Section 6 Report Review

Attachment to letter dated September 11, 2001

Project: *Rare Plants, Birds, and Mammals in the Trans-Pecos Ecoregion of Western Texas*

Final or interim report? Final

Job #: WER39(86)

Reviewer's Station: Austin Fish and Wildlife Service Office

Lead station was contacted and concurs with the following comments:
___ Yes ___ No __X__ Not applicable (reviewer is from lead station)

Report: ____ is acceptable as is

_____ is acceptable as is for an interim report, but the following comments are made for future reference

__X__ needs revision (listed below)

Comments: (Note to commenter: If you make comments directly on a copy of the report, write legibly and dark so comments will reproduce well when photocopied.)

1) Plant sections - The efforts by the author are appreciated and certainly provide initial data for reviewing the status of the plant species mentioned in the report. However, we have some serious concerns regarding this report as outlined in the following comments. Overall, we find the survey work for the plants inconclusive.

The Service relies heavily on species information from outside sources such as Section 6 reports, status surveys, and other contracts, to help make delisting (or listing) determinations. However, we prefer reports such as this one to only present the species facts and science in an unbiased manner, rather than recommend a change in a species' legal status. There are many factors involved in a delisting (or listing) decision. For example, how many of the species' populations are viable, have the recovery goals (not just recovery tasks) been met, and have the threats been taken away? Rarely are all of the factors addressed in one study.

Even if a Section 6 report was the proper mechanism to suggest listing or delisting a species, we could not make a delisting decision based on the information provided in this report

because the plant information is inadequate. However, the Service would be happy to sit down and discuss in a meeting what information gaps exist for a species, and what specific issues related to delisting need to be addressed.

1A) For **Terlingua Creek cat's-eye**, there is only one year of survey work. This is obviously not enough data for any projected trend in the population and we are glad the author made no attempt to do so. In addition, (Moon 1952), (USFWS 1991), and (Poole 1994) were cited but not listed in 'literature cited'. Throughout the report, this seems to be a problem. Before suggesting seed collection and ultimately reintroduction, genetic studies should be conducted to minimize native genetic contamination within the extant populations. Finally, on p. 4, under Conservation and Management Recommendations, the Chihuahuan Desert Research Institute (CDRI) is located in Ft. Davis, not Alpine, Texas.

2A) For **Nellie cory cactus**, (Backeberg 1961), (Weniger 1970), (Benson 1970), and (Heil 1984) are all cited but not listed in 'literature cited'. In addition, the conclusion that the recovery plan estimate of distribution included only manipulated rights-of-way of highways is incorrect.

The statement that the plants are very abundant appears insupportable from the amount of habitat area identified and the small number of sites that were reported to be visited, particularly in light of the statement that populations are clumped. While they may be abundant in some spots they are not uniformly present across the appropriate habitat type. Botanists are unsure at present why the plants appear in such limited sites. This may be due to some habitat parameter that has not yet been recognized in microhabitats within the broader areas where the Caballos- Novaculite formation is exposed at the surface (which is a smaller subset of the total area of the formation).

Unless a methodical, comprehensive, range-wide status assessment has been performed, it is potentially misleading to refer to the plants as very abundant based on the profile of one or a few sites, rather than a range-wide analysis. One survey plot is insufficient to support analysis of the status of the species in general, and significantly more monitoring plots across the range are needed before the range-wide status of the species can be evaluated. Longer term monitoring may be necessary since the recruitment of new cacti individuals is very moisture sensitive, and survivorship to 5

years of age is often limited by periodic drought. For a range-wide status survey of a species like this, longer term monitoring over a wider area is important, since one significant threat is legal and illegal collection, which is episodic in nature but often devastating to a population when it occurs.

It is unclear from the report whether the monitoring plot established encompasses the entire population at the site. In one part of the report it says one ridge was selected and one plot was established. In other places the report refers to study "plots". This needs to be clarified. However, we caution against unquantitative assessment of population health without examining plant demographics over time. While 879 total plants may seem like a lot, in fact a population containing 879 fully reproductive adults may be only marginally viable for a relatively short lived, small, obligate out-crossing species living in a stressful habitat, such as the cacti. This is particularly true if the plants are slow to come to reproductive maturity, or if the successful establishment of new individuals who survive to reproductive maturity is limited, as it frequently is for cacti. Longer term population monitoring, evaluated quantitatively, that encompasses the time interval for seedlings to reach reproductive maturity is needed. If the study plot encompasses most of the population, the population's initial numbers do not appear to reach a level for a comfortably vigorous population, and the increase in size due to a good season for seedlings may be tempered by higher mortality in years to come. It would be helpful to have the additional information about size classes and reproduction that should be in the raw data collected, included. All of this data should be incorporated in the next revision of this final report.

Also we note that the author states that "area-wide" surveys were conducted to determine the presence/absence of Nellie Cory Cactus on ranches scattered throughout the area, but does not enumerate the results of that survey. All of this information about numbers and localities of areas searched where populations were found, number and localities of areas searched where the cactus was not found, approximate population sizes and evidence of current or past collection at the sites should be included in the next revision of this final report.

The Service finds it inappropriate to conclude, based on one plot and so few years of monitoring, that all recovery criteria are being met, particularly when no comprehensive data is being collected about the identified threats. The Service strongly disagrees that sufficient information has been developed to conclude that the

species is very abundant, protected, and should be delisted. Further, the report appears to be confusing recovery plan tasks with recovery criteria. The recovery plan for this species is in need of revision. Today we have a much better understanding of plant conservation biology than was known in the field at the time the plan was written. The recovery criteria for most of the listed cacti species in Texas are in need of revision. It is the Service's intention to update these criteria, but higher priority conservation actions have forced a delay.

Based on what we have seen in this current report on the methods used and the data collected and presented, we could not adequately document the condition of the species sufficiently to proceed with a delisting of the species. Many statements in the report are unsupported by data, or have insufficient or inappropriate data. Conjecture on the status of the species throughout the range based on a rough habitat estimate is inappropriate. If additional documentation of a quantitative range-wide status assessment is available, we look forward to reviewing this in the next revision of this the final report.

It also appears to be largely conjecture that collection is not a threat, and this must be more thoroughly and reliably demonstrated. The statement that there are no perceived natural threats to the species is also conjectural based on short term, largely qualitative observation. This is not sufficient evidence. The case of Tobusch fishhook cactus, where the decimating impact of grubs on the cacti was only revealed through quantitative, more long-term monitoring is a good example of the need for more rigor in evaluating population condition.

A simple statement that landowners have locked gates and do not allow collection of the species does not constitute documentation that collection is not occurring. Many collectors collect illegally, and it is a problem for several Texas species. Landowners have reported the theft of these and other species from their lands and from display gardens. The plants are still illegally collected from the highway right-of-way, etc. Obviously the plants are still very desirable and people are traveling and going to some effort to obtain them. A more thorough assessment of legal and illegal trade availability, evidence of collection in the field, and anonymous surveys of cactus and succulent enthusiasts would be a more credible way of assessing the threat to the species from collection.

In addition, paragraph A.2 on page 6 states that the recovery objective "Obtain management rights for existing populations of Coryphantha minima" has been met because "Ranch owners and managers are already managing for this species by not allowing collection of plants on their property, by posting no trespassing signs, locking gates, and by making no major modifications in habitats." While the Service appreciates the good stewardship of most private landowners, we need to have a more formalized, documentable commitment (i.e. a Memorandum of Agreement) from landowners before we can consider this recovery criteria met. We would be happy to work with the landowners and the author to get signed Memoranda of Agreement completed.

