30 newly located populations later, I had reached a pinnacle point. I realized that no matter how many populations I located on private land, trying to downlist or delist this species was still going to be difficult, because the USFWS tends to consider endangered plant populations on private land in Texas as "unprotected." Since the Endangered Species Act

protects listed plants on private land only during activities that use federal funds or permits and since our state law covers less than that, these populations theoretically could meet their demise at any time. We needed something tangible that showed that the threats (land clearing, root plowing, herbicide broadcasting) to these populations would be alleviated. What about a conservation agreement?

I started asking the landowners what they thought about a voluntary conservation agreement. Most landowners indicated that it sounded okay to them, so I decided to set up a meeting with as many of the landowners with the species on their property as I could get. I invited people by mail and announced it in the local newspapers. I was nervous. At this time landowners all over Texas (and the nation) were lashing out against these issues. At one point I got so scared that I did a guest editorial in the local paper stating that this meeting was not a forum for anti-government and anti-endangered species debates, but an opportunity for landowners to make a difference.

We had our meeting in May of 1995, and approximately 50 people attended. I am happy to report that the meeting was civil and productive. We reviewed the legalities of the Endangered Species Act, the differences between the plant and animal laws, and the issues that faced the community. We discussed the conservation agreement and how it would be completely voluntary, their choice, to conserve these plants on their ranches even when they were not using federal money or using a federal permit. After what seemed hours of discussion, I finally asked, "Well, do you all want to do it?" There was dead silence. Then finally one landowner, actually the son of the landowner who wanted to shoot me, said, "I'll do it." Then all the other landowners in the room started shifting in their chairs saying things like, "Well, okay maybe, but we need to see this thing in writing." At that point I promised to write it up with the help of some landowners and I would then share it with everyone to review. This is where I am today.

After the landowner meeting we had a free barbecue dinner outdoors. During the dinner, something happened that touched me so deeply that I will never, ever forget it. I looked up and noticed one of the landowners approaching me. He had his son, who appeared to be early college age, with him. Throughout this time when I was thinking of developing this conservation agreement, it was this very landowner who was now approaching me, that I thought would probably not do this conservation agreement. He owned only about 10 acres and the Johnston's frankenia was on practically every acre of his property. He and his family are poor (or at least poorer than all the other landowners I had been working with) and that 10 acres is all they have. In the back of my mind I told myself that they would probably never do this and I could understand why. But I was wrong. He and his son came and stood next to me and said "Gena, we want to ask you something. Would it be okay if, you know this conservation agreement thing, if we just did that on half of our property so that maybe we could still build a house or something on the other half?" I got a lump in my throat. I was so moved with emotion, that all I could say was, "Yes, of course you can." He said, "Okay then, next time you're in the neighborhood stop by and we'll mark off which half." I said, "Sure," and they turned around, got into their truck and left.

I still get choked up every time I think about it. It makes me just want to scream to the world, "See! We *can* work these things out!"

A Learning Experience

I am certainly not the expert, but there are a few things that I have learned through this project. I believe there are five important elements that you need to consider when dedicating yourself to working with private landowners: time, patience, the ability to listen, compassion, and honesty.

It takes time to build a relationship with people. You cannot simply knock on someone's door and ask, "Would you be interested in doing a conservation agreement?" There is a process of building trust and mutual respect that cannot be done in one visit. With time comes familiarity and with familiarity fear and distrust start to fade. I have found, also, that people actually *need* your time. There is no one out there with whom landowners can discuss endangered species issues and concerns and you in turn become their one and only source of accurate, honest information. I find myself explaining over and over to each and every landowner how the Endangered Species Act differs with respect to plants and animals, what is legal and what is not legal, and what is true and what is untrue about what they have heard in the media or from their neighbors. Another important factor about time and building relationships is that they must be maintained. I found that people start to get fearful again when you have not been around for a while—they start wondering what

you're up to. For example, I went on vacation in June, so I was unable to visit the community for the entire month of June. When I came in July, everyone said, "Where have you been? We thought you were never coming back!" The same is true when I neglect to stay in touch often with some landowners. When I do finally call to say hello and update them on the project or whatever, they often make a comment such as, "Yeah, we were wondering what happened to you."

Patience is something that I do not have much of. To practice patience was a learning experience for me. I believe many of us who work for various private and governmental agencies become focused on our performance plans, career goals, field schedules, and calendars, and usually work in over-drive thinking, "I've got to get this done now!" But, nothing goes too fast in rural Texas, and I had to calm down. There is a fine line between being persistent and being a big pain in the neck and unfortunately there were a few times that I learned this the hard way (like the time this woman told me that I was like a wart that needed to be lanced off). Relax. If people are going to do something, they are going to do it in their own time.

If there is one thing that I have done more than any other one thing, it would be listening. And I mean *really* listen. Listening is not simply waiting for someone to stop talking just so you can make your righteous conservation point—you can do that later. Listen with compassion to their opinions, fears, and concerns. You do not have to agree, but at least you can try to understand their point of view. This is their life, their livelihood, their family, and most importantly, *their land*. Be compassionate. You do not need to have all the answers, only understanding. If you want people to listen to what you have to say, you need to be equally as respectful to what they have to say. As time passes you realize that you are really not so different from one another. Your values about conservation are almost identical, you just have different jobs.

Honesty goes a long way. Sometimes honesty is painful when you know the person you are talking to is not going to like what is about to come out of your mouth—but be strong. Do not compromise the truth for the sake of avoiding conflict. I was honest with every person I met about my project, how I needed to do it, the accuracy of the data I needed, etc. When I asked for permission to access private ranches, I did not say I was looking for plants; I said I was looking for endangered plants. In trying to build trust, I went out of my way to explain what I was doing in detail. I never tried to strike shady deals or triangulate against the federal government. Things like that will only come back later to haunt you. Play by the rules. I never wanted to give anyone the opportunity to find a reason not to trust me. I never crossed a fence line if I was not exactly sure of where I was and I never mapped a population of endangered plants without the landowner knowing exactly what I was doing. In a rural community, if someone feels you have done them wrong, then for all practical purposes, you have done every landowner in that community wrong. News travels fast, bad news even faster, and bad endangered species biologist news travels like lightning! Avoid as many pitfalls down the road as possible—always be honest.

Because of all of the landowner and community outreach, which has taken so much time, heart, and soul, we now have a tremendous opportunity for intensive biological studies that without outreach, would never have been possible. Today we have implemented a grazing exclosure experiment, pollination syndrome studies, and soil seed bank analyses, and in the future we will also initiate a genetic analysis of each population. It seems like such a long, hard way to get there, but in Texas, it may be the only way.

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APPENDIX C

CONSERVATION AGREEMENT

for

Johnston's frankenia (*Frankenia johnstonii*)

A Federal and State Endangered Species

Introduction

Johnston's frankenia was listed as endangered by the U. S. Fish and Wildlife Service (USFWS) in August 1984, and listed endangered by the State of Texas in January, 1987. At the time of its federal listing, only five populations were known: two in Zapata County; two in Starr County; and, one in Nuevo Leon, Mexico. Recently, because of the commitment and cooperation of private landowners and the Texas Parks and Wildlife Department, many additional populations have been verified on private and federal land. Today, at least 45 population complexes are known (with one population on federal property), and the range as been extended to include Webb County and Tamaulipas, Mexico.

Purpose

This Conservation Agreement has been initiated to conserve Johnston's frankenia by reducing the threats, stabilizing the populations, and maintaining its habitat. This document's primary purpose is to conserve Johnston's frankenia throughout its range on private land in Texas. Individual landowners are capable of protecting Johnston's frankenia and its habitat on their land, interested in achieving conservation, and take pride in maintaining these rare resources for our Texas heritage.

This document's secondary purpose is, with assured landowner protection, to initiate the state and federal downlisting process.

I. Species Involved: Johnston's frankenia (*Frankenia johnstonii*)

II. Parties Involved:

A. _____
Landowner Name

_____
Address

_____
Telephone

B. Texas Parks and Wildlife Department

Endangered Resources Branch

3000 IH 35 South, Suite 100, Austin, Texas 78704

If the annual monitoring of the populations of Johnston's frankenia reveals that a significant number of populations have been destroyed; the need to relist the species as endangered at the state and federal level will be reviewed.

VII. Other unforeseeable impacts:

Even the most perfectly laid plans are subject to mishaps. If at any time there may be impacts to the populations of Johnston's frankenia that are out of the landowner's control [For Example: seismic lines, pipelines, gas well pad sites], Texas Parks and Wildlife staff should to be notified if possible. Texas Parks and Wildlife staff may be able offer recommendations in difficult situations if the landowner requests Department assistance. If at any time there are impacts to the populations of Johnston's frankenia that are accidental [For Example: root plow operator did not follow instructions], again Texas Parks and Wildlife staff should be notified. Often times accidents provide a perfect learning opportunity, and a study could be initiated to determine the recovery potential of the species.

VIII. Signatures:

_____
Landowner Name

_____

_____
Address

_____ _____
Signature Date

Andrew Sansom, Executive Director
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

_____ _____
Signature Date

APPENDIX D

Association of Texas Soil and Water Conservation Districts
P. O. Box 658 • Temple, Texas 76503 • 254-778-8741

December 8, 1998

Andrew Sampson, Executive Director
Texas Parks and Wildlife Department
4200 Smith School Rd.
Austin, Texas 78744

Dear Mr. Sampson:

Enclosed are three resolutions adopted by delegates to the Annual Meeting of the Association of Texas Soil and Water Conservation District Directors held in Corpus Christi, Texas October 12-13, 1998.

The Board of Directors of our Association ask that you review these resolutions and take those actions that may be necessary to bring our concerns to the attention of the appropriate groups or individuals that will aid us in accomplishing the goals outlined in these resolutions.

Our Association is keenly interested in accomplishing the objectives established by local soil and water conservation district directors. We hope you will be able to lend your support as we attempt to accomplish the objectives outlined in these resolutions.

We look forward to working with you on these and other issues concerning the protection and wise use of our soil and water conservation resources.

Sincerely,

T. Wayne Register
President

Enclosure

SUPPORT FOR DELISTING JOHNSTON'S FRANKENIA (FRANKENIA JOHNSTONII)

WHEREAS, in August 1984, Johnston's frankenia was listed as Endangered by the U. S. Fish and Wildlife Service (USFWS) and was listed as Endangered by the State of Texas in 1987, and at the time of the listings there were only four known Texas populations: two in Zapata County and two in Starr County; and

WHEREAS, in the early 90's local NRCS personnel and landowners from Zapata County began claiming that the species was abundant, and Texas Parks and Wildlife Department (TPWD) met with the Zapata County Soil and Water Conservation District Board and NRCS personnel from Zapata, Starr, Webb and Jim Hogg Counties to discuss the possibility of delisting Johnson's frankenia and learned that in order to delist the species TPWD needed to confirm the presence of other populations; and

WHEREAS, in May 1995 TPWD met with many landowners regarding the status of the project and although surveys were revealing more populations, they were all on private land and not fully protected under the Endangered Species Act; and

WHEREAS, the USFWS considers private land sites "unprotected" since they could be legally destroyed at any time; and

WHEREAS, to prove to the USFWS that landowners with Johnston's frankenia were indeed conserving/protecting it, TPWD decided to pursue Voluntary Conservation Agreements as tangible documentation that all these private lands sites were secure; and

WHEREAS, TPWD met with private landowners and got permission to survey many private ranches in Zapata, Starr, and Webb Counties and verified 50 populations and committed to turn in an annual report to the USFWS on the progress of the project; and

WHEREAS, the USFWS recommends that Johnston's frankenia be taken off of the Endangered Species List based on TPWD's annual progress reports and TPWD will continue to seek additional Voluntary Conservation Agreements and population occurrence data in preparation for the delisting;

NOW, THEREFORE, BE IT RESOLVED, that the Association of Texas Soil and Water Conservation Districts and the Texas State Soil and Water Conservation Board work with Texas Parks and Wildlife Department and the United States Fish and Wildlife Service on getting the Johnston's frankenia (Frankenia johnstonii) delisted as an Endangered plant.

APPENDIX E

EUTRICO (del griego eu
Son moderadamente ácidos y más fértiles que los dístricos. Su símbolo es (De).

RANKER. (Del austriaco rank: pendiente fuerte. Literalmente, de la pendiente fuerte.)

Son suelos de climas templados húmedos, o semifríos húmedos. Su vegetación natural es de bosque. Se caracterizan por tener una capa superficial obscura y rica en humus, pero ácida e infértil. Debajo de ella se presenta la roca, de colores claros generalmente, que nunca es roca caliza o caliche.

Su principal uso en México, donde son poco abundantes es el forestal. Su susceptibilidad a la erosión es alta cuando sufren desmonte,

Esquema de un Podzol Húmico

Fig. 22

las laderas. No tienen subunidades. Su símbolo es (U). (figura 24).

REGOSOL. (Del griego rhegos: manto, cobija. Denominación connotativa de la capa de material suelto que cubre a la roca.)

Son suelos que se pueden encontrar en muy distintos climas y con diversos tipos de vegetación.

Se caracterizan por no presentar capas distintas. En general son claros y se parecen bastante a la roca que los subyace, cuando no son profundos.

Se encuentran en las playas, dunas y, en mayor o menor grado, en las laderas de todas las sierras mexicanas, muchas veces acom-

Esquema de un Podzoluvisol Dístrico

Fig. 23

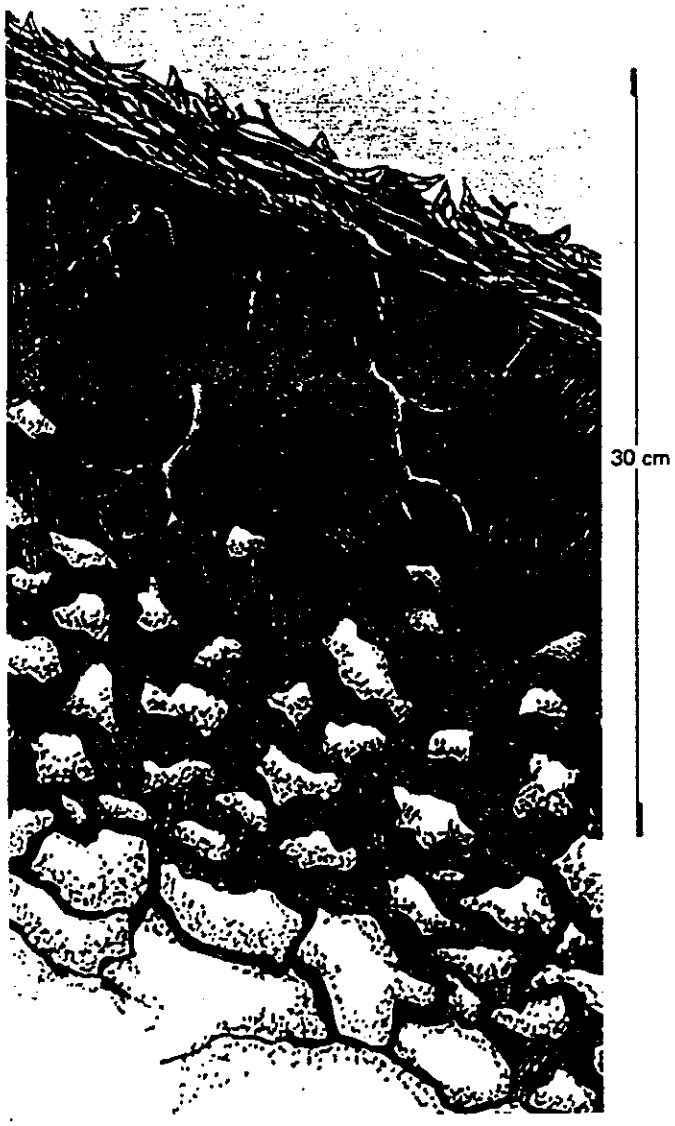
pañado de Litosoles y de afloramientos de roca o tepetate.

Frecuentemente son someros, su fertilidad es variable y su uso agrícola está principalmente condicionado a su profundidad y al hecho de que no presenten pedregosidad. En las regiones costeras se usan algunos Regosoles arenosos para cultivar cocoteros y sandía, entre otros frutales, con buenos rendimientos.

En Jalisco y otros estados del centro, se cultivan principalmente granos, con resultados moderados o bajos. En las sierras encuentran un uso pecuario y forestal, con resultados variables, en función de la vegetación que exista.

Son de susceptibilidad variable a la erosión, Su símbolo es (R). (figura 25).

Esquema de un Ranker Fase Lítica Fig. 24



GELICO (del latín **gellidus**: congelado).
Presentan congelamiento permanente en alguna parte del subsuelo; se encuentran en las cimas nevadas de los volcanes. Su símbolo es (Rx).

CALCARICO (del latín **calcareum**: calcáreo).
Son suelos ricos en cal. Son los más fértiles de los Regosoles. Su símbolo es (Rc).

DISTRICO (del griego **dys**: malo, enfermo).
Son suelos infértiles y ácidos. Su símbolo es (Rd).

EUTRICO (del griego **eu**: bueno).
No presentan las características señaladas para los tres grupos anteriores. Son de fertilidad moderada o alta. Su símbolo es (Re).

RENDZINA. (Nombre polaco que se da a los suelos poco profundos y pegajosos que se presentan sobre rocas calizas.)

Estos suelos se presentan en climas cálidos o templados con lluvias moderadas o abundantes. Su vegetación natural es de matorral, selva o bosque.

Se caracterizan por poseer una capa superficial abundante en humus y muy fértil, que descansa sobre roca caliza o algún material rico en cal. No son muy profundos. Son generalmente arcillosos.

Cuando se encuentran en llanos o lomas suaves se utilizan sobre todo en Tamaulipas y la península de Yucatán, para sembrar henequén, con buenos rendimientos, y maíz, con rendimientos bajos.

Si se desmontan se pueden usar en la ganadería con rendimientos bajos o moderados, pero con gran peligro de erosión en las laderas y lomas.

El uso forestal de estos suelos depende de la la vegetación que presentan. Su susceptibilidad a la erosión es moderada. No tienen subunidades. Su símbolo es (E). (figura 26).

SOLONCHAK. (Del ruso **sol**: sal. Literalmente, suelos salinos).

Son suelos que se presentan en diversos climas, en zonas en donde se acumula el salitre, tales como lagunas costeras y lechos de lagos, o en las partes más bajas de los valles y llanos de las zonas secas del país.

Se caracterizan por presentar un alto contenido de sales en alguna parte del suelo, o

Esquema de un Vertisol Pélico Fig. 29

naloa y Nayarit, donde se cultivan el jitomate y el chile.

En el Norte se usan para la agricultura de riego, básicamente de algodón y granos, con rendimientos buenos en todos los casos. Para la utilización pecuaria, cuando presentan pastizales, son también suelos muy adecuados, sobre todo en el Norte y Noreste del país.

Tienen por lo general una baja susceptibilidad a la erosión. Su símbolo es (V).

CROMICO (del griego **kromos**: color).

Son Vertisoles que se caracterizan por su color pardo o rojizo. Donde más frecuentemente se encuentran es en climas semisecos, y generalmente se han formado a partir de rocas calizas. Su símbolo es (Vc).

PELICO (del griego **pellos**: grisáceo, sin color).

Estos son Vertisoles negros o grises obscuros. Se encuentran en las costas, en el Bajío y en la parte Sur del país. Su símbolo es (Vp) (figura 29).

XEROSOL. (Del griego **xeros**: seco. Literalmente, suelo seco.)

Estos suelos se localizan en las zonas áridas y semiáridas del Centro y Norte de México. Su vegetación natural es de matorrales y pastizales.

Se caracterizan por tener una capa superficial de color claro y muy pobre en humus. Debajo de ella puede haber un subsuelo rico en arcillas, o bien muy semejante a la capa superficial. Muchas veces presentan a cierta profundidad manchas, polvo o agiomeraciones de cal, y cristales de yeso, o caliche, de mayor o menor dureza. A veces son salinos. Su utilización agrícola está restringida, en la mayoría de las ocasiones, a las zonas con agua de riego, pero, sobre todo en los estados de Zacatecas, Aguascalientes, San Luis Potosí y el sur de Durango, existen Xerosoles que pueden cultivarse en el temporal debido a que en esa zona las lluvias son un poco más abundantes que en las del Norte. La agricultura de temporal, en este tipo de suelos, es insegura y de bajos rendimientos. La agricultura de riego, con cultivos de algodón y granos, así como de vid, es de rendimientos altos, debido a su alta fertilidad.

El uso pecuario es también importante en ellos, sobre todo en el Norte, en los estados de Coahuila, Chihuahua y Nuevo León, en donde se cría ganado bovino, ovino y caprino, con rendimientos variables en función de la vegetación. La explotación de los matorrales, cuando existen plantas aprovechables, como la lechuguilla o la candelilla, también se lleva a cabo en estos suelos.

Los Xerosoles son suelos con baja susceptibilidad a la erosión, salvo cuando están en pendientes y sobre caliche o tepetate, en donde sí presentan este problema. Su símbolo es (X). (figura 30).

LUVICO (del latín **luvi, luo**: lavar).

Se caracterizan por tener un subsuelo con acumulación de arcilla. Son rojizos o pardos claros. En muchas ocasiones

de contar con agua de riego. Cuando la hay, se pueden obtener rendimientos altos en cultivos como el algodón, los granos o la vid. Cuando estos suelos tienen vegetación de pastizal o, como ocurre en el caso de algunos matorrales, la ganadería es posible con rendimientos moderados o bajos. La explotación de ciertas plantas del matorral, como la candelilla y la lechuguilla, es también común en estos suelos. Su símbolo es (Y).

TAKIRICO (del uzkebistano **takyr**: llano estéril).
Presentan en la superficie una capa arcillosa que se rompe en forma de polígonos cuando se seca. Su símbolo es (Yt).

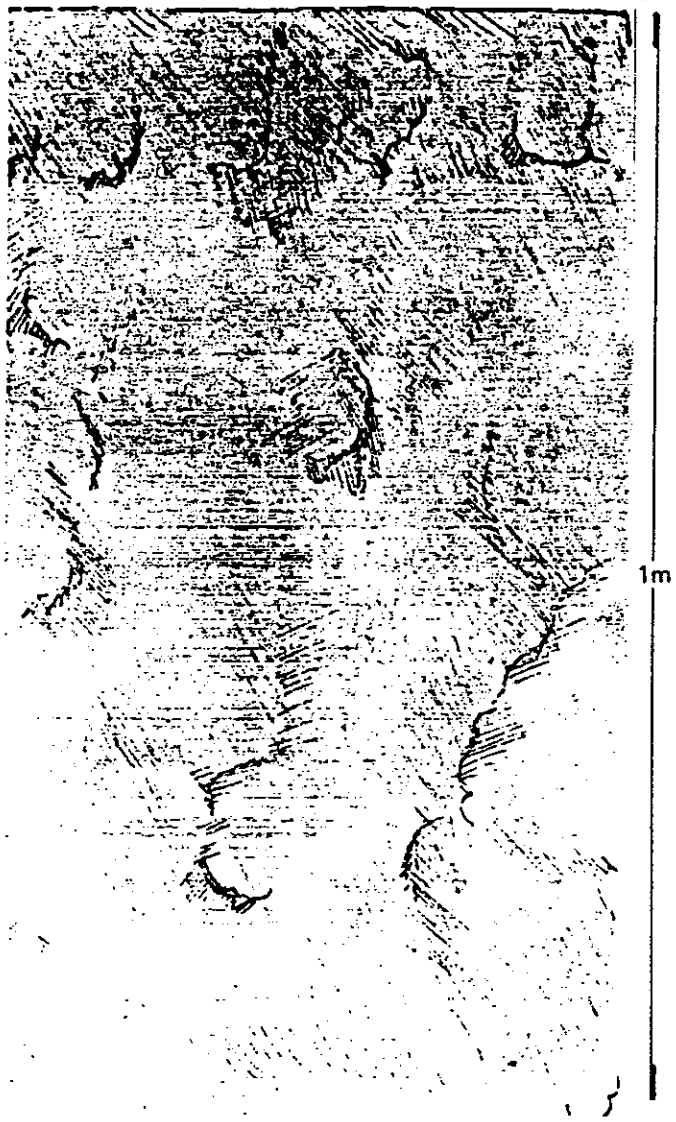
LUVICO (del latín **luvi, luo**: lavar).
Se caracterizan por tener un subsuelo con acumulación de arcilla. son rojizos o pardos claros. En muchas ocasiones acumulan más agua que los otros Xerosoles. Su vegetación es generalmente de pastizal, y su símbolo (Yl).

GYPSICO (del latín **gypsum**: yeso).
Presentan acumulación de yeso en el subsuelo, en forma de cristales. A veces son de color rosado claro. Su símbolo es (Yg).

CALCICO (del latín **calcium**: calcio).
Presentan acumulación de cal en el subsuelo. Su símbolo es (Yk).

HAPLICO (del griego **haplos**: simple).
No presentan las características mencionadas para los tres grupos anteriores. Su símbolo es (Yh). (figura 31).

Esquema de un Yermosol Háplico Fig. 31



II.4. Ejemplos de interpretación de la carta

En la simbología de la carta se señalan los límites de cada una de las unidades cartografiadas y, por medio de colores, se marcan las diferentes unidades de suelos con su clave respectiva; por medio de esta clave y pantallas sobreimpresas se identifica a la unidad, por ejemplo: Xk + Je – Is – n/3.

Xk se refiere a un tipo de suelo que técnicamente se conoce como xerosol (X), y cuya unidad secundaria (k) indica que es cálcico; como segundo componente del suelo aparece otro denominado fluvisol (J) éutrico (e); en seguida se hace referencia a las fases sódicas o salinas que presenta el suelo (Is)(n) y por último a la textura (3). Debe recordarse que las fases físicas se muestran en la carta mediante pantallas (cruces, círculos, rectángulos, etcétera) sobrepuestas al color que corresponde al tipo de suelo.

El color utilizado para identificar al suelo que se trata será el que corresponda a la primera unidad (Xk) y la segunda clave (Je) sólo se indica en el mapa en segundo término.

En resumen, el ejemplo queda como sigue: Xk + Je – Is – n/3 = unidad y subunidad de suelo predominante + unidad y subunidad de suelo en segundo término –fase ligeramente salina– fase sódica/textura fina arcillosa (figura 32).

Ahora supongamos que una unidad cartográfica nos indique: Hh+Re= Feozem háplico+ Regosol éutrico.

Se trata de Feozems que se encuentran en las partes planas del terreno, con buena calidad

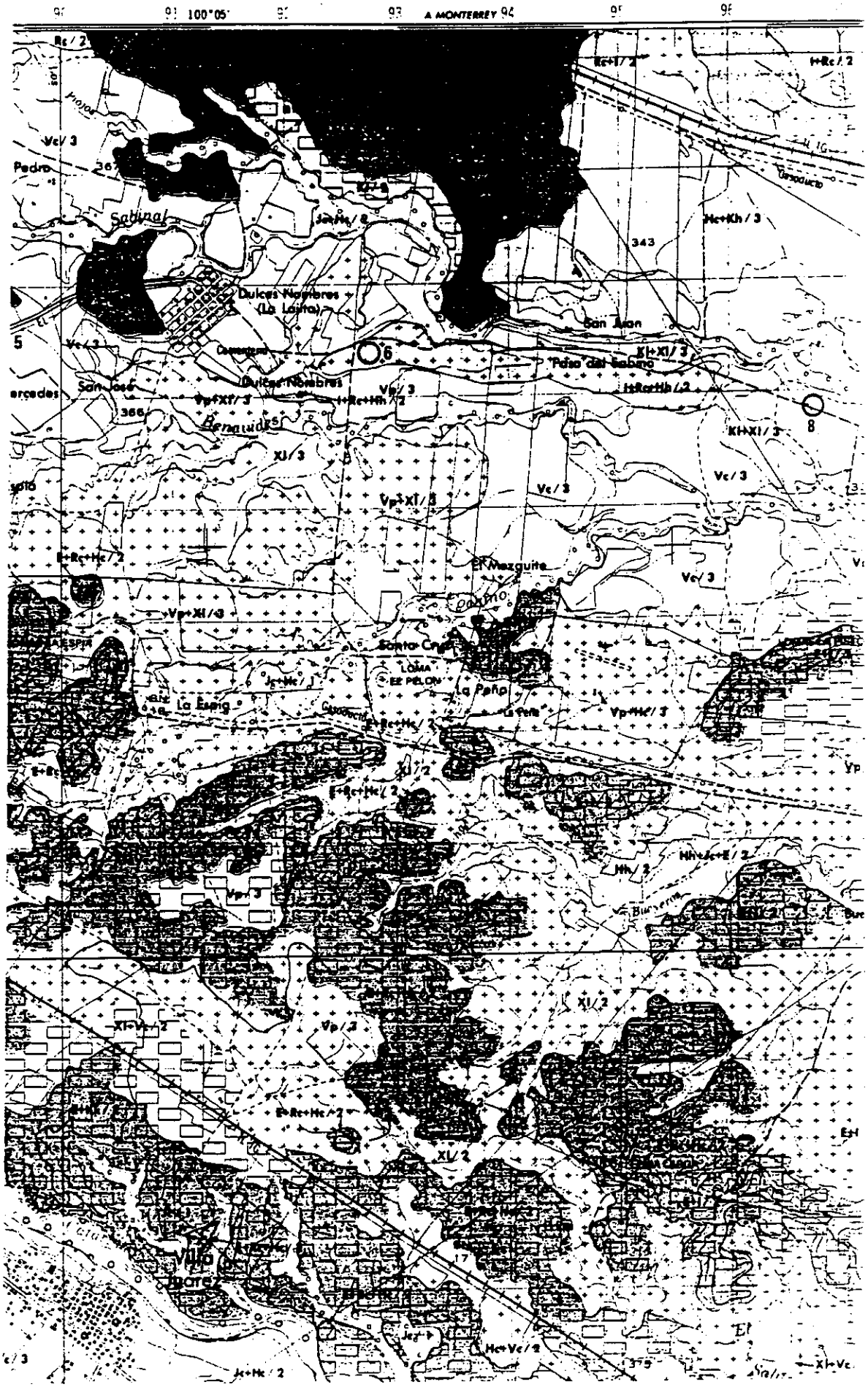


Fig. 32

Ejemplo
de unidades

de suelos

de materia orgánica y nutrientes, de fácil manejo; generalmente profundos y con buen drenaje, que se pueden usar tanto en riego como en temporal, para el cultivo de granos, legumbres u hortalizas con altos rendimientos. En pastoreo o ganadería también se pueden emplear con buenos resultados. Hay que utilizarlos con cuidado, pues son susceptibles a la erosión.