3A) For **Davis' green pitaya**, there is a picture of Lloyd's Mariposa cactus where a picture of Davis' green pitaya should be. There are also questions as to the spelling of authors' names: is it "Brock" or "Bock" 1941, on pp. 1 & 8 and "Backeberg" or "Backberg" 1960, on pp. 1 & 8?

In many ways this report is identical to the Nellie Cory cactus discussion with regard to range, habitat and population condition, and threats. The same comments on these issues outlined above apply to the Davis' green pitaya section of this report.

Once again it is unclear from the report if this is a full population assessment or a single subplot of a larger population. However, based on the data presented, the author should be aware that this population monitoring data presented, if it encompasses most of the population on the site, definitely would NOT be considered a viable population for a plant, using almost any "rule of thumb" assessment of the number of mature, fully reproductive individuals needed in a population of perennials. If these are population numbers, or near population numbers, this population does not appear viable. The Service disagrees that the species has been demonstrated to be in good enough condition to initiate a delisting action.

4A) For **Lloyd's Mariposa cactus**, Anderson and Schmalzel did some status survey work primarily in Big Bend National Park. At that time, they also recommended delisting (Jackie Poole, TPWD, pers. comm., August 27, 2001). However, Ms. Poole mentioned that none of the plant species in the Anderson and Schmalzel report had enough monitoring data to support a delisting. Both the Service's and the Texas Parks and Wildlife's botanists agree that there is inadequate monitoring data to

support a conclusion to delist the Lloyd's Mariposa cactus. Overall population trends of this cactus have not been shown to be decreasing or increasing.

The author also concludes that collecting pressure has decreased for this species, based upon monitoring data collected from study plots that were placed away from areas where collectors had easy access. Therefore, before drawing the conclusion that collection has subsided, additional series of survey plots starting at, and extending away from, the highway should be monitored.

Additionally, the author includes data that show that over a period of 3 years in two survey plots, there was a decrease in the number of individuals in Plot 1 and an increase in numbers at Plot 2. Tables and graphs containing data for the number of dead plants, number of flowering plants, and total number of plants (alive and dead) for each plot should be included in the next revision of this report. This will allow for the tracking of both mortality and recruitment. In addition, clarification is needed on how the author defines "juvenile". Is it a plant that is only vegetative and not flowering? How are juveniles distinguished from an infertile specimen?

We are impressed with the landowners' willingness to participate with coordinating agencies in these studies and be a partner in management of the above mentioned plant species. This will enhance all of our efforts to sustain these rare plant species.

We would also appreciate the inclusion of the raw data that this report is based upon when the next revision is submitted. It is difficult to evaluate the quality of the data collected when it is only provided in summary form. Again, were this report to contain sufficient information to suggest delisting some of the species, it would not withstand the peer review and external scrutiny that the Service often faces when we propose a listing or delisting decision, without the raw data.

2) For the section on rare birds, please include: a) An explanation for why the two dead peregrine falcons found in 1987 and 1988 near Eyrie #99 were not sent to the lab for necropsy or analysis if environmental contaminants were a potential concern; and, b)A map of general eyrie locations with perhaps an overlay of adjacent mine sites for reference and correlation with lab results.

In addition, while we don't disagree that there is reason to be concerned about the American

Peregrine Falcon in the Big Bend region, the Service considered the status of the Rocky Mountain/Southwest population in making a delisting decision and determined that while not all recovery objectives were met in all states, the level of reproduction was sufficient to support considerable population growth. Specifically for Texas, we recognized that while Texas exceeded their goals for number of pairs, current productivity is below the goal of 1.25 yg/pr and below their long term productivity averages by 44%. However, the average for all states in this region met or exceeded the recovery goals outlined (64 FR 46542).

3) For the section on rare mammals, where is it? The title of this study is *Rare Plants, Birds and Mammals in the Trans-Pecos Ecoregion of Western Texas*, yet this final report does not contain a section on rare mammals, nor does it provide an explanation for why they were dropped from the study if this is what happened.

4) For all of the species included in this report, specific geographic location information on where the data were collected should be included. These data were collected using Federal funds and therefore should be disclosed in the next revision of this report. The Service has discussed this requirement with Texas Parks and Wildlife staff several times in the past. Although we understand that not all landowners may be willing to share this information, if work is conducted using Federal funds then they need to be aware of the disclosure requirement.

5) Until all of these concerns are addressed, the Service can not accept this as a final report for this Section 6 project.

FINAL REPORT

As Required By

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. E-1-12

Endangered and Threatened Species Conservation

Project Number WER39 (86): Rare Plants, Birds, Mammals in the Trans-Pecos Ecoregion of Western Texas

Prepared By:
Bonnie Reynolds McKinney

TEXAS
PARKS &
WILDLIFE

Andrew Sansom
Executive Director

John Herron
Program Director, Wildlife Diversity

Gary Graham
Division Director, Wildlife

November 30, 2000

FINAL REPORT

STATE: Texas **GRANT NUMBER:** E-1-12

GRANT TITLE: Endangered and Threatened Species Conservation

REPORTING PERIOD: September 1, 1998 through August 31, 2000

PROJECT NUMBER: WER39 (86)

PROJECT TITLE: Rare Plants, Birds, Mammals in the Trans-Pecos Ecoregion of Western Texas.

OBJECTIVE: To develop a management and conservation strategy that covers the six species of concern, providing guidelines should more habitat be converted to non-conservation uses.

Prepared by: Bonnie Reynolds McKinney **Date:** November 1, 2000

Approved by: Federal Aid Coordinator **Date:** July 16, 2001

SURVEY, MONITOR AND MANAGE SELECTED ENDANGERED, THREATENED AND RARE PLANTS, BIRDS AND MAMMALS IN THE TRANS-PECOS ECOREGION OF WESTERN TEXAS

Bonnie R. McKinney, Texas Parks and Wildlife

The major objective of this research was to determine the current status of several state and federally listed species found in the Trans-Pecos area of western Texas. Species include 3 cacti; Lloyd's mariposa (*Neolloydia mariposensis*), Davis' green pitaya (*Echinocereus virdiflorus var. davisii*), and Nellie Cory cactus (*Coryphantha minima*); one endemic plant, Terlingua Creek cat's eye (*Cryptantha crassipes*), and two bird species, the black-capped vireo (*Vireo atricapillus*), and American peregrine falcon (*Falco peregrinus anatum*).

The United States Fish and Wildlife Service (USFWS) listed Lloyd's mariposa cactus as a threatened species on November 6, 1979. This species is known from the lower Big Bend Region of western Texas and from several localities in Coahuila and Nuevo Leon, Mexico. The focus of this study was to determine distribution, search for new populations, identify threats and monitor the population. Study results indicate that this species has a very wide distribution in western Texas and northern Mexíco. New populations were discovered, and study plots established and monitored for three years. There is no evidence of collecting, and livestock trampling is not a threat. The largest populations occur on state and federal lands. Management recommendations included starting the formal delisting process for this species.

Davis green pitaya and Nellie cory cactus were both listed as endangered by the USFWS on November 7, 1970. These miniature cactus are endemic to the Novaculite grasslands found in the Marathon basin of western Texas. Landowner permission was obtained to survey and establish study plots. Extensive surveys revealed large populations of both species, and recovery criteria set forth in the Recovery Plans (USFWS) are being met. Recommendations include starting the formal delisting process for both species.

Terlingua Creek cat's-eye was federally listed on September 30, 1991. This endemic plant is known from a small area in Brewster County, Texas. All known populations are located on private lands. The biggest threat to this species continued habitat destruction by trespass vehicles, mining and sport vehicle recreation. Conservation and management recommendations include; (1) collection of seeds for propagation, (2) searching for sites with similar geologic features as possible reintroduction sites and (3) continued monitoring.

The black-capped vireo in western Texas is considered an edge of a much larger population occurring in adjacent northern Mexico. Two small populations in western Texas have been monitored since 1985. Total population size averages fifty individuals; one population is located in Big Bend National Park and the other on Texas Parks and Wildlife's Black Gap Wildlife Management Area. Recommendations include continued monitoring and surveys in northern Mexico to determine distribution.

The American Peregrine falcon was formally delisted by the USFWS in August 1999. The small geographically isolated population in western Texas continues to suffer erratic reproductive rates, poor recruitment, and high mortality of young. Continued monitoring and further studies in contaminants are high priorities in the conservation of this species.

Surveying, Monitoring, and Managing Select
Endangered/Threatened Species
Of Concern in the Trans-Pecos Ecoregion
of Western Texas

Attachment A. Status of the Peregrine Falcon in Western Texas and Adjacent Northern Mexico, Final Report.

Attachment B. Final report: The Black-capped Vireo (Vireo atricapillus) at Black Gap Wildlife Management Area, western Texas and in northern Coahuila, Mexico.

Attachment C. Final Report: Terlingua Creek Cat's-Eye (Cryptantha crassipes).

Attachment D. Final Report: Nellie Cory Cactus (Coryphantha minima).

Attachment E. Final Report: Davis' Green Pitaya Cactus (Echinocereus virdiflorus var. davisii).

Attachment F. Final Report: Lloyd's Mariposa Cactus (Neolloydia mariposensis).

Attachment A:

Final Report: Status of the Peregrine Falcon in Western Texas and Adjacent Northern Mexico.

STATUS OF THE PEREGRINE FALCON IN WESTERN TEXAS AND ADJACENT NORTHERN MEXICO

Prepared by
Bonnie Reynolds McKinney
Texas Parks and Wildlife Department

INTRODUCTION

The American peregrine falcon (*Falco peregrinus anatum)* was listed as endangered by the United States Fish and Wildlife Service (USFWS) in the Federal Register on October 13, 1970; and was officially delisted on August 20, 1999, with the delisting notice appearing in the Federal Register on August 25, 1999 (USFWS Federal Register October 13, 1970 and Endangered Species Act, 1973).

In the draft addendum to the "Recovery Plan," the USFWS recommended delisting the southwestern region (including Texas and northern Mexico) peregrine falcons, because recovery goals were being met (USFWS 1993). Recovery objectives of 1.25 young fledged per occupied site are required to meet recovery criteria. The small population of peregrine falcons breeding in Texas in the Trans-Pecos, and along the Rio Grande corridor (RGC) (Appendix A.), which forms a boundary with northern Mexico, have experienced erratic reproduction for 26 years (Table 1.).

Over this 26 year period from 2 to 18 breeding areas (BA's) have been monitored yearly. The production of young fluctuated widely, and only in 9 of the 26 years did production reach or exceed the 1.25 young fledged per occupied site as deemed necessary for stabilization of a population. A total of 178 young have been observed during this time period, with 163 young actually fledging.

The monitoring has been a cooperative effort between Texas Parks and Wildlife (TPW), Big Bend National Park (BBNP), and Secretaria de Medio Ambiente Recursos y Naturales (SEMARNAT) in Mexico City. This represents a very unique partnership among state, federal and foreign agencies, as well as private landowners in two countries working together on an endangered species project. This effort by all parties clearly indicates the concern over the health of this small peregrine falcon population.

Table 1. Historic reproduction of peregrine falcons in western Texas and northern Mexico.

Year	#Active BA's	Total # Young Observed	Total # Young Fledged	Av. # Young Per. Ad. Pr.
1975	2	0	0	0.00
1976	3	2	2	0.66
1977	3	5	5	1.66
1978	3	7	7	2.33
1979	4	5	5	1.25
1980	4	4	4	1.00
1981	N/D	---	---	-----
1982	5	7	7	1.40
1983	5	1	1	0.20
1984	6	3	3	0.50
1985	6	10	10	1.66
1986	8	10	10	1.25
1987	7	8	7	1.00
1988	6	7	7	1.16
1989	8	9	9	1.12
1990	11	9	9	0.81
1991	12	15	15	1.25
1992	11	9	9	0.81
1993	12	6	6	0.50
1994	14	7	5	0.36
1995	15	5	2	0.13
1996	14	6	6	0.42
1997	12	17	17	1.41
1998	11	7	2	0.18
1999	10	7	3	0.42
2000	18	12	12	0.66
	TOTALS	178	163	

N/D= No data

OBJECTIVES

The objectives of the research closely follow the criteria set forth in the "Addendum to the Recovery Plan," (USFWS 1984, 1993). This includes:

1. Survey potential habitat.
2. Survey wintering habitat.
3. Monitor productivity.
4. Analyze environmental contaminants, eggshells, feathers, prey species.
5. Protect breeding and winter habitat.
6. Research population dynamics.

METHODS

The principal investigator has monitored this population of peregrine falcons since 1985. The National Park Service (NPS) at Big Bend National Park (BBNP) also monitors, and all data is shared to provide continuity. The survey protocol to collect data is the same used by other southwestern states, and by the principal investigator since 1985. Survey protocol (described below) is modified as necessary to fit the unique canyons system within the Trans-Pecos and adjacent northern Mexico. Continuity and a definite protocol in monitoring techniques have to be used to obtain data that is biologically sound, and thus can be used to interpret behavior, and problems, which may be encountered in monitoring. This data when consistently collected does provide a baseline for developing, or continuing trends within the population being studied.

Surveys

Aerial survey's of potential habitat were conducted along the RGC from Lajitas, Texas eastward through BBNP, the Black Gap Wildlife Management Area (BGWMA), the lower canyons of the Rio Grande Wild and Scenic River (RGWSR), and south in the Sierra Del Carmen and Maderas Del Carmen in northern Coahuila, Mexico; then westward into the Sierra De Santa Elena, and Sierra Rica in Chihuahua, Mexico in 1994, 1997, 1999 and 2000. All known breeding areas (BA's) were marked on USGS topographic maps, Federal Aviation maps were used for several areas in Mexico. Methods used for the aerial survey included low level, slow flight, and circling in a Cessna 206 (TPW). Potential sites, and known BA's were checked for whitewash, perched or flying birds, and all information recorded in a field notebook. General locations for all known BA's in the Trans-Pecos area, and adjacent northern Mexico are located in Table 2.

Table 2. Peregrine falcon breeding areas (BA's) in Trans-Pecos, Texas and adjacent northern Mexico, 2000.