El regosol anotado en segundo lugar, nos indica que hay laderas o pendientes donde se están perdiendo las capas superiores del Feozem y el material suelto forma zonas menos profundas (cárcavas). Este segundo suelo es somero, poco profundo, de color claro, por haber perdido nutrientes. Su uso agrícola es moderado o bajo y se puede utilizar más bien con fines pecuarios o forestales, dependiendo de la vegetación que contenga. También nos indica que hay principios de erosión que hay que detener. La subunidad eútrico, indica que proviene de un material rico en nutrientes (Feozem) y que dentro de las subunidades de Regosol tiene una fertilidad moderada, es decir, todavía conserva algunos de los nutrientes del material que le dio origen.

Por otra parte cabe señalar que las fases químicas (salinas y sódicas) generalmente no aparecen en el texto como un criterio de clasificación, sino que son solamente el señalamiento de una realidad observable, que limita progresivamente el tipo de rendimiento de las especies vegetales naturales o cultivadas. En el entendido de que son propiedades del suelo susceptibles de ser atenuadas o eliminadas, es necesario su conocimiento a fin de evaluar hasta qué punto es costeable el tratamiento de los suelos que las presentan, o. en su caso, la utilización de éstos con especies vegetales que puedan prosperar en un medio con sales.

Las características morfológicas, físicas y químicas, como ya se ha señalado, se manifiestan de manera específica en cada uno de los horizontes del suelo, dándonos la cantidad de materia orgánica, y el grado y tipo de elementos que han migrado o se han acumulado; esto es lo que puede ser cuantificado y clasificado.

Con base en estas características, se puede señalar en primera instancia cuál es la vocación del suelo y cuáles son las medidas que hay que tomar en cuenta a fin de conservar permanentemente una utilización óptima.

Con respecto a la vocación de los suelos para diferentes usos —agrícola, pecuario y forestal—, se recalca una vez más que ella no depende exclusivamente del tipo de suelo, pues hay que considerar el medio ecológico en el que éste se encuentra, y los avances tecnológicos que pueden superar o modificar muchos de los elementos de esta vocación.

Cuando se señala que un suelo es bueno para usos agrícolas, por ejemplo, esto indica que puede destinarse a ese fin, sin que la inversión inicial sea muy alta; no obstante, si se quiere mantener una buena productivad, hay que lograr esto por medio de la fertilización y el manejo adecuado al tipo de suelo y cultivos que en él se desarrollan. En el caso de suelos que no son marcadamente agrícolas, hay que considerar más detalladamente la relación costo-beneficio, pues la inversión puede resultar más alta en drenaje, control de erosión, etcétera, por lo cual en muchas ocasiones conviene destinarlos a actividades pecuarias o forestales en las que se tiene mayor seguridad de conservar el recurso.

CHAPTER 2

REPRODUCTIVE BIOLOGY

INTRODUCTION

The importance of biological diversity has received much attention in recent years. In 1991, the Ecological Society of America listed biodiversity as an area of highest research priority (Lubchenco, 1991). Maintaining biological diversity requires an understanding of the biology of the species to be preserved. Unfortunately, little is known about the reproductive biology of most rare plants (Karron, 1991). Conservation of rare or endangered plant species has, in the past, been based on animal models due to the paucity of research on reproductive biology of rare or endangered plant species in the scientific literature (Falk and Holsinger, 1991). Most plant conservation programs focus on habitat preservation that involves knowledge of the demographic features, such as population size and growth rates. Demographic features provide important, but limited information because long-term survival of endangered species depends on gene flow (Barrett and Kohn, 1991). In plants, genetic variability depends on two mechanisms of gene flow, pollen and the seed. Therefore, understanding pollination and seed biology is critical in evaluating the reproductive success and potential for survival of an endangered plant species.

Reproductive failure is a common concern when considering threats to rare species (Havens, 1999). Therefore, an assessment of reproductive capacity, the breeding system, pollen viability and pollen vectors is of utmost importance in evaluating the status of an endangered plant species.

Successful recovery and management of endangered plant species involves knowledge of underlying biological processes that affect population stability, such as duration in the seed bank, survivorship and fecundity (Pavlik, 1996). Determining percent seed viability and seed set is crucial in evaluating long-term survival rate. Because of the genetic challenges to the long-term survival of rare plants, persistent seed banks

could be of particular importance (Falk and Holsinger, 1991). Soil seed banks act as genetic reservoirs and are of importance because they affect evolutionary potential of plant populations (Templeton and Levin, 1979; Brown and Venable, 1986; Levin, 1990; Kalisz and McPeek, 1993; McCue and Holtsford, 1998). Seed banks could positively alter long-term population growth rates (Cohen, 1966; Kalisz and McPeek, 1993), and could place restraints on possible extinction time (Kalisz and McPeek, 1993).

Recruitment and establishment of the seedling are crucial for maintaining high population numbers of species that regenerate by seed. There can be high mortality rates of seedlings due to desiccation and burial of seedlings, particularly in arid or sand dune areas. Biotic factors, such as predation, disease and competition, also play a role in seedling mortality. Seed dispersal can affect seedling establishment. Suitable safe sites for seeds might be in the vicinity of the parent plant rather than farther away, this is often true of desert plants (Ellner and Shmida, 1981).

Knowledge of the reproductive biology of a particular plant species is critical to understanding factors that result in species rareness, in determining the classification of a species as rare or endangered and in constructing a management program for long-term survival. The existing scientific literature, however, offers little information concerning the biology of *Frankenia johnstonii* Correll (Caryophyllidae: Frankeniaceae). Correll and Johnston (1979) describe *F. johnstonii* as a woody shrub with sessile flowers that occur singly at the apex of axillary branchlets. Flowers are small, white and have 5 sepals, 5 clawed petals, 6 stamens and a compound ovary with styles that are 3 cleft. The fruit is a small (2.8-3.5 mm long, 1.2-1.4 mm wide), single-celled capsule. Whalen (1980, 1987) characterized the taxon as restricted to a highly specialized gypsiferous habitat and placed *F. johnstonii*, most closely related to *F. fischeri* and *F. salina*. Whalen (1980) provides some reproductive data used in systematic analysis of the genus and considered the species to show little propensity to reproduce. Turner (1980) noted low seed viability (less than 50%) as well as difficulty in germinating seeds, and suggested that low

reproductive potential may be a threat to the species. Due to the paucity of information on the reproductive biology of this endangered species, we investigated the pollination and seed biology of *Frankenia johnstonii*. This chapter reports on our findings.

MATERIALS AND METHODS AND RESULTS

DESCRIPTION OF STUDY SITES

Data for the study of reproductive biology were collected from six Texas populations, two in Webb County (Population 1 and Population 4), three in Zapata County (Population 9, Population 47 and Population 23) and one in Starr County (Population 53).

CLIMATOLOGICAL DATA

Materials and Methods:

Climatological data for Zapata County and Starr County were obtained from the Department of Commerce National Climate Data Center based in Asheville, North Carolina. Monthly average means of precipitation and temperature were provided for the time period between January 1993 through December 1996. This information was used to determine phenological trends of *F. johnstonii* associated with varying degrees of temperature and rainfall amounts. The Webb County populations were not studied until 1999, and then only for seed collection, therefore climatological data were not obtained for Webb County.

Climatological Data Results:

Climatological data for Zapata and Starr Counties is shown in Figures 1–4. Normal annual precipitation in Zapata County is 50.1 cm. Average annual rainfall in 1993 measured 47.2 cm, 49.2 cm in 1994, 39.9 cm in 1995 and 32.8 cm in 1996. Highest rainfall amounts in 1993 occurred in June and September, producing 15.7 cm and 10.8 cm respectively. In 1994, only April and September had amounts over 7 cm, with April reaching 9.1 cm and September recording 8.3 cm. Highest rainfall amounts in 1995 occurred in September, with 11.1 cm and in November, with 10 cm. In 1996, August showed a monthly rainfall average of 8.6 cm, the highest monthly amount of that year.

The average annual precipitation in Starr County is 56.6 cm. In 1993 the average annual rainfall was 66.9 cm, 30.7 cm in 1994, 43.3 cm in 1995 and 23.1 cm in 1996. Highest rainfall amounts in 1993 occurred in June producing 33.7 cm and September with 14.1 cm. In 1994, October produced the most rainfall with 7 cm. August, September and October of 1995 showed highest monthly rainfall amounts of 6.4 cm, 13.6 cm and 5.5 cm respectively. Highest recorded monthly precipitation for 1996 was 10.4 cm in August.

The normal annual average temperature in Zapata County is 23°C. The annual average temperature for 1993 was 22.9°C. No annual average was available for 1994. 1995 and 1996 had an annual mean temperature of 23.8°C. In 1993, June, July and August had maximum temperatures of 40°C, 38.9°C and 39.4°C respectively. October and November had temperatures below 0°C. May, June, July and August of 1994 had maximum temperatures of 37.8°C, 40.6°C, 41.1°C and 38.3°C respectively, representing the warmest months. Only February had below freezing temperatures for that year. Months in 1995 with temperatures exceeding 37.7°C occurred in April, May, June, July, August and September, with April experiencing 45.6°C. No months experienced temperature below 0°C in 1995. April through September of 1996 had days in which the temperature exceeded 37.7°C, with August reaching 41.7°C. January, February, March, November and December had days with temperatures below 0°C.

Average annual temperature in Starr County is 23.3°C. Average annual temperature for 1993 was 23°C. Average annual temperature for 1994 was unavailable. 1995 had an average annual temperature of 23.6°C and in 1996 the annual mean was 24.4°C. April, June, July, August and September of 1993 had maximum temperatures of 37.7°C, 38.9°C, 38.3°C, 38.9°C and 38.9°C respectively. October and November had temperatures below freezing and one day in December experienced a temperature of 0°C. May, June, July and August of 1994 had temperatures above 37.7°C and only January showed below freezing temperatures. Temperatures exceeded 37.7°C in March through September of 1995, with May reaching 43.3°C. No months had below freezing temperatures, but January and February had temperatures reaching 0°C. In 1996, February through September experienced temperatures at or above 37.7°C, with the highest temperature of 42.8°C occurring in August. Below freezing temperatures of -5°C, -4.4°C and -5°C, respectively occurred in January, February and December.

REFUGIUM

We planned to establish a refugium of plants at the Southwest Texas State University (SWT) Department of Biology greenhouses. However, this proved unsuccessful because the greenhouse does not provide suitable growing conditions. *Frankenia johnstonii* naturally grows under conditions of high light. The glass used in the SWT Biology greenhouses filters out 50% of light and thus does not provide sufficient quantity and quality of light to grow the plants. Seedlings resulting from a soil seed bank study and seed germination study quickly perished in the greenhouse environment (see Soil Seed Bank and Seed Germination sections below).

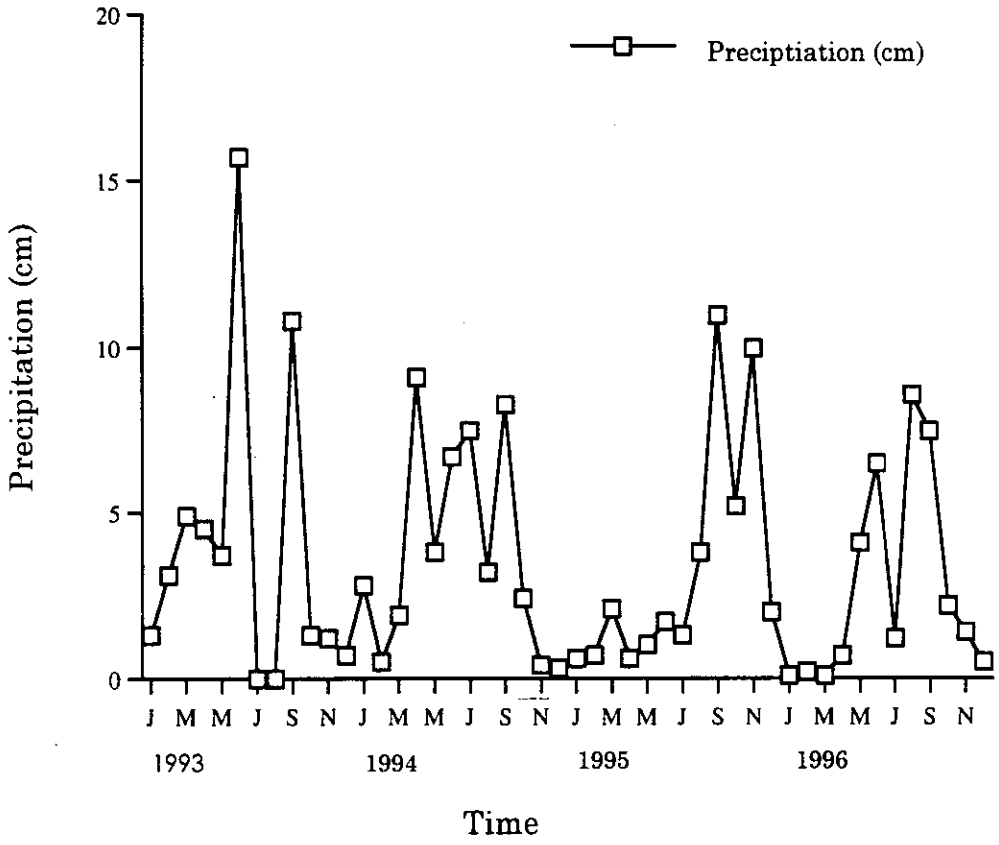


Figure 1. Average monthly rainfall in Zapata County from January, 1993 to December, 1996.

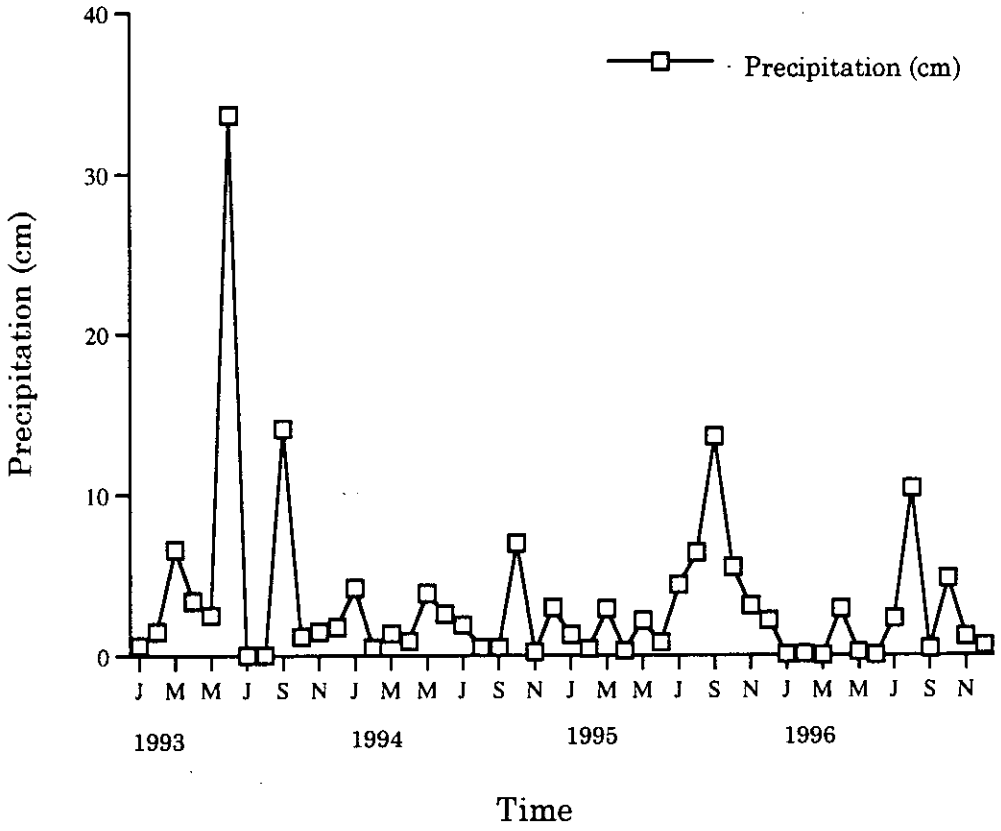


Figure 2. Average monthly rainfall in Starr County from January, 1993 to December, 1996.

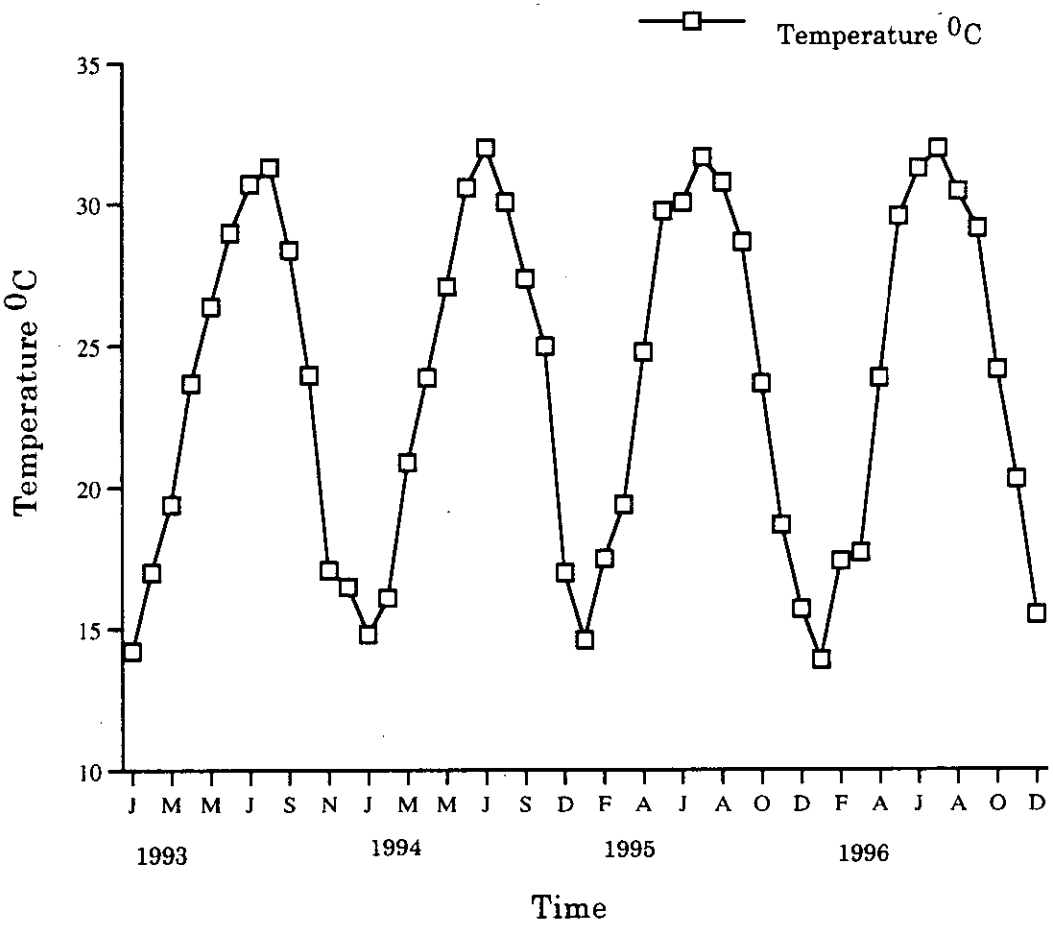


Figure 3. Average monthly temperature in Zapata County from January, 1993 to December, 1996.

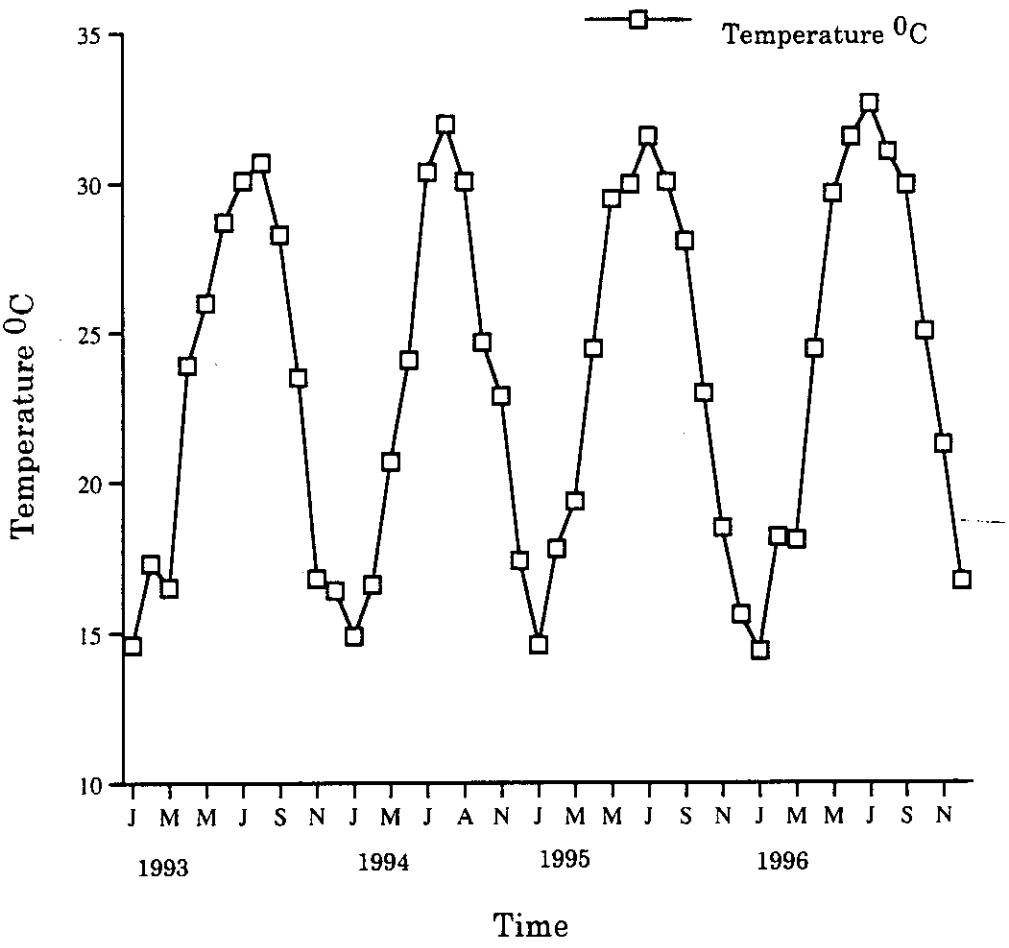


Figure 4. Average monthly temperature in Starr County from January, 1993 to December, 1996.

PEHNOLOGY AND REPRODUCTIVE CAPACITY

Materials and Methods

Seasonal trends in flowering and fruit production of *F. johnstonii* were monitored at Population 9 (Zapata County) and Population 53 (Starr County) using a technique for monitoring non-rhizomatous perennial plant species (Lesica, 1987). Two permanent belt transects were established each consisting of 50 adjacent 1 m^2 quadrats along one side of a 50 m tape stretched tightly between two pieces of iron reinforcing rod marking the starting and ending points. The quadrat side was to the left of the tape when looking from start point to end point. Two 1 m sticks marked in 10 cm increments were used to delimit each 1 m^2 quadrat. The tape acted as the bottom side of the quadrat. The meter sticks were moved along the tape as each quadrat was inspected. The number of individuals at the post-seedling stage, vegetative stage, at anthesis and in fruit were counted and recorded on data sheets monthly from July 1993 to June 1995. Data were not collected at either population in November 1993 or March, November and December 1994. Data were also not collected in February 1994, September-December 1994 and May 1995 at Population 9. The populations occur on private property and landowner permission for access was not granted during those months. Data were correlated with climatological data to determine seasonal trends.

Phenology and Reproductive Capacity Results

This study revealed that plants are capable of flowering throughout the year, although flowers are not as abundant in the winter months. Plants tend to produce a greater number of flowers in the spring and early summer and fruit production is also greatest at this time. Percentage of plants in fruit was 37% in Population 9 (Zapata County) and 32% in Population 53 (Starr County).

A total of 88 individuals were at the reproductive stage in the Zapata County population transect during the two year study period (Figure 5). In July 1993, 85 plants

were in bloom, but no fruits were observed. Plants were not in bloom and there was no fruit production during August, September, October and December of 1993 or January of 1994. Plants were in flower during April (n=81), May (n=81) and June (n=77) of 1994. Fruit production also occurred during these months with 1, 75 and 45 plants in fruit respectively. Fruit to flower ratio was 0 : 18,512 in July, 1 : 14,635 in April, 7,528 : 3,844 in May and 957 : 9,314 in June.

During the second year of this study, plants did not flower or set fruit in January 1994 (Figure 5). Plants were in flower and/or fruit all other months of observation (Figure 5). In July, 1994 there were no plants in flower, but 85 plants were in fruit. In August of 1994 there were 30 plants in flower and 27 in fruit. In February and March of 1995 there were 23 and 59 plants in flower respectively, but no fruit production. In April 1995 there were 71 plants in flower and 84 were in fruit, and in June 1995 there were 30 plants in flower and 31 produced fruit. Fruit to flower ratio was 5,074 : 0 in July, 1,286 : 818 in August, 0 : 168 in February, 0 : 685 in March, 3,063 : 1,968 in April and 8,981 : 105 in June.

The Starr County population had only 19 reproductive individuals located within the transect (Figure 6). During the first year of study plants were in flower in all months except August 1993. In July 1993 all 14 plants were in flower and one was in fruit. In September, October and December of 1993 there were 6, 11 and 3 plants in flower respectively. No fruits were observed during these months. In January 1994 there were 7 plants in flower, but no plants in fruit. In February, April and May of 1994 there were 5, 14 and 15 plants in flower respectively, but no plants in fruit. In June there were 14 plants in flower and 14 plants in fruit. The fruit to flower ratio was 1 : 1,091 in July, 0 : 17 in September, 0 : 212 in October, 0 : 18 in December, 0 : 46 in January; 0 : 51 in February, 0 : 609 in April, 0 : 373 in May, and 130 : 731 in June.

During the second year of study, flowers were produced during each month of observation (Figure 6). In 1994 there were 13 plants in flower and 3 plants in fruit in

July; in August 14 plants in flower and 9 in fruit; in September 14 plants in flower and 5 in fruit and in October 11 plants in flower and 10 in fruit. In January 1995 there were 2 plants were in flower, but no fruits observed; in February there were 12 plants in flower and 4 in fruit; in March there were 13 in flower and 9 in fruit; in April there were 17 in flower and 13 in fruit; in May there were 14 in flower and 14 in fruit; and in June there were 14 in flower and 19 in fruit. Fruit to flower ratios were 95 : 498 in July, 121 : 76 in August, 18 : 447 in September, 235 : 118 in October, 0 : 33 in January, 14 : 112 in February, 45 : 142 in March, 160 : 398 in April, 465 : 217 in May, and 434 : 174 in June.

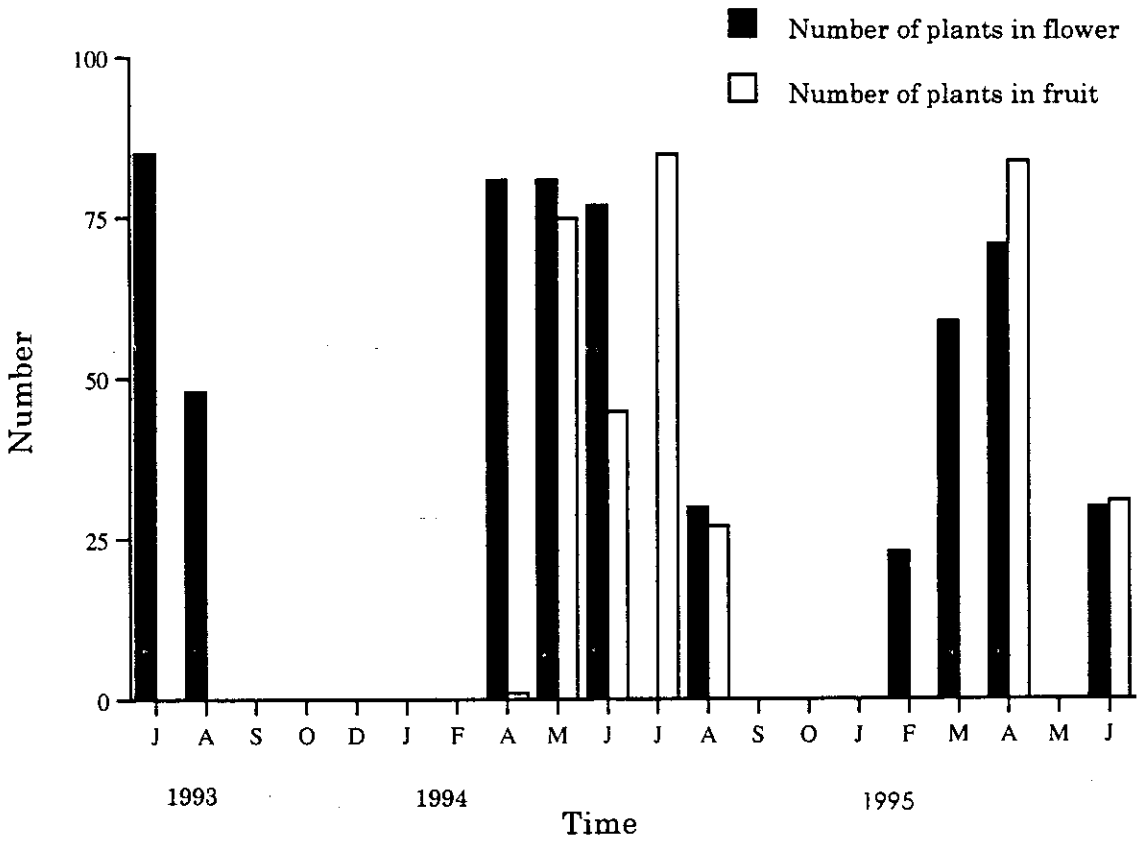


Figure 5. Number of plants of *Frankenia johnstonii* in flower and in fruit on a monthly basis from July, 1993 to June, 1995 in Population 9 (Zapata County).