Eyrie/BA#	Name	Location
88	South Rim	Chisos Mountains, BBNP
29 (**33b)	Crown Mountain	Chisos Mountains, BBNP
46 (***111b)	Toll Mountain	Chisos Mountains, BBNP
99	Rockslide	RGC, Texas and Chihuahua, Mexico
44	Santa Elena	RGC, Private land, Chihuahua, Mexico
28	Fern Canyon	RGC, Private land, Chihuahua, Mexico
11	Mariscal Canyon	RGC, Private land, Coahuila, Mexico
12	Lower Mariscal Canyon	RGC, Private land, Coahuila, Mexico
11B	Upper Mariscal Canyon	RGC, BBNP, Texas & Coahuila, Mexico
66	Boquillas Canyon	RGC, Private land, Coahuila, Mexico
69	Lower Boquillas	RGC, BBNP, Texas
89	Marufa Vega	RGC, BBNP, Texas
19	Bonnie's	RGC, BGWMA, State of Texas
45	Maravillas	BGWMA, State of Texas
55	John's	RGC, Private land, Tx., & Coahuila, Mexico
79	Roy's Crater	RGC, Private land, Texas
59	Bullis Fold	RGC, Private land, Coahuila, Mexico
40=	Juan's Bota	RGC, Private land, Texas
30=	Panther	RGC, Private land, Coahuila, Mexico
33	Lost Mine	Chisos Mountains, BBNP
111	Casa Grande	Chisos Mountains, BBNP
86	Nugent Mountain	Chisos Mountains, BBNP
13	Vernon Bailey Peak	Chisos Mountains, BBNP
398	Burro Bluff	RGC, Private land, Texas
222	Sierra de Santa Elena	Private land, Chihuahua, Mexico
01	Chupadero	Private, Serranias Del Burro, Coahuila, Mex
02	Las Margaritas	Private, Serranias Del Burro, Coahuila, Mex
03	Schott Tower	Private, Sierra Del Carmen, Coahuila, Mex
04	Lost Canyon	Private, Sierra Del Carmen, Coahuila, Mex
05	Madera Canyon	Private, Maderas Del Carmen, Coah., Mex

, *, =, are symbols for alternate sites.

Prey Base Surveys

Peregrine falcons hunt a very large area, and it is virtually impossible to determine the absolute amount of prey available to a pair of birds on a breeding territory. However, mile-long walking transects are helpful indicators of prey species available, and tend to show peaks or declines in numbers.

Two transects were established in BBNP in 1994. One transect was established along the RGC east of BA#44, and the second was established in pine-oak woodlands in the Chisos Mountains west of BA#111. One transect was established on the RGC on the BGWMA southwest of BA#19, and two transects were established in the Serranias del Burro in northern Coahuila, Mexico.

Prey base is considered adequate on a year-round basis in al habitats due to the extreme mobility and hunting techniques of peregrine falcons. Peaks in prey numbers occurred in mid-winter along the RGC because of the influx of waterfowl, and during spring and fall migration in all habitats. Lows in prey base numbers was apparent in late summer and early fall along the RGC. Prey numbers were lower in mid-winter in the pine-oak woodland habitats, and in the woodlands of Coahuila, Mexico because summer breeding birds had migrated from the area.

Main prey items in the diet of the peregrine in western Texas, and northern Mexico are the mourning dove (*Zenaida macroura*) and white-winged dove (*Z. asiatica*), with Mexican jay (*Aphelocoma ultramarina*), yellow-breasted chat (*Icteria virens*), blue grosbeak (*Guiraca caerula*), brown-headed cowbird (*Molothrus ater*), white-throated swift (*Aeronautes saxatalis*), cliff swallow (*Hirundo pyrrhonota*), and northern rough-winged swallow (*Stelgidopteryx serripennis*) being secondary prey items (McKinney 1985, 1986, 1987, 1988, 1989, 1992, 1993, 1994 and Enderson 1985). Duck species were taken when available (McKinney 1985, 1994). Identified prey items in the peregrine diet at BA's located in pine-oak woodland habitat in the Chisos Mountains in BBNP include northern flicker (*Colapetes auratus*), white-winged dove, mourning dove, Mexican jay, and to a lesser extent small songbirds. Resident species such as the Mexican jay and doves appear to form the major portion of the diet.

Monitoring/Surveys

Monitoring begins in January and ends in July, or when all young have fledged. Monitoring methods include observation periods of 6 to 10 hours, once or twice weekly, at varying distances from the eyrie scrape. Observations were made from a natural blind of river cane (*Arundo donax*) at eyries along the RGC, and from thickets of trees or brush at eyries in pine-oak woodland habitat. A 50-power scope and 8 x 40 binoculars were used for observations. All data was recorded in a field notebook and transferred to a standard "Eyrie Data Form (Appendix B.). Data was collected on all aspects of the breeding chronology including courtship activities, confirmation of cliff occupancy, daily routines of mated pairs, disturbances, onset of incubation through hatching, fledgling behavior, fledging dates, prey items and interpretation of behavior.

RESULTS AND DISCUSSION

Reproductive rates continue to be erratic with nest failures, failure of young to fledge, and deserted sites particularly along the RGC continue to be common occurrences. Numbers of breeding pairs have increased since 1975; however, this may be attributed to

the expansion of the survey area. When falcon survey's began in 1975 (Hunt 1975) only the three major canyons in BBNP (Santa Elena, Mariscal, and Boquillas) were surveyed. Today surveys encompass over 300 river miles, and a vast area distant from the RGC. Combining data for the 26 years falcons have been monitored, there was a decrease in pairs in 1988. The number of pairs monitored peaked in 1995 with 15 pairs on territories. In 1996 a decline was apparent, and this decline continued through the 2000 field season (Figure 1.). The total number of young observed in eyrie scrapes climbed from zero in 1975, to a high of 17 eyasses in 1997; then began a sharp decline in 1998 (Figure 2.). In 1999, only 7 young were produced from 10 pairs of adults, and very low fledging success was apparent with only 3 young fledging (Figure 3.) The 2000 field season was somewhat encouraging, a total of 18 sites were monitored, 9 sites produced 12 young (Figure 3). The total number of pairs, number young being produced, and actual number of young fledging has clearly shown a marked decline through 1999, in this already fragile population.

The 2000 field season effort by TPW and BBNP yielded a total of 18 BA's checked. Nine adult pairs were on territories, no immature birds were observed. Twelve young were observed, and 12 fledged from nine active sites. Early in the season peregrines were observed at several historic sites, however no nesting attempts were made and the birds abandoned the sites. In addition, 2 BA's were checked in the Sierra Del Carmen, one site was abandoned and one site produced and fledged one young. One new eyrie site was located in the Maderas Del Carmen (contiguous with the Sierra Del Carmen) and, this site fledged one young. Two territories remain deserted in the Serranias Del Burro in Coahuila. One site was taken over by golden eagles (Aquila chrysaetos), and a very rare pair of solitary eagles (Harpyhaliaetus solitarius) are in the general area of the second BA.

Several reports were received from the Del Rio, Texas (Val Verde County) area during breeding season. All reports were of birds hunting over Lake Amistad. Old sites were checked in the Davis Mountains and remain deserted.

Several reports were received from other areas in northern Mexico, but eyrie status is uncertain at this time. Two pairs of peregrines were reported from the Sierra Madre between Saltillo, Coahuila, and Monterrey, Nuevo Leon (D. Tobon pers. comm.). A pair of peregrines have been observed frequently in downtown Saltillo, Coahuila hunting pigeons and roosting in the cathedral (Aldegundo Garza DeLeon pers. comm.). Tables 3 and 4 provide productivity information for all known breeding areas in 2000.

Figure 1. Number of breeding areas monitored 1975-2000.

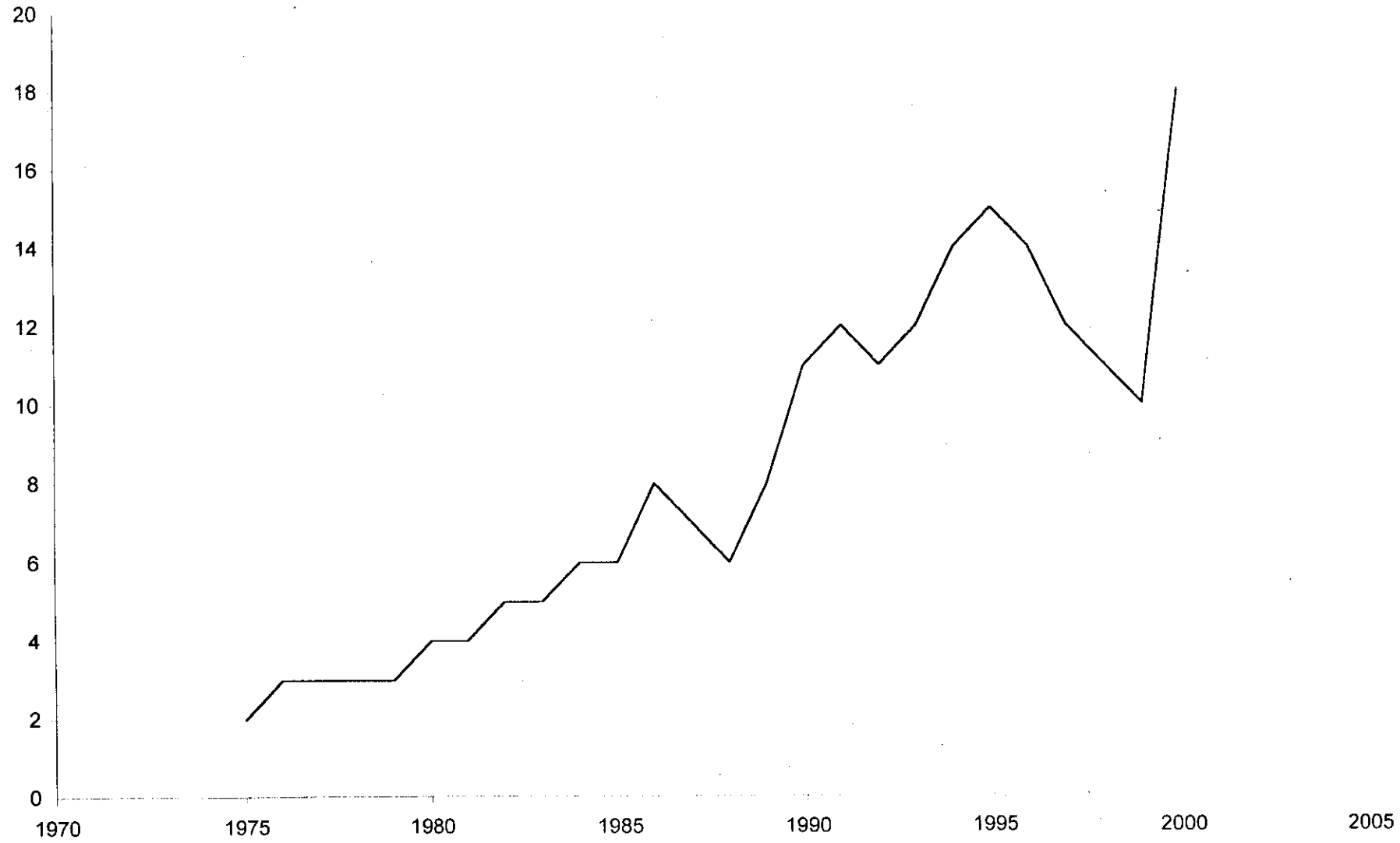


Figure 2. Number of young observed at all monitored breeding areas 1975-2000.

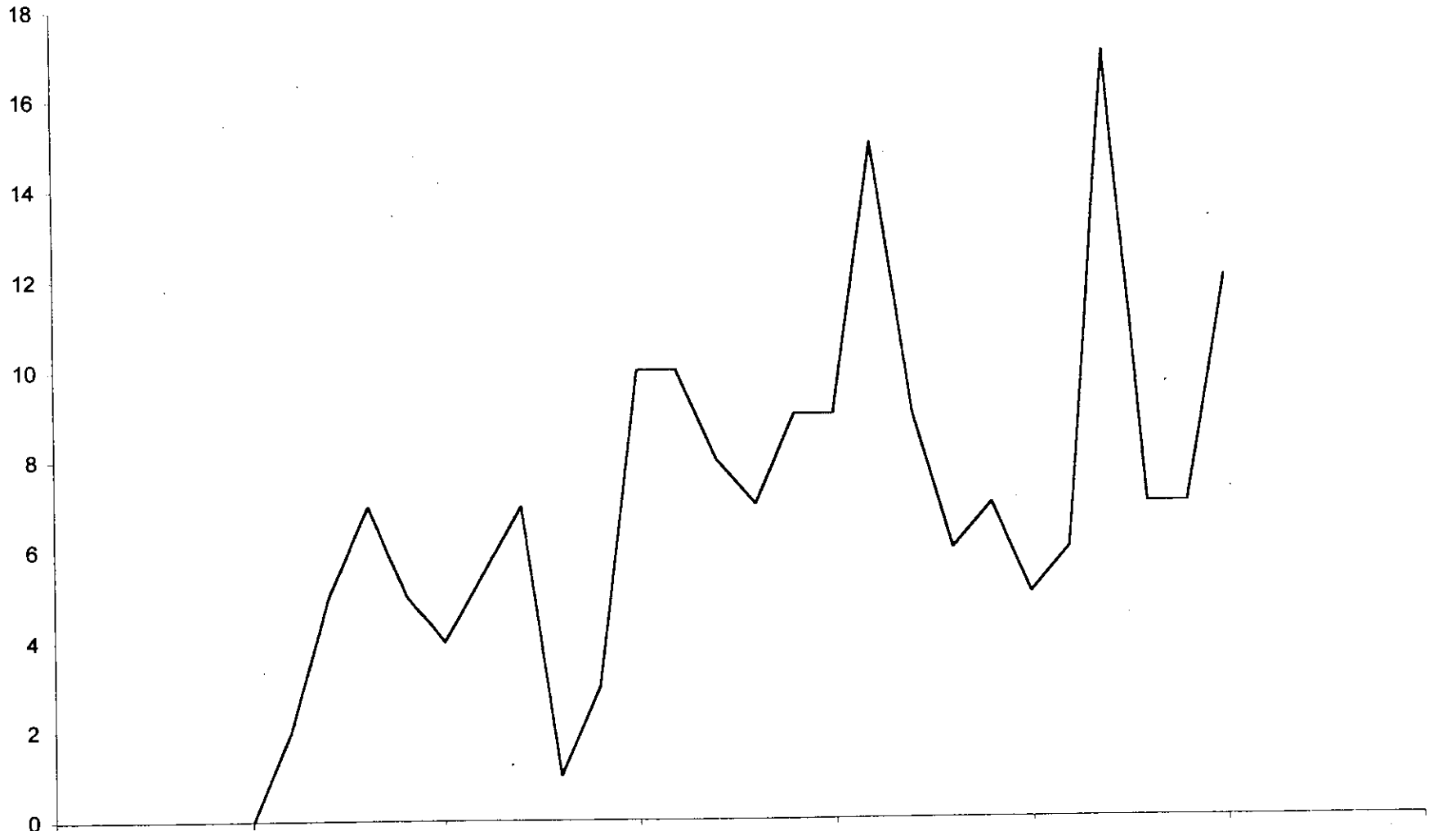


Figure 3. Actual number of fledged young observed from 1975-2000.