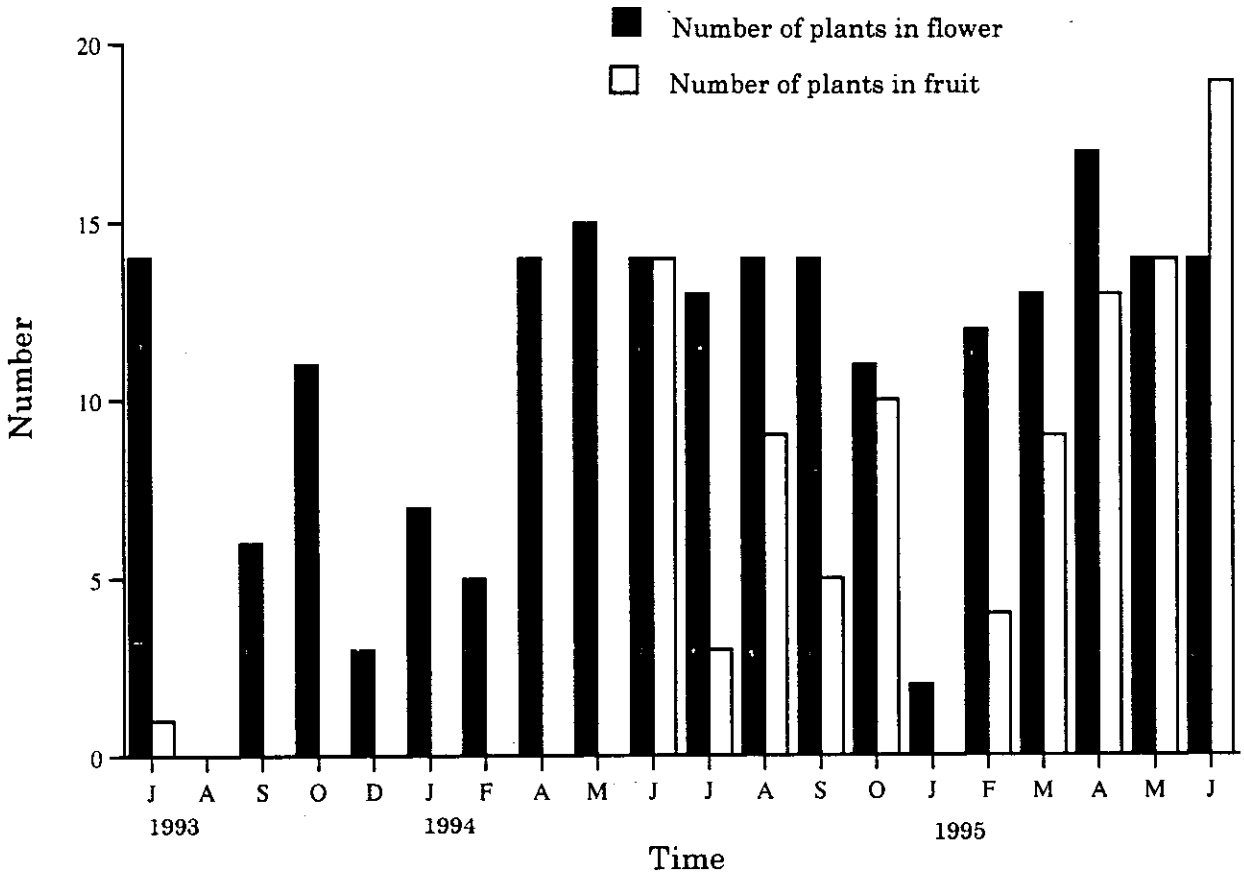


Figure 6. Number of *Frankenia johnstonii* plants in flower and in fruit on a monthly basis from July, 1993 to June, 1995 in Population 53 (Starr County).

FLORAL MORPHOLOGY AND MATURATION

Materials and Methods:

Twenty flowers taken from ten plants in Population 53 were measured using calipers. Timing of floral movements was observed at Population 53 and Population 47. Floral maturation was studied at Population 53 by marking floral buds with paint sticks prior to opening and then marking with a different color of paint the first day of opening.

Floral Morphology and Maturation Results:

The plant produces solitary, sessile flowers borne axillary. There are five sepals fused to form a calyx tube basally, with five free lobes distally. Overall calyx length averages 4.27 mm and ranges from 2.29 mm to 5.69 mm (n=20 flowers). The petals are five in number, white, and clawed. The corolla extends an average of 3.12 mm beyond the calyx; the range is 2.29 mm to 3.84 mm (n=20 flowers). Nectar is secreted at the base of the flower; quantity of nectar is relatively low. There are six stamens. The lower three stamens have an average length of 4.71 mm with a range of 3.35 mm to 5.96 mm (n=20 flowers); the upper three stamens average 6.10 mm in length and range from 4.98 mm to 7.77 mm (n=20 flowers). The ovary is superior and compound, composed of three carpels, and contains three ovules. The stigma is three cleft. Combined style and stigma length averages 6.19 mm.with a range of 4.72 mm to 7.28 mm (n=20 flowers). Total diameter of a fully opened flower averages 6.71 mm and ranges from 5.21 mm to 8.36 mm (n=20 flowers). The central opening of the flower, not including the petals, averages 2.19 mm with a range of 1.67 mm to 2.73 mm (n=20 flowers).

The flower is open only one day. Flowers open at approximately 2:00 pm (CST) and begin to close around 5:00 pm. Stigmas and upper stamens are positioned at approximately the same level in the flower and the stigma is receptive at the time pollen dehiscence occurs. No morphological barriers to self-pollination are apparent.

NECTAR ANALYSIS

Materials and Methods:

Flowers from three plants were collected and the inner surface of the floral tube dabbed onto a Fisher High Contrast Hand Refractometer to analyze sugar content of nectar. This procedure was attempted on several occasions.

Nectar Analysis Results:

Sufficient nectar could not be obtained to detect the sugar content due to low volumes produced and rapid evaporation from the refractometer instrument.

POLLEN VIABILITY

Materials and Methods:

The pollen viability of five *F. johnstonii plants* from Population 53 was tested. The pollen from two to five flowers of each plant was placed on a slide and immersed in a drop of 1% aniline blue in lactophenol stain (Radford, et al., 1974). The slides were stained for two to three hours then examined using an AO light microscope at 40X magnification. All pollen on each slide was observed and scored as viable or non-viable. Pollen that stained blue was considered viable; non-viable pollen does not stain. Care was taken to examine all pollen grains on a slide rather than performing random counts because it is known that non-viable pollen, lacking a living protoplast, is lighter in weight and therefore tends to accumulate near the edges of the cover slip (Kearns and Inouye, 1993).

Pollen Viability Results:

The percentage of viable pollen ranged from 94% to 100%, with an average viability of 96%.

BREEDING SYSTEM

Materials and Methods:

The number of pollen grains present on stigmas of plants caged to exclude pollinators was counted to determine if the plants undergo self-pollination. The number of pollen grains deposited on stigmas that were open-pollinated was also counted.

Plants in Population 53 were caged as follows: three rebar stakes were driven into the ground to form a teepee frame around each of five plants. Bags constructed of a double layer of bridal veil material were placed over the rebar frame and secured at the base to exclude potential pollinators.

Ten flowers in each of the two treatments (caged and open-pollinated) were collected and examined. The stigmas were removed from a given flower and placed on a microscope slide. Basic fuchsin gel (Kearns and Inouye, 1993) was added and the slide was passed over the flame of an alcohol lamp to melt the gel, then the tissue was covered with a coverslip to make a semi-permanent slide. The stigmas were examined using a Zeiss microscope and the number of pollen grains on the stigmas was recorded. The number of pollen grains on each of the three stigmas was pooled to give a total number of pollen grains per flower. A pollen reference slide was made using the basic fuchsin gel technique to ascertain that *F. johnstonii* pollen was counted.

Seed set in caged plants (n=5) experimentally cross- and self-pollinated by hand was also examined. The following types of experimental crosses (Faegri and van der Pijl, 1979) were made:

Autogamous cross - Plants were self-pollinated by transferring pollen from the anther to the stigma of the same flower.

Xenogamous cross - Plants were cross-pollinated by transferring the pollen from one plant to the stigma of an emasculated flower on a different plant.

Mature fruits were collected and the number of seed and the number of ovules that did not develop into seeds were counted to assess fertilization and seed set resulting from self- and cross-pollination.

Breeding System Results:

The ten caged flowers were found to have 22, 25, 28, 29, 32, 38, 40, 41, 57, and 71 pollen grains. The ten open-pollinated flowers were found to have 55, 72, 81, 89, 93, 96, 99, 113, 142, and 177 pollen grains. A greater number of pollen grains were found in open-pollinated flowers (average of 102) vs. those of caged flowers (average of 38).

Caged plants with flowers experimentally self-pollinated (n=10) and emasculated flowers that were cross-pollinated (n=8) both set seed (one seed per fruit) indicating that the plant is self-compatible.

POLLEN TUBE GROWTH

Materials and Methods:

Flowers were experimentally hand self- and cross-pollinated and rates of pollen tube growth were examined to determine whether differential pollen tube growth occurs in the taxon.

Plants (n=5) with developing floral buds were caged at Population 53 as described above. The following types of experimental crosses (Faegri and van der Pijl, 1979) were made:

Autogamous cross - Plants were self-pollinated by transferring pollen from the anther to the stigma of the same flower (n=10 flowers).

Xenogamous cross - Plants were cross-pollinated by transferring the pollen from one plant to the stigma of an emasculated flower on a different plant (n=10 flowers).

Following pollination, flowers were fixed for use in studying pollen germination and pollen tube growth.

Flowers were fixed 24 hours following hand-pollination in 70% ethanol (Mulcahy and Mulcahy, 1982; Aizen et al., 1990). Fixed tissues were treated with 1N NaOH at room temperature for approximately one hour to soften and clear the styles (Kho and Baër, 1968). A 0.01% decolorized aniline blue solution was prepared by dissolving aniline blue dye in K_2HPO_4, which after one or two hours at room temperature becomes colorless (Currier, 1957). Tissues were rinsed in water and stained for 24 to 48 hours in the decolorized aniline blue. Then tissues were mounted in a drop of the stain on a microscope slide and squashed with a coverslip. Tissues were viewed under a Zeiss epifluorescent microscope using a blue excitation, yellow transmittance filter. Pollen grains and pollen tubes with callose plugs, deposited periodically as the pollen tubes grow down the style, will fluoresce a yellow color using this particular filter combination. The number of pollen grains adhering to the stigma, number germinating to form pollen tubes, lengths of pollen tubes at one, two, six, 12, and 24 hours, and the region of the carpel where the tubes stop growing were recorded.

Pollen Tube Growth Results:

Fluorescent microscopic examination of stigmas following experimental crosses indicates that both self- and cross-pollen readily adhere to the stigmatic surface. Both self- and cross-pollen grains germinate forming pollen tubes that penetrate the carpel tissue and reach the ovary within 24 hours. No difference in length of pollen tubes was evident at one, two, six, 12, or 24 hours. These results suggest differential pollen tube growth does not occur in *F. johnstonii*.

POLLINATION

Materials and Methods:

Pollination biology was studied at Population 53 in 1995. This population was selected for study because it consistently flowered. Plants, at anthesis, were observed in the field in 1995 on the following dates: May 15, May 17, May 18, May 31, June 1, June 29, November 11, and November 12 with one or two observers in different areas of the population during each observation period. Flowers were observed prior to opening, during opening, until flowers closed near dusk. Visitation rates and movements of floral visitors were recorded. Visitation rates of insects were recorded during a one hour time span corresponding to the peak of floral visitor activity (3:00-4:00pm CST) on each of three days. Five plants with a combined total of 15 flowers were observed on May 31, 1995, four plants with a combined total of 10 flowers were observed on June 1, 1995, and eight plants with a combined total of 73 flowers were observed on June 29, 1995. The visitors were classified as bee, fly, or butterfly.

Potential pollinators were captured using insect nets, killed in kill jars containing amyl acetate, and transported to the Department of Entomology at Texas A&M University for identification. Floral visitors were examined for the presence of pollen using light microscopy and the lengths of tongues (proboscis) were measured using clipers.

Pollination Results:

A large variety of diurnal floral insect visitors including bee flies, bees, and butterflies were observed (Table 1). The insects were seen in flight visiting several flowers of a plant in rapid succession, moving from flower to flower between plants and were seen to insert their proboscis into the flowers.

Observations of insect visitation rates indicate that flies (n=147 visits during the combined three hour observation period) and bees (n=108 visits during the combined

three hour observation period) are the most common floral visitors. Butterfly visits are rare (n= 4 visits during the combined four hour observation period. The Pygmy Blue butterfly, although common at the population site, does not appear to be a primary pollinator of *F. johnstonii.*

Table 1. List of insect visitors to *F. johnstonii* flowers. The number of voucher specimens is shown in parenthesis.

Floral Visitor
LEPIDOPTERA
Lycaenidae
Brephidium exilis Boisduval (n=2)
HYMENOPTERA
Unidentified bees (n=10)
DIPTERA
Bombyliidae
Exoprosopa sp. (n=6)
Geron sp. (n=1)
Unidentified bee flies
HEMIPTERA
Rhopalidae
Arhyssus lateralis (Say) (n=1)

SEED SET

Materials and Methods:

Fruits (n=540) of *F. johnstonii* were collected from Population 9 on May 27, 1994. Fruits (n =87) of *F. johnstonii* were also collected from Population 53 on November 11, 1995. Fruits (n=154) were collected from Population 1 on May 19, 1999. Fruits (n=24) were collected from Population 4 on May 20, 1999. Fruit collection was limited due to the endangered status of this species. Fruits were determined to be mature if they could be easily removed from the plant. The fruits were placed in paper bags and transported to the physiology laboratory at Southwest Texas University. To determine the percentage seed set, fruits were dissected and the number of mature seeds and the number of ovules that did not develop into seeds were counted. Due to the small size of the fruit, double-sided tape was used to hold the fruit in place on a microscope slide for dissection and examination.

Seed Set Results:

The ovary contains three ovules. Most fruits contain seed (Table 2). However, examination of the fruits revealed that typically only one of the three ovules (usually the middle ovule) develops into a seed. The other two ovules abort. The percentage seed set among populations ranges from 15% to 30% (Table 3).

Table 2. Percentage of *F. johnstonii* fruits that set seed

Population	No. Fruits	No. with Seed	Percentage Fruit Setting Seed
1	154	122	79%
4	24	11	46%
9	540	297	55%
53	87	78	90%

Table 3. Percentage seed set in *F. johnstonii*

Population	No. Ovules	No. Seeds	Percent Seed Set
1	462	122	26%
4	72	11	15%
9	1620	297	18%
53	261	78	30%

SEED VIABILITY

Materials and Methods:

Seeds of *F. johnstonii* were tested for viability using the tetrazolium staining method (Grabe, 1970; Copeland, 1981). The seeds (n = 78) were dissected from capsules collected from the Population 53 in November, 1995. The seeds were placed in petri

dishes, covered with a 0.1% tetrazolium solution and allowed to stand for one hour to ensure penetration of the stain. Embryos were considered viable if they stained red. Non-viable embryos do not stain.

Seed Viability Results:

Seeds (n = 78) dissected from mature fruits exhibited 31% viability (24 viable, 54 nonviable).

SEED GERMINATION

Materials and Methods:

Difficulty in germinating seeds was found in previous studies (Turner, 1980; Whalen, 1980). Whalen examined the effects of salinity on germination and found higher rates of germination when seeds were exposured to fresh water for several days (Whalen, 1980). The purpose of this experiment was to assess germination rates under optimal conditions. Seeds (n=30) were collected from Population 1 on May 19, 1999. Seeds (n=80) were collected from the Population 23 on May 21, 1999. Seed germination experiments were conducted in June 1999. Seeds were soaked overnight in DI water, placed between two pieces of moist filter paper in petri dishes and placed in the greenhouse. Seeds were scored as germinated when the radicle had emerged 1 mm.

Seed Germination Results:

Seed germination (Table 4) varied from 25% in seeds collected from Population 23 to 70% in seeds collected from Population 1. Seeds germinated within one week of soaking without further manipulation (scarification or stratification). Seeds were collected in late May and germinated in early June. After germination, seeds were planted in

vermiculite and placed in the SWT Biology greenhouse. All perished within one month of germination (see Refugium section above).

Table 4. Percentage seed germination in *F. johnstonii*

Population	No. Seeds	No. Germinated	Percent Germination
1	30	21	70%
23	80	20	25%

SOIL SEED BANK

Materials and Methods:

To determine the presence or absence of a persistent seed bank, soil samples were collected from each of three *F. johnstonii* populations (Populations 9, 47, and 53). Ten soil samples were taken from each site approximately every six weeks for one year. A 50 m transect was set up in an area of each population. The samples were selected randomly within a 10x10 m square on either side of the transect using a random numbers table. Samples were taken using an auger 5 cm in diameter. After removal of surface litter, the auger was inserted into the soil to a depth of 2.5 cm (Gross, 1981; Thompson and Grime, 1979). Each of the ten soil samples from the 10x10 m plots was placed in a separate paper bag. The soil samples were then placed in flats about 2.5cm deep to simulate field soil depth and kept in the SWT Biology greenhouse under conditions suitable for germination. Seed germination was monitored.

Soil Seed Bank Results:

At the conclusion of the one year study, four *F. johnstonii* seedlings had germinated. Two seeds in soil collected from Population 53 and one seed in soil collected from Population 47 in April 1996 germinated and produced seedlings in June 1996. In October of 1996 a fourth seedling was observed in soil collected in June 1996 from Population 53. The seedlings died shortly after germination (see Refugium section above).

SEEDLING RECRUITMENT

Materials and Methods:

Seedling recruitment was monitored within the 50m belt transects established to study phenology and reproductive capacity (see above). Seedlings were defined as individuals with a single stem and one to three leaves per plant. Seedling positions were mapped on a data form with corresponding boxes for each quadrat along the transect. Seedling recruitment data were recorded at each transect on a monthly basis over a two year period from July 1993 to June 1995.

Seedling Recruitment Results:

At the beginning of the seedling recruitment study (July 1993) 93 individuals were located within the Population 9 transect, seven of these were identified as seedlings (Figures 7, 9). By June 1995, a total of 32 new seedlings had been observed (Figure 7); new seedlings were observed during 1993 in August (n=3), September (n=3), October (n=12) and December (n=2). In 1994, new seedlings were observed in April (n=3), May (n=1), July (n=1), and in August (n=1). In 1995, new seedlings were observed in February (n=2), March (n=1), April (n=2), and June (n=1). Seedling mortality occurred in December 1993 (n=1), June 1994 (n=1), January 1995 (n=1), March 1995 (n=2) and

June 1995 (n=2) (Figures 7, 9). At the conclusion of the study, 32 of the 39 seedlings observed over the study period survived, resulting in 82% recruitment.

In Population 53, there were 24 plants located within the transect in July 1993, ten of these were seedlings (Figures 8, 9). New seedlings were observed in October 1993 (n=2). In 1994 new seedlings were observed in February (n=1), April (n=2), May (n=1) and July (n=1). In 1995 one new seedling was observed in January. One seedling suffered mortality in October 1994 (Figure 9). A total of 17 of 18 seedlings observed were recruited over the two year study resulting in a recruitment of 95% (Figures 8, 9).

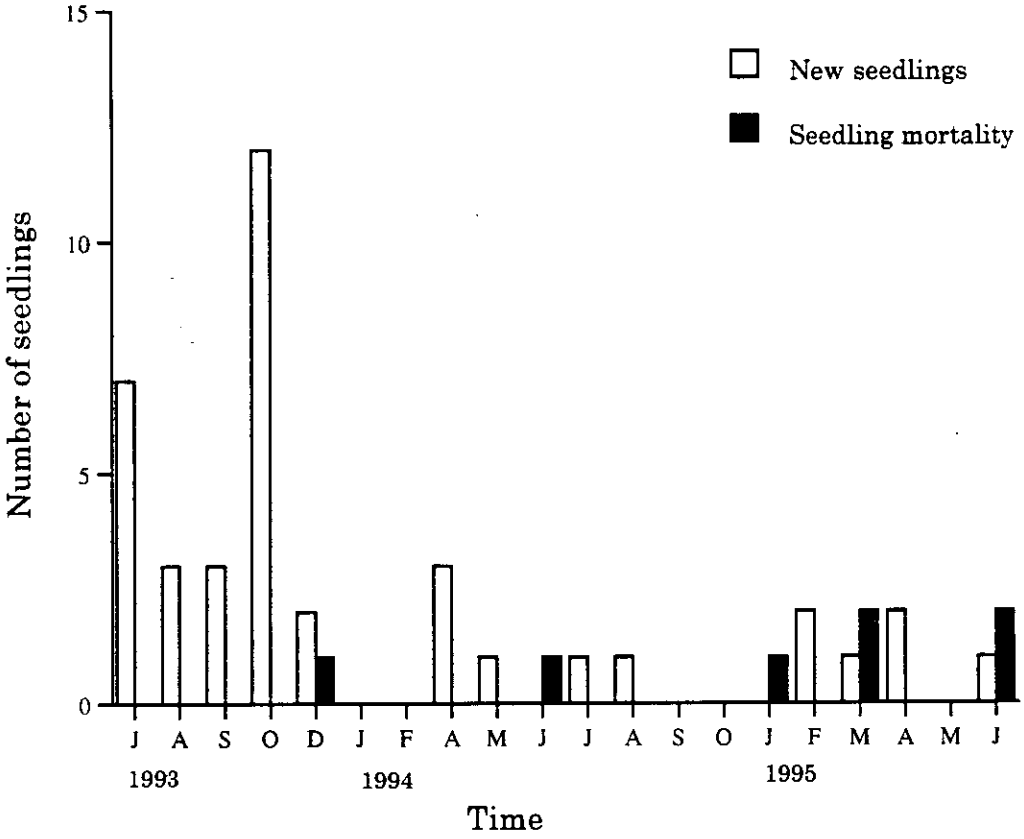


Figure 7. Number of seedlings recruited and seedling mortality of *Frankenia johnstonii* on a monthly basis from July, 1993 to June, 1995 within belt transect in Population 9 (Zapata County).

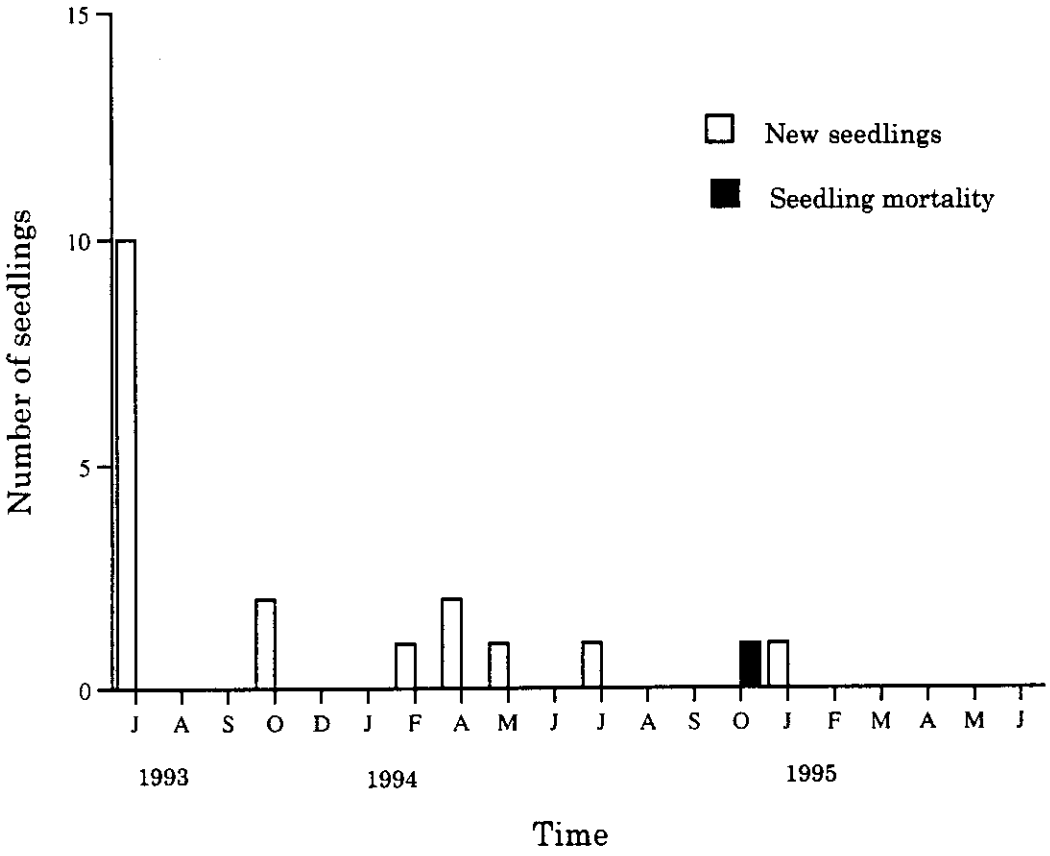


Figure 8. Number of seedlings recruited and seedling mortality of *Frankenia johnstonii* on a monthly basis from July, 1993 to June, 1995 within belt transect in Population 53 (Starr County).

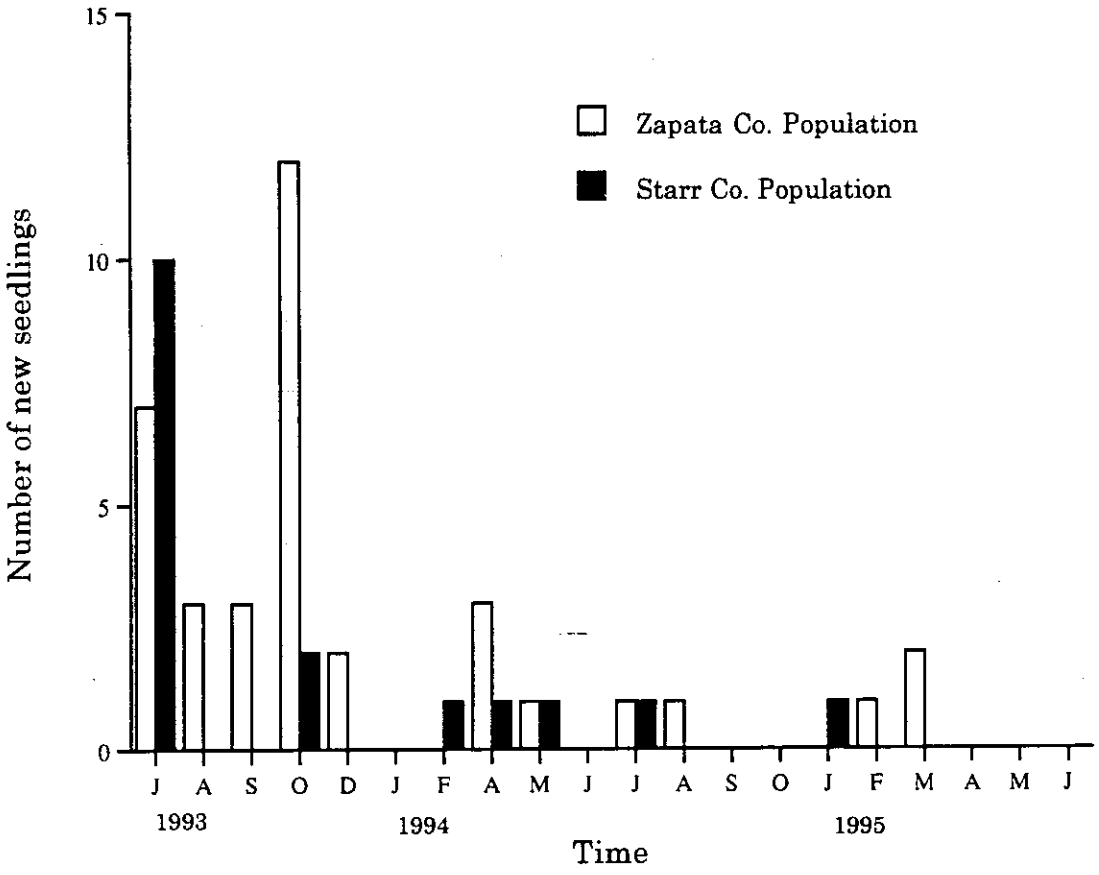


Figure 9. Number of new seedlings of *Frankenia johnstonii* recruited monthly in Population 9 (Zapata County) and Population 53 (Starr County) from July, 1993 to June, 1995.