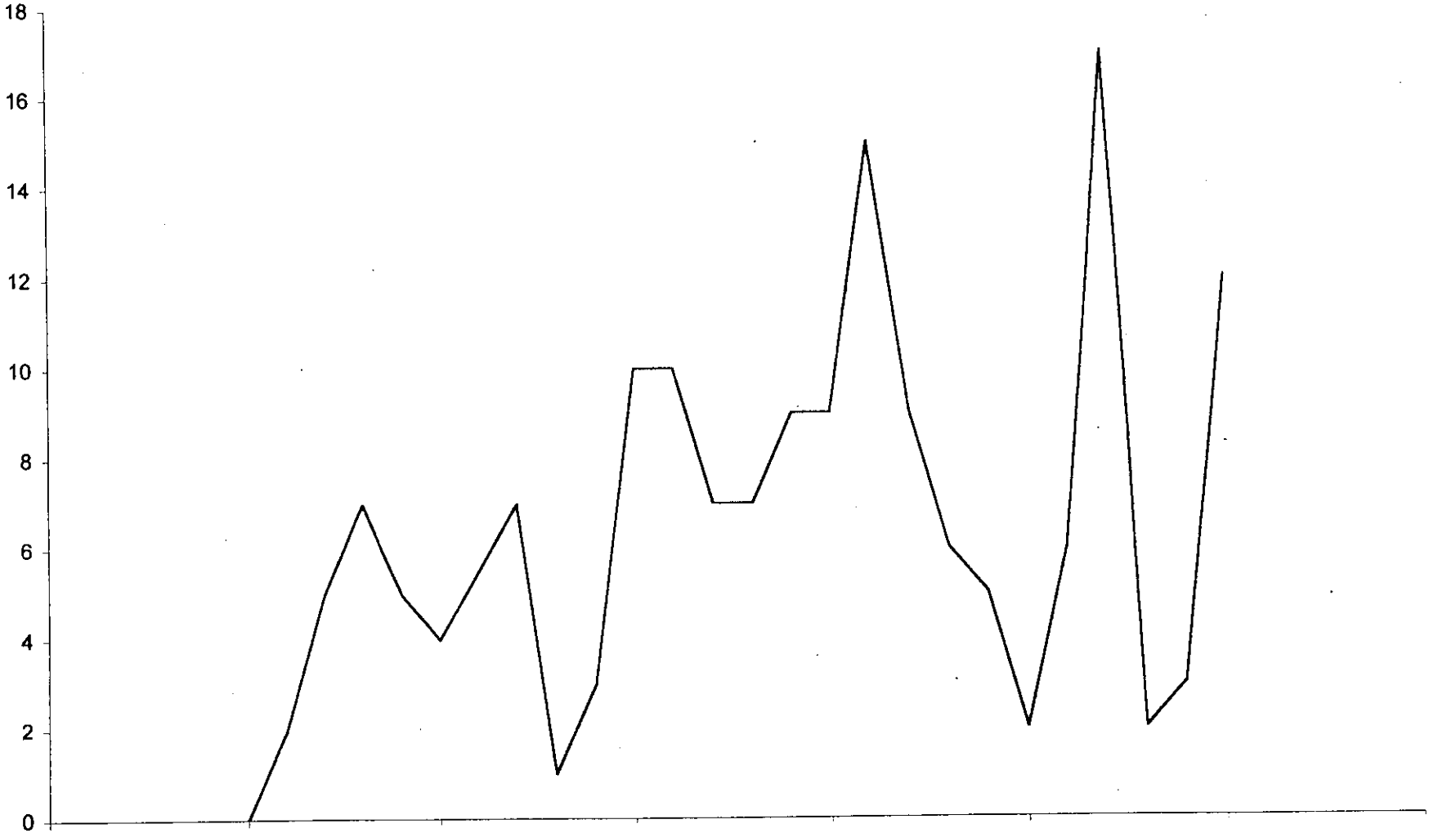


Table 3. Eyrie productivity in western Texas and along the adjacent Rio Grande corridor in northern Mexico, 2000.

BA#	Status	# Young Observed	# Young Fledged
99	AP. early	0	0
44	AP, renested	0	0
11	AP	0	0
12	AP	0	0
66	AP	0	0
45	AP	0	0
19	Deserted	--	--
55	AP	0	0
398	Deserted	--	--
30=40	AP,early	0	0
79	Deserted	--	--
33	Deserted	--	--
46	AP	2	2
111	Deserted	--	--
29	AP	1	1
59	AP	1	1
88	AP	2	2
89	Deserted	--	--
11b	AP	2	2
69	AP	0	0
86	AP	1	1
13	Deserted	--	--
398	Deserted	--	--
28	AP	1	1
	TOTALS	10	10

Table 4. Eyrie productivity in northern Mexico, 2000.

BA#	Status	#Young Observed	# Young Fledged
01	Deserted	--	--
02	Deserted	--	--
03	AP	1	1
04	Deserted	--	--
08	AP	1	1
	TOTALS	2	2

Future efforts should be concentrated on ground and aerial surveys of potential habitat in Coahuila, Nuevo Leon, and Chihuahua, Mexico. There are many remote areas containing suitable habitat. Numerous sites possess Class I. cliffs (McKinney 1985). These areas are subject to little disturbance, both prey and water are available, and they are located in areas free of contaminants. The Texas population along the Rio Grande corridor may represent an edge of a much larger peregrine population in northern Mexico. Documentation of population numbers as well as genetic work to determine if Texas birds are from a Mexican population would provide very valuable data in the management of this species in Texas.

Historical perspective

A historical perspective on reproduction at each eyrie/BA that has been monitored follows, and shows the erratic reproductive rates, and high occurrence of nest failures in this population of peregrines. The key to all tables and references for all historical data are given after the last table. Data starts with the year the eyrie/BA was located and ends with the 2000 field season.

Table 5. Reproductive history of eyrei/BA #44, 1975-2000.

Year	Eyrie Status	Total # Young Observed	Total # Young Fledged
1975	AP	NF	0
1976	AP	NF	0
1977	AP	3	3
1978	AP	3	3
1979	AP	1	1
1980	AP	NF	0
1981	ND	--	--
1982	AP	2	2
1983	AP	NF	0
1984	AP	NF	0
1985	AP	2	2
1986	AP	1	1
1987	AP	3	2
1988	AP	1	1
1989	AP	NF	0
1990	AP	NF	0
1991	AP	NF	0
1992	DESERTED	--	--
1993	DESERTED	--	--
1994	AP	NF	0
1995	AP	3 (all died)	0

1996	AP	NF	0
1997	AP	2	2
1998	AP	NF	0
1999	AP	NF	0
2000	AP	NF, (renested)	0
	TOTALS	21	17

Eyrie #44 has been occupied by an adult pair of peregrine falcons 23 out of 26 years, and has fledged a total of 17 young. Two years the site was deserted, and one year data were not obtained. A great horned owl (Bubo virginianus) took one nestling from this site in 1987 (McKinney 1987). In 1987, I observed an unmated adult female repeatedly try to enter the eyrie scrape where the resident female was incubating. The tiercel would drive the intruding falcon off. She returned daily for five days, and was driven off each time. In 1995, eyasses were observed in the scrape, and the adults were seen feeding the young. All three young died of unknown causes or were taken by predators before they fledged (R.Skiles pers. comm.). In 2000 the nest failed early in the incubation stage and the peregrines renested and the second attempt also failed. Production has been very erratic and nest failures are common at this historical peregrine eyrie in Santa Elena Canyon on the Chihuahua, Mexico side of the Rio Grande.

Table 6. Reproductive history of eyrie/BA #69, 1988-2000.

Year	Eyrie Status	Total # Young Observed	Total # Young Fledged
1988	AP	2	2
1989	DESERTED	--	--
1990	AP	NF	0
1991	AP	NF	0
1992	AP	NF	0
1993	AP	1	1
1994	AP	NF	0
1995	AP	NF	0
1996	AP	NF	0
1997	DESERTED	--	--
1998	DESERTED	--	--
1999	DESERTED	--	--
2000	DESERTED	--	--
	TOTALS	3	3

Eyrie #69 has been occupied 8 out 13 years and fledged a total of 3 young. Nest failures are common at this site, and the site has been deserted the past four years.

Table 7. Reproductive history of eyrie/BA# 99, 1985-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1985	AP	2	2
1986	AP	NF	0
1987	AP	NF	0
1988	DESERTED	--	--
1989	DESERTED	--	--
1990	DESERTED	--	--
1991	DESERTED	--	--
1992	DESERTED	--	--
1993	DESERTED	--	--
1994	AP	3	1
1995	AP	NF	0
1996	AP	NF	0
1997	AP	2	2
1998	AP	NF	0
1999	AP	2	0
2000	AP	NF	0
	TOTALS	9	6

Eyrie #99 has been monitored for 16 years. Three years the site was occupied, then deserted for six years, and reoccupied in 1994. In 1987 an adult peregrine was found dead one mile upstream from this BA. The following year another peregrine was found dead in the same general area. Both birds were turned over to NPS at BBNP (R. Skiles 1991). These birds were not sent to a laboratory for analyses. In 1994, a new pair of peregrines occupied the site, and produced a total of three young, all three were observed in the scrape B. Moore pers. comm). However, only one young fledged, the remaining two were never observed flying, and an immature peregrine was found dead in this area on July 11, 1994 (B. Moore pers. comm.). This eyass apparently could not fly, and was observed by river rafting parties on a sandbar. The river level rose, the eyass was washed downriver, managed to climb out of the river and wedge itself between rocks. It apparently died of exposure. The dead eyass was collected by B. Moore and turned over to NPS at BBNP. McKinney (1996) obtained feathers from this bird and sent them to the USFWS/TPW laboratory at San Marcos, Texas for analyses of heavy metal contaminants. Additionally, an adult male was found dead at the Boquillas overlook in February 1996, NPS released both falcons to TPW and they were sent to the same laboratory at San Marcos for analyses (Appendix C.). In 16 years this BA has fledged a total of six young.

Table 8. Reproductive history of eyrie/BA# 11, 1975-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1975	AP	NF	0
1976	AP	NF	0
1977	AP	2	2
1978	AP	1	1
1979	AM	0	0
1980	AP	1	1
1981	ND	--	--
1982	AP	3	3
1983	AP	NF	0
1984	AP	NF	0
1985	AP	NF/2 attempts	0
1986	AP	1	1
1987	AP	2	2
1988	AP	1	1
1989	AP	NF	0
1990	AP	NF	0
1991	AP	1	1
1992	AP	NF	0
1993	AP	NF	0
1994	AP	NF	0
1995	AP	NF	0
1996	AP	NF	0
1997	DESERTED	--	--
1998	DESERTED	--	--
1999	AP	2	2
2000	AP	NF	0
	TOTALS	14	14

Eyrie #11 has been monitored for 26 years. Only twice in 26 years a mated pair has not been at this site. A total of 14 young have fledged from this site. In 1985 two nesting attempts were made and both failed (Enderson 1985, McKinney 1985). A clutch of four eggs was observed in the scrape, this attempt failed and the pair moved downstream and laid a second clutch of three eggs. This second attempt failed early in incubation. This eyrie was closely monitored, no other peregrines were located in this canyon, and the adult female was easily identified by plumage and voice. A total of 14 nesting attempts have failed at this site. Nest failures usually occur during the early incubation stage. This eyrie is located near the old Mariscal mercury mine.

Table 9. Reproductive history of eyrie/BA# 66, 1975-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1975	AM	0	0
1976	AP	2	2
1977	AP	NF	0
1978	AP	3	3
1979	AP	1	1
1980	AP	3	3
1981	ND	--	--
1982	AP	2	2
1983	AP	1	1
1984	AP	NF	0
1985	AP	2	2
1986	AP	2	2
1987	AP	1	1
1988	AP	1	1
1989	AP	NF	0
1990	AP	NF	0
1991	AP	3	3
1992	AP	NF	0
1993	AP	NF	0
1994	AP	NF	0
1995	AP	2	2
1996	AP	2	2
1997	AP	2	2
1998	AP	2	2
1999	AP	NF	0
2000	AP	NF	0
	TOTALS	29	29

Eyrie #66 in Boquillas Canyon, BBNP on the Coahuila, Mexico side of the Rio Grande has been monitored for 26 years. In 1975 a lone male occupied the site, the remainder of the years a mated pair has been in residence. This BA has fledged a total of 29 young, and experienced a total of 8 nest failures. Despite the nest failures being a common occurrence, this site is one of the most consistently productive sites in the population. It should be noted that this site receives less disturbance than other BA's along the RGC from large groups of river rafters, hikers and campers.

Table 10. Reproductive history of eyrie/BA #12, 1993-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1993	A1	0	0
1994	AP	NF	0
1995	AP	NF	0
1996	AP	NF	0
1997	AP	2	2
1998	AP	3	0
1999	AP	2	0
2000	AP	NF	0
	TOTALS	7	2

A new BA was set up in this area by a lone adult (sex unknown) in 1993. A mate was recruited in 1994, the nesting attempt failed in 1994, and nest failure occurred in 1995 during the incubation stage (Skiles and Moore, NPS pers. comm.). Adults were observed during courtship, and incubation was documented at this site in 1996, the nesting attempt failed. In 1997 this site produced two young and both fledged. This BA produced three young in 1998, all three died in the eyrie scrape or were taken by predators, no young fledged from this site. The 1999 field season produced 2 young. One young eyass fledged prematurely and was hand captured on the riverbank by NPS personnel. This eyass was incapable of flight and NPS called TPW to evaluate the peregrine's condition. I examined the peregrine on May 25, 1999; the keel was prominent indicating the poor dietary condition. Other injuries such as wounds or broken bones were not apparent. I banded this bird with USFWS lock on band #877-01268 on the left leg, and a black peregrine falcon rivet band #2 horizontal, and #9 vertical on the right leg. Raymond Skiles (NPS) transported the peregrine to Last Chance Forever (San Antonio, Texas) for rehabilitation. This peregrine has been fully rehabilitated and will be released this fall in BBNP. The second eyass from this BA in 1999 did not fledge and died of unknown causes or was taken by a predator. This nest failed early in the incubation stage in 2000 and did not produce young. This site has produced a total of 7 young in 8 years, and fledged only two of the seven young.

Table 11. Reproductive history of eyrie/BA # 79, 1989-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1989	AP	2	2
1990	AP	NF	0
1991	AP	3	3
1992	AP	1	1
1993	AP	NF	0
1994	AP	1	1
1995	AP	NF	0
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	7	7

This BA was located in the Lower Canyons of the Rio Grande Wild and Scenic River (RGWSR) in 1989. This site produced and fledged 7 young in 12 years. The site has remained deserted since 1997.

Table 12. Reproductive history of eyrie/BA #13, 1979-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1979	AP	2	1
1980	AP	NF	0
1981	N/D	---	---
1982	Deserted	---	---
1983	Deserted	---	---
1984	Deserted	---	---
1985	Deserted	---	---
1986	Deserted	---	---
1987	Deserted	---	---
1988	Deserted	---	---
1989	Deserted	---	---
1990	Deserted	---	---
1991	Deserted	---	---
1992	Deserted	---	---
1993	Deserted	---	---
1994	Deserted	---	---

1995	Deserted	---	---
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	2	1

This BA was used only two years. The site produced 2 young in 1979, and fledged one. The cliff has remained deserted since 1981. The possibility exists that this BA was an alternate site for BA#111. It should also be noted that during the winter of 1985-86, the tiercel from #111 roosted on this cliff and hunted the area to the west and east (McKinney 1986). This site is less than 1 air mile from BA #111.