DISCUSSION

Reproductive failure is of concern when considering threats to rare species (Havens, 1999) and low reproductive potential has been suggested as a specific threat to *F. johnstonii* (Turner, 1980, United States Fish and Wildlife Service, 1988). Several factors increase the risk of reproductive failure in plant populations, including high degree of dependence on specialized pollinators, absence of reproductive assurance mechanisms such as self-fertilization and vegetative reproduction, and poor ability to compete with more abundant taxa for pollinators (Havens, 1999). This study has shown that *F. johnstonii* is a generalist, pollinated by a variety of insects, including bees and flies. The species is not reliant on a specialized pollinator association. There is therefore, no danger of extinction of one pollinator species resulting in subsequent extinction of the plant. Pollinator visitation rates are high, thus the plant appears to compete successfully for pollinators and is readily cross-pollinated.

Outcrossing results in greater genetic variability than does selfing. Flowering plants have developed mechanisms to promote outcrossing and prevent self-fertilization. Examples include dioeciousness, protogyny, protandry, self-incompatibility systems, and differential pollen tube growth (Richards, 1986). Flowers of *F. johnstonii* are perfect and do not exhibit protogyny or protandry. Floral morphology readily allows self-pollination and the plant is self-compatible. No differential pollen tube growth was detected. A greater number of pollen grains were found on stigmas of open-pollinated flowers than those that were caged and allowed to spontaneously self. However, since only one ovule per fruit develops into a seed, only one pollen grain per fruit is ultimately utilized. It is doubtful that even with fewer pollen grains, reproductive capacity would be affected. Selfing would result in less genetic variability, but this may not be a detriment considering the narrow ecological habitat to which this species is adapted. Knowledge of genetic

variability in this taxon is limited and would be improved by a detailed study to assess levels and patterns of genetic variability within and among populations.

Plant population growth and stability can be limited by production of viable seeds, particularly when a species is not known to reproduce asexually (Pavlik et al., 1993). With the exception of *F. salina*, *F. juniperoides*, *F. palmeri*, and *F. microphylla*, American species of *Frankenia* are not known to undergo asexual reproduction (Whalen, 1980). The inability to reproduce vegetatively makes seed production critical to perpetuation of *F. johnstonii*. Seed production depends on plant size, fruit to flower ratio and the number of ovules that actually develop into seed (Gross, 1981; Lee and Bazzaz, 1982; Hirose and Kachi, 1986; Weins et al., 1987; Winn and Werner, 1987).

Both intrinsic and extrinsic limitations can reduce plant size, fruit to flower ratio and seed to ovule ratio (Pavlik et al., 1993). Intrinsic limitations include genetically programmed fruit or ovule abortion, especially in outcrossing species (Weins et al., 1987, 1989). Extrinsic limitations include abiotic resource levels (van Andel and Vera, 1977; Bookman, 1983; McCall and Primack, 1985). Also, predation on seeds, fruits or portions of the whole plant can limit plant size, fruit to flower ratio and seed to ovule ratio (Janzen, 1971; Lee and Bazzaz, 1982; Evans et al., 1989).

Frankenia johnstonii exhibits low fruit to flower ratios, seed set and seed viability. Although the mechanism is not known, a regular pattern of ovule abortion was noted in *F. johnstonii*. Ovule abortion resulted in a low seed set (15-30%). Disparity in seed set among populations could be the result of differences in vigor among the four population studied. Seed viability was also low (31%). This could also reflect reduced vigor.

Frankenia johnstonii showed annual variation in flower production. This appeared to be correlated with the variation in rainfall amounts over the two year study period. Correll and Johnston (1979) indicate *F. johnstonii* flowers during the months from November to April. However, this study revealed that plants flower anytime of the year following rains, with a peak flowering period during spring and early summer. The

majority of plants were at anthesis in April, May and June, months typically receiving the most rainfall. Limited precipitation at other times of the year may place an extrinsic restraint on flower, fruit and seed production.

Temperature may also play a role in flower and fruit production. Plants were observed to be in flower during the winter months. However, the number of plants in flower and the number of flowers per plant was much lower than in spring and summer and there was almost no fruit production. Browsing pressure is also high in the winter. Increased browsing coupled with decreased precipitation and lower temperatures during the winter months could be factors resulting in reduced flower and fruit production.

Production of seeds is critical to population survival of plants that do not reproduce asexually, and the presence of a seed bank can be especially important in long-term survival. Thompson and Grime (1979) described seed banks as either transient or persistent. Transient seed banks exploit gaps that become available for colonization by seasonally predictable damage and mortality in the vegetation. Seeds will germinate in these areas soon after release and do not remain persistent in the soil. Persistent seed banks are those in which seeds remain viable in the soil for at least one year. They tend to occur when disturbance of the established vegetation is temporally and/or spatially unpredictable. This study was not designed to provide a complete assessment of seed flora but to detect the presence or absence of a persistent soil seed bank in populations of *F. johnstonii*. During the year long study, only four seedlings germinated from the soil samples taken. Germination was observed in soil samples collected in spring and early summer, the time when plants are largest and flower production is at its peak. Despite the low germination rate found in the soil seed bank study, laboratory germination tests yielded a germination rate of 25-70%. It does not appear from this study that *F. johnstonii* has a reservoir of buried viable seeds that would account for a persistent seed bank. It is likely that most seeds remain in the litter of the soil. This could be advantageous because seeds are small and probably unable to emerge if germination occurs

too far below the soil surface. However, this could also lead to herbivory or seeds being removed, by biotic or abiotic means, to an unsuitable habitat.

Structural features of the seed may also preclude the formation of a persistent soil seed bank. Seeds have a thin seed coat (Whalen, 1980) that may not provide sufficient protection for long term survival in the soil. However, a thin seed coat may be advantageous in the process of seed germination. A thin seed coat would favor rapid imbibition and subsequent germination. Whalen (1980) found that seeds readily germinate after a few days of exposure to fresh water. The exposure to water may leach chemicals from the seeds that act as germination inhibitors or leach salts that influence osmotic potential thereby altering water potential such that the seed inbibes water. Seeds soaked overnight in water in this study germinated within five days. Rapid germination could be a mechanism for exploitation of short periods of favorable environmental conditions. The leaching requirement may ensure that sufficient water is present in the soil when the seed germinates to support seedling growth. This is a common dormancy breaking mechanism in desert species (Fenner, 1985).

Although seed set and seed viability are low, seeds that do germinate exhibit a high rate of recruitment. Seedling recruitment in Population 9 was 82% and Population 53, which was much smaller, had 94.7% recruitment. Fruits have no apparent specializations for dispersal. Due to a seed shadow that is strongly leptocarpic, seedlings are always found in close proximity to the parent plant. Callaway (1992) found biogenic safe sites for oak seedlings provided by shrubs, and that this could affect recruitment. This has also been suggested for some desert species (Turner et al., 1966). The parent plant may provide a safe site for the seedlings of *F. johnstonii*, reducing the possibility of trampling and increasing the chance of recruitment.

Studies have indicated that timing of germination and seedling size can be critical factors in determining the fate of seedlings, with larger seedlings having better survivorship and ability to reach reproductive stage sooner than smaller seedlings of the

same cohort (Cook, 1979, 1980). In *F. johnstonii* timing of germination is variable and seedling survival could be dependent on the amount of rainfall after germination. The largest number of seedlings observed in one month occurred at Population 9 in October 1993, following a month in which rainfall amounts reached 10.8 cm. Increased precipitation amounts during the months before new seedlings were observed could have promoted rapid growth and provided a better chance of successful survival and establishment. Although small seedling size can be a contributing factor to seedling mortality (Fenner, 1985), five of the unrecruited seedlings at the Population 9 had aerial diameters ranging from 4 cm to 20 cm. Seedling size did not appear to be a factor in the loss of these seedlings. Seedling loss in *F. johnstonii* seems to result primarily from browsing, trampling and drought stress. It is not well understood how seedling size and survivorship relate where drought stress and herbivory also play important roles (Parker, 1982).

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Ranchers, parks and wildlife make history with draft of conservation memorandum

ZAPATA - Over 40 Webb and Zapata county ranchers met recently in Zapata to discuss endangered species and how best to coordinate the conservation efforts of land owners with those of the Texas Parks and Wildlife Department (TPWL).

The meeting, at which TPWL botanist Oena R. Janssen of Austin addressed about 40 ranchers and landowners, was sponsored by the Zapata Soil and Water Conservation District. The SWCD drew up a memorandum of understanding by which ranchers and TPWL would agree jointly toward conservation and the specific voluntary protection of Johnston's frankenia (Frankenia johnstonii) and Ashy dogweed (Thymophylla tephroleuca), two South Texas plant species listed as endangered by the U.S. Fish and Wildlife Service (USFWS) in 1984.


Johnston's frankenia

According to Zapata County rancher José Oscar Dodier, Jr., of the SWCD, the essence of the agreement centers around the understanding that landowners will protect the plants and that TPWL will start the process to de-list the plants.

"Either party can say at any time that they no longer wish to do it. While it is not a binding agreement, it sure seems like a good way to do the right thing," Dodier elaborated. "Root plowing soil where Johnston's frankenia grows doesn't do any good. Generally, it is very salty soil and of little use. It would be easy enough to just agree not to root plow that clump. Legislatively, the landowners have the upper hand, but what Oena and TPWL are asking is that we work together. She has conducted a much more thorough study than the one that put the plant on the endangered list," Dodier said, adding that the memorandum offers a completely workable plan for both the rancher and TPWL and a very viable effort to balance the rights of the property owners with the need to address an environmental issue.

According to Janssen, a creative partnership between TPWL and the Webb and Zapata county ranchers could produce better results for the conservation of the plants than if other measures were implemented. "A conservation agreement strengthens and focuses protection, and in fact, it can change the listing of the plant species or eliminate its listing altogether," she said.

"When I first began asking for permission to get on ranches to look for Johnston's frankenia and Ashy dogweed, ranchers were not that open to the idea. There was some resistance," Janssen said of the effort she began nearly three years ago. "This has changed," she said. "And that speaks well for the ranchers of this area who want to do the right thing. The agreement we proposed is the first of its kind," Janssen added. "With each new population of Johnston's frankenia that we can verify, the closer we are to full recovery of this endangered species. The idea is to down-list the species to threatened or possibly de-list," she said.

The Texas Legislature authorized the Texas Parks and Wildlife Department to establish a list of threatened and endangered plant species for the state. An endangered plant is one that is in danger of extinction throughout all or a significant portion of its range.

At the time of its listing in 1984, only five populations of Johnston's frankenia were known — two in Zapata County, two in Starr County, and one in Mexico. Periodic visits by Janssen to Zapata County, however, have revealed the existence of more populations of this gray-to-green halophytic (salt-loving) subshrub. At maturity, Johnston's frankenia grows a foot high and one or two feet wide, forming a convex-shaped, almost perfectly spherical sub-shrub with tiny, oblong leaves. Salt crystals are often visible on the lighter colored undersides of leaves. The white flowers of this desert plant are smaller than a dime when open with five slightly fringed or toothed petals and a distinct yellow center. The subshrub blooms April to November, particularly after rainfall. The plant is easiest to identify from November to February when it takes on its crimson autumn color.


Ashy dogweed

In 1984, only one colony of Ashy dogweed was identified, and that was in Zapata County. Today there are three known colonies in northern Zapata County. Ashy dogweed is a herbaceous perennial wildflower that takes its name from the ashy grayish-green color of its stems and leaves. Woolly white hairs cover its stems and very thin leaves. At maturity the species can reach almost a foot tall, but generally they are a little smaller and form dense, circular clumps. The stems near the base of the plant are woody. Its pawny-sized golden flowers with golden centers resemble composite-like daisies. Numerous flowers cover the plant in spring and summer, and in winter the plant becomes brittle and dry.

"Zapata County is the only place in the world that Ashy dogweed is known to grow. There is a population on both sides of the right-of-way of Highway 83 along a private property fenceline 1.7 miles south of the Webb-Zapata county line. If you have Ashy dogweed on your ranch, we would like to know. With each population we can verify of this rare species, we can learn more about its biology, ecology, and true status," Janssen said.

For further information on the proposed agreement between ranchers and the Texas Parks and Wildlife Department, please call Janssen at the Endangered Species Program of the Texas Parks and Wildlife Department at (512) 912-7011.

Zapata County News

Thursday
May 14,
1998

All that is necessary for the forces of evil to win the world is for enough good men to do nothing.
Edmund Burke

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Vol. 19, No. 18 Serving the Peoples and Communities of Zapata County - Viva Zapata

Rare plant 'common' in Zapata

Botanist/biologist Janssen works with ranchers to take it off endangered plant lis

EDITOR'S NOTE: Last week the federal goverment announced that the bald eagle, symbol of our nation, was no longer an endangered species. This symbol of our nation was on its way to extinction befor the passage of the Endangered Species Act of 1973 – only the elimination of certain pesticides and many, many years of hard work by thousands of concerned people allowed this magnificent bird to increase its numbers.

Although it's not off the endangered list yet, a small, often overlooked but not insignificant plant knwon as Johnston's frankenia may leave its pages just after the turn of the century. This will happen thanks to the hard work of Texas Parks and Wildlife Dept. botanist/biologist Gena Janssen and growing numbers of Zapata County landowners.

But, we'll let Ms. Janssen tell the story – a success story of major proportions, with Zapata County landowners about to make history as the community enters the next century.

By Gena K. Janssen
Texas Parks and Wildlife Department

Never, in the history of the Endangered Species Act, has the active participation, cooperation and conservation of a community of private landowners been solely responsible for the delisting of an endangered species in Texas. The private ranchers of Zapata County are setting a new standard for conservation of endangered species on private property. Not only are the Zapata County landowners making a difference – they're making history!

Congratulations Zapata County, it is finally happening. The U.S. Fish and Wildlife Service (USFWS) Region 2 Headquarters in Albuquerque, New Mexico, has recommended that Johnston's frankenia be taken off of the endangered species list. In an official memo from the Regional Director in Albuquerque to the Field Supervisors in Texas, the delisting package for Johnston's frankenia should be submitted no later than March 1999.

Why? Two simple words: Cooperation and Conservation. The private landowners of Zapata County have cooperated with the Texas Parks and Wildlife Department (TPWD) by graciously opening their gates and allowing access to survey for this endangered species. This access has led to the discovery of at least 45 confirmed population complexes of Johnston's frankenia – all but one on private property.

But simply a few more populations will not assure that a species gets delisted – especially a plant. So many of the landowners of Zapata County went a step further by voluntarily committing to conserve this species on their ranches through voluntary conservation agreements with TPWD.

It is the existence of these voluntary conservation agreements, the commitment of this community of landowners of Zapata County to the voluntary conservation of this species, that has led to the recommended delisting.

Laws do not conserve endangered plants on private land – landowners do!

Why are these voluntary conservation agreements so important? Because the Endangered Species Act cannot assure the protection of endangered plants on private land, but ranchers can!

Flowers are white with five fringed petals; have their unde sides covered with salt, are tiny and curl under at the edg

Unlike endangered animals, endangered plants are not thoroughly protected on private land under the Endangered Species Act of 1973. The only time that endangered plants must be protected on private property under the Act is during a federally funded or a federally permitted activity (this does not mean that landowners with endangered plants cannot receive federal assistance or permits, it is just that they cannot destroy their endangered plants during those activities).

Essentially, if a landowner is not using federal money or a federal permit (which is 99.99% of the time), it is perfectly legal to destroy plants, including any hat may be listed as endangered, on a man or woman's private property. Given these facts, we knew that it would be very difficult-to-impossible to delist this species because the USFWS would consider all these private land sites lunprotected.l

That is, they would remain "officially unprotected" unless we could prove to the USFWS that the landowners of Zapata County are taking care of these endangered species voluntarily.

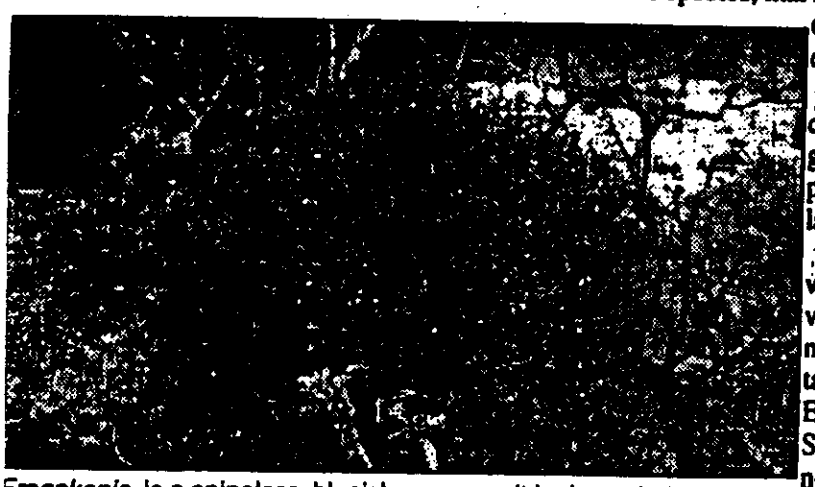
That is why many of the landowners and I met in May 1995 and decided pursue voluntary conservation agre ments. The conservation of endangere plants on private land is completely vo untary, and a voluntary conservatio agreement gives us something to tangibl demonstrate that voluntary commitment

The USFWS has now recognized tha commitment, and has recommended tha Johnston's frankenia be delisted.

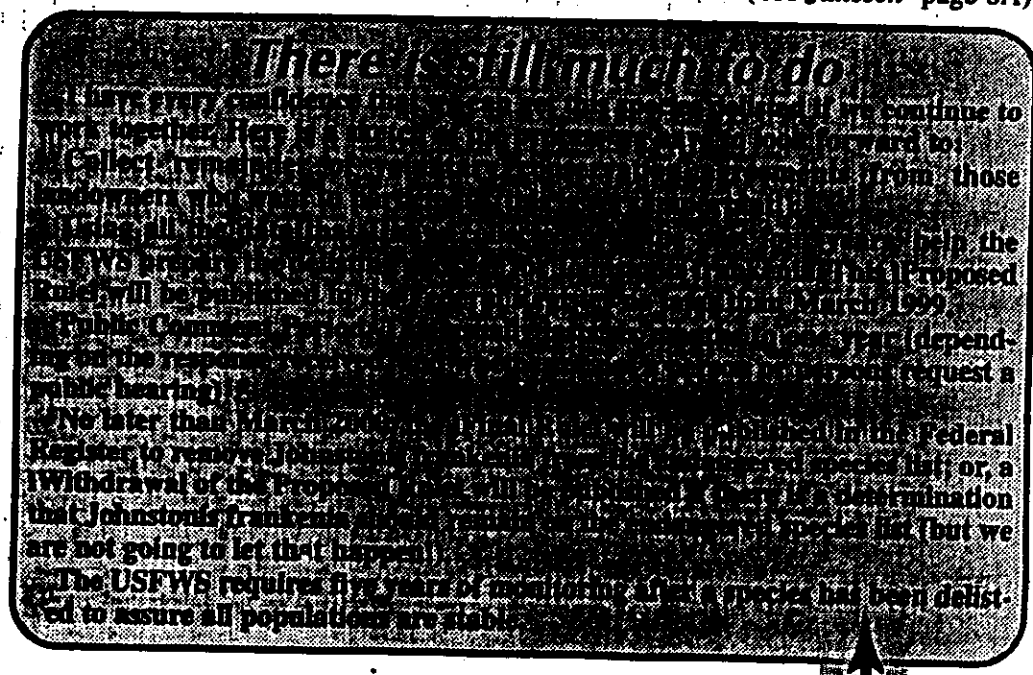
I recently called Steve Spangle, who i the USFWS Listing Coordinator fo Region 2, to make sure that all the news that I had received from Albuquerque was official. Steve assured me that we were ready to proceed with the preparation of the delisting package.

lAs a matter of fact,l he said, lif you could help us get the delisting package ready even sooner, it would be a great

(See *Janssen* page 8A)



Fraqnkenia is a spineless, blueish-green, salt loving subshrub. It will lower after rainfall in any season.



Janssen Continued from 1A

help because this is a success story that we need to shout from the roof tops!

I did not even petition the USFWS to delist this species (although I was planning to). They came out with this recommendation based solely on my annual progress reports. "But remember," Steve added, "this delisting is still simply a recommendation. Nothing is final until it is signed by the Director of the USFWS in Washington."

How have we come so far?

Johnston's frankenia was listed as an endangered species in 1984. At the time of its listing, it was known in only five localities: two each in Zapata and Starr Counties; and one in Nuevo Leon, Mexico.

Back in the early '90s the former Zapata County District Conservationist and the members of the Zapata County Soil and Water Board wanted someone to come to Zapata and help them take another look at this "so called" endangered species. They said it was everywhere in Zapata County, and, maybe, they said, the species did not need to be listed at all.

"Where are they?" I asked. No one would say. "But how can I delist this species if I cannot verify that there is actually a bunch more out there?" Silence. Tough crowd. Basically the message I got was: That 's your job, we're just here to let you know that there is a lot of that stuff out there.

So, off I went on one of the greatest Easter egg hunts of all time, and everyone knew where all the eggs were but me.

It took me a while before I actually gained access to the first ranch. But, one ranch turned into two, two turned into three, and so on. Some days were easier than others.

Most landowners were kind and inquisitive, cautious but gracious. Over and over again I would explain how the law was different for plants and how I was trying to take this species off of the endangered species list, if they would just help me out a little.

And do you know what? Over and over again the gates opened up; and over and over again the landowners would tell me not to worry, that they really cared deeply about the ranch and that they would take care of their little endangered plants. Those days would put me on top of the world.

But then there were other days.

I'll be honest – there were some days, some weeks, where I just wanted to call the whole thing off. I would be on the receiving end if a good tongue lashing at about 1,000 decibels that would send me into a tail-spin. There were a few times I was actually brought to honest-to-goodness tears.

I never gave up because I truly believed that if we worked together we could make this happen. I also had something else that was even more important: the constant, unending, positive support from the former NRCS DC and members of the Soil and Water Conservation Board of Zapata County. Whenever I felt ready to give up, all I had to do was walk into the local NRCS office. The folks there would always pick me up, put me back on my horse, and send me back out there to face the next day with a recaptured spirit and positive attitude.

Four years and 45 thriving Texas populations later, we now know that this species extends up into Webb County and into Tamaulipas, Mexico. The majority, however, approximately 80% of those, are in Zapata County.

That is why the commitment of many of the Zapata County ranchers is so important – they have most of them. Johnston's frankenia is by no means prolific; but, it is certainly more abundant than the earliest data revealed. More important than that, however, is that the landowners of Zapata County are conserving this species for the future – voluntarily.

I hope, more than anything in the world, that people will begin to look at the endangered species on their ranches as the treasures that they truly are. These simple gifts from Mother Nature are among the rarest jewels in the world, and some of you are lucky enough to have them!

Not only that, but conserving these endangered species is so easy. All it takes is just a little awareness, a little careful thought. That is part of the beauty of these voluntary conservation agreements – the private landowners of Zapata County are not agreeing to do anything that they were not doing already! And for that, they are making history. What a story! If Oprah didn't put Zapata on the map, this certainly will!

An open invitation

Although we are 9/10ths of the way there, I do not want to jump the gun. The last thing we want is for this delisting package not to make it to the final signature. We need to have good, solid data that will withstand the litany of reviews the delisting package will face, and I believe we have it. I would, however, like to invite anyone who is not yet involved with this project and has this endangered species their ranch to join us in this cooperative, positive success story. It is not too late. I will be collecting more data and conservation agreements until September.

I would also like to invite any of the local corporations that are interested to become involved. I am willing to provide on-the-ground field days and endangered plant identification training for any local gas, pipeline, or seismic companies that would like to become involved in a more proactive approach. Again, this would be completely voluntary. You all have a lot of potential to make a great contribution to conservation (like I said, it just takes a little awareness and a little careful thought) while conducting business as usual, and I encourage you to give this opportunity some consideration.

What about recognition?

Currently the TPWD media department is working on an official press release for the state of Texas. This will be out soon.

Additionally, all the private landowners (and any corporations that would like to participate) will be recognized by the Texas Parks and Wildlife Department for their commitment and contributions to conservation. Although this new recognition program for private landowners who voluntarily conserve their endangered species is not yet official, I am working hard on pushing it through and acquiring needed funds. I will let you all know when we are ready to announce the start of this new program.

A community like no other

I feel very privileged and very blessed. I have met some of the most wonderful people and seen some of the most beautiful country. To see the peyote blooming beneath the guajillo while the coyotes sing in the distance will simply take your breath away.

Even though I was always an outsider, I always felt at home in Zapata. The community of Zapata County is so welcoming. I have never experienced a community with so many caring people and such warm hearts. I just want to take this opportunity to tell all of you how much I have appreciated your help, your support, your guidance, your trust, and most of all, your patience.

LareDOS
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Landowners help remove plant from endangered list

ZAPATA – For the first time in the history of the federal Endangered Species Act, active cooperation and conservation by private landowners has been solely responsible for a recommendation to remove a Texas species from the federal endangered species list.

A group of private ranchers in Zapata County has voluntarily signed conservation agreements to protect the rare Johnsten's *frankenia*, a one-foot tall shrub with flowers that have white petals around a yellow center. At the time of its listing in 1984, only five populations or local groups of the plant were known, all in South Texas. Since then, through the help of ranchers, many more have been discovered.

The U. S. Fish and Wildlife Service (USFWS) regional office in Albuquerque, New Mexico, has recommended that Johnsten's *frankenia* be taken off of the endangered species list. According to a recent memo from the Albuquerque regional director to field supervisors in Texas, the delisting package for Johnsten's *frankenia* should be submitted no later than March 1999.

"The reasons for this success story can be summed up in two words: cooperation and conservation," said Oena Janssen, a Texas Parks and Wildlife Department (TPWD) biologist. "The private landowners of Zapata County have cooperated with us by graciously opening their gates and allowing access to survey for this endangered species. This led to the discovery of at least 45 confirmed populations of Johnsten's frankenia – all but one on private property."

Jansen and the ranchers realized that simply finding a few more populations will not assure that a rare plant gets delisted. So, many Zapata County landowners went a step further by committing to conserve this species on their ranches through voluntary conservation agreements with TPWD.

"It is these voluntary conservation agreements, representing the commitment of the landowners of Zapata County to the voluntary conservation of this species, that has led to the recommended delisting," explained Janssen.

Unlike endangered animals, endangered plants are not heavily protected on private land under the federal Endangered Species Act. Essentially, if a landowner is not using federal money or operating under a federal permit (which is 99% of the time), it is legal to remove endangered plants on their property.

"Given these facts, we knew that it would be difficult to impossible to delist this species because the U.S. Fish and Wildlife Service would consider all these private land sites 'unprotected," continued Janssen, "unless we could prove to the USFWS that the landowners of Zapata County are taking care of these endangered species voluntarily."

Steve Spangle, USFWS Listing Coordinator for Region 2 (including Texas), recently assured Janssen that all is ready to proceed with the preparation of the delisting package. She notes that while Spangle and others think it is likely to occur, the Johnston's frankenia delisting is still a recommendation, and nothing is final until it is signed by the Director of the USFWS in Washington.

"Although we are nine-tenths of the way there, we must have good solid data that will withstand the litany of reviews the delisting package will face, and I believe we have it," Janssen said. "However, I would like to invite anyone who is not yet involved with this project to join us. I will be collecting more data and conservation agreements until September. I am willing to provide on-the-ground field days and endangered plant identification training for any landowners, including local gas, pipeline, or seismic companies. Again, this would be completely voluntary conservation that most landowners can easily do in the course of their normal business routine."

When Johnsten's frankenia was listed as an endangered species in 1984, it was known from only five localities – two in Zapata County, two in Starr County, and one in Nuevo Leon, Mexico.

Then, in the early 90s, the former Zapata County District Conservationist and members of the Zapata County Soil and Water Board wanted someone to come to Zapata and help them take another look at this 'so-called' endangered species. They said it was everywhere in Zapata County, and maybe, they said, the species did not need to be listed at all.

Starting in May of 1995, Janssen began meeting with landowners, many of whom eventually decided to pursue voluntary conservation agreements. But it took time, patience, and persistence.

"'Where are they?' I asked," said Janssen. 'No one would say. 'But how can I delist this species if I cannot verify that there is actually a bunch more out there?' Silence. Tough crowd. Basically the message I got was: 'That's your job, we're just here to let you know that there is a lot of that stuff out there.' So off I went on one of the greatest Easter egg hunts of all time, and everyone knew where all the eggs were but me."

Janssen says it took a while before she actually gained access to the first ranch. But one ranch turned into two, and two turned into three, and so on. Some days were easier than others. Most landowners were kind and inquisitive, cautious but gracious. Over and over again she would explain how the law was different for plants and how she was trying to take this species off of the endangered species list if they would just help out a little.

Over time, as trust and understanding grew, the gates opened up. Landowners would tell her not to worry, that they cared deeply about the ranch and that they would take care of their endangered plants. Those days were gratifying for Janssen. But then there were other days....

"I'll be honest–there were some days, some weeks, where I just wanted to call the whole thing off," Janssen said. "I would get a good tongue lashing at about 1,000 decibels that would send me into a tailspin. There were a few times I was actually brought to honest-to-goodness tears. But, I never gave up because I truly believed that if we worked together we could make this happen."

Four years and 45 thriving Texas populations later, scientists now know that the species extends up into Webb County and into Tamaulipas, Mexico. The majority, however, approximately 80% of those, are in Zapata County. That is why the commitment of many of the Zapata County ranchers is so important – they have most of them.

"I hope that people will begin to look at the endangered species on their ranches as the treasures they truly are," Janssen said. "These simple gifts from Mother Nature are among the rarest jewels in the world, and some of us are lucky enough to have them! Not only that, but conserving these endangered species is so easy. All it takes is just a little awareness, a little careful thought."

Janssen says the beauty of these voluntary conservation agreements is that the private landowners of Zapata County are not agreeing to do anything that they were not doing already. And for that, they are making history.