Table 13. Reproductive history of eyrie/BA #11b, 1996-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1996	AP	NF	0
1997	AP	NF	0
1998	AP	NF	0
1999	Deserted	---	---
2000	AP	2	2
	TOTALS	2	2

BA#11b was discovered in 1996. Three consecutive nesting attempts failed in the incubation stage. The site was deserted in 1999. The 2000 field season indicated an adult pair on territory. The pair nested and were successful in fledging two young from this site. Two young have fledged in 4 years.

Table 14. Reproductive history of eyrie/BA # 30, 1994-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1994	AP	NF	0
1995	Deserted	---	---
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	0	0

The author thinks that BA #30 and #40 are alternate sites, not two separate BA's. The sites are 2.5 river miles apart. Two adult pairs have never been observed at both sites simultaneously, and field notes from NPS (NPS file 1994) indicate the possibility that the observers were seeing one of the adults from alternate site #30 hunting in BA#40. From 1995 through the field season in 2000 this site has remained deserted.

Table 15. Reproductive history of eyrie/BA #40, 1991-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1991	AP	NF	0
1992	AP	1	1
1993	Deserted	---	---
1994	A1	0	0
1995	Deserted	---	---
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	1	1

This BA was established in 1991 and has produced and fledged only 1 young in 10 years. The habitat is excellent, prey is available, and the site receives little disturbance. This site has remained deserted since 1995.

years. The habitat is excellent, prey is available, and the site receives little disturbance. This site has remained deserted since 1995.

Table 16. Reproductive history of eyrie/BA #398, 1979-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1979	AP	1	1
1980	N/D	---	---
1981	N/D	---	---
1982	Deserted	---	---
1983	Deserted	---	---
1984	Deserted	---	---
1985	Deserted	---	---
1986	Deserted	---	---
1987	Deserted	---	---
1988	Deserted	---	---
1989	Deserted	---	---
1990	Deserted	---	---
1991	Deserted	---	---
1992	Deserted	---	---
1993	Deserted	---	---
1994	Deserted	---	---
1995	Deserted	---	---
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	AP	NF	0
2000	Deserted	---	---
	TOTALS	1	1

BA#398 has produced and fledged only 1 young in 21 years. Insufficient data was available in 1980 and 1981 to determine the actual status of this site. Three nest failures occurred, one each year in 1982 through 1984. The site remained deserted from 1985 through the breeding season in 1998. An adult pair was on territory in 1999, however both adults deserted the site during the incubation stage in 1999 and the nesting attempt failed. The site remained deserted in 2000. This cliff has all the attributes of the perfect "peregrine cliff," water is nearby in the Rio Grande, prey is available year-round, and the cliff is sheer with many nesting sites.

Table 17. Reproductive history of eyrie/BA # 111 (*111c=#46), 1983-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1983	AP	NF	0
1984	AP	NF	0
1985	AP	1	1
1986	AP	2	2
1987	AP	1	1
1988	NF	0	0
1989	AP	1	1
1990	AP	NF	0
1991	AP	2	2
1992	AP	3	3
1993	AP	1	1
1994	AP	NF	0
1995	AP*46	NF	0
1996	AP*46	2	2
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	AP	2	2
	TOTALS	15	15

This BA encompasses 3 cliffs, each cliff is an alternate site in different years. Casa Grande #111; Pinnacles #111b, and Toll Mountain #111c=#46. This BA has been monitored for 18 years, and fledged a total of 15 young. One adult peregrine was observed at this site in early spring 1998, and in 1999 the site was deserted.

Table 18. Reproductive history of eyrie/BA #86 (*formerly #16), 1996-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1995	AP	No nesting attempt	0
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	AP	1	1
	TOTALS	1	1

	TOTALS	1	1

The BA was discovered in 1995, an adult pair were on territory but no nesting attempt was made. From 1996 through the 1999 field season the site was deserted. A new pair of birds were on territory in 2000 and fledged one eyass.

Table 19. Reproductive history of eyrie/BA # 33 (#33b=#29), 1986-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1986	AP	2	2
1987	AP	1	1
1988	Deserted	---	---
1989	AP	1	1
1990	AP	2	2
1991	AP	3	3
1992	AP	NF	0
1993	AP	3	2
1994	AP	1	1
1995	AP	NF	0
1996	AP	NF	0
1997	AP	NF	0
1998	A1	0	0
1999	Deserted	---	---
2000	AP	1	1
	TOTALS	13	13

McKinney (1986) discovered this BA, and by consistent monitoring documented the peregrines alternate cliffs. Over the years data has proved when peregrines are present at Lost Mine (#33), they are absent at Crown Mountain (#33b=#29), and vice versa (McKinney 1987, Moore 1990). This site has been monitored for 15 years and has fledged a total of 13 young. In 1998 one adult peregrine occupied this territory, and apparently did not recruit a mate. This site and the alternate cliff receive less disturbance than other sites located in the Chisos Mountains in BBNP. Both sites have tall sheer cliffs, prey is available in the mountains as well as in the surrounding desert. The site has been deserted two years out of 15, and 4 nest failures have occurred.

Table 20. Reproductive history of eyrie/BA #88, 1985-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1985	AP	3	3
1986	AP	NF	0
1987	AP	NF	0
1988	AP	2	2
1989	AP	3	3
1990	AP	3	3
1991	AP	2	2
1992	AP	1	1
1993	Deserted	---	---
1994	AP	NF	0
1995	AP	NF	0
1996	AP	2	2
1997	AP	3	3
1998	AP	NF	0
1999	AP	NF	0
2000	AP	2	2

This BA was discovered by R. Skiles, NPS in 1985, and has been monitored for 15 years, fledging a total of 21 young. This site has been fairly consistent in production of young with the exception of the 6 nest failures. BA#88 is located in the high country of the Chisos Mountains within BBNP in pine-oak woodland habitat. The peregrines probably feed mainly on resident species of birds such as Mexican jays, white-winged and mourning doves, which may reduce the risk of feeding on contaminated prey that may be present in migrant species. Uncontaminated water sources are nearby eliminating long distance travel to the Rio Grande for water and a bathing source. The popular South Rim hiking trail parallels the cliff, but disturbance is minimal

Table 21. Reproductive history of eyrie/BA #55, 1984-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1984	AP	3	3
1985	AP	2*EX	0
1986	AP	2	2
1987	AF	0	0
1988	I?	0	0
1989	IM	0	0
1990	IP	0	0
1991	AP	1	1
1992	AP	2	2
1993	AP	2	2
1994	AP	NF	0
1995	AP	NF	0
1996	AP	NF	0
1997	1A, 1I	NF	0
1998	AP	NF	0
1999	AP	1	0
2000	AP	NF	0
	TOTALS	13	10

This BA was discovered by John Morelock (NPS) in 1984. In 1985 (2*EX) the Peregrine Func removed 2 eggs from the scrape and transported them to their facility in Idaho. Both eggs hatched and the birds were eventually placed in their captive breeding program (J. Enderson pers. comm.). The pair at this site in 1985 did not attempt to re-nest after the first clutch of eggs was removed, and reproduction was zero for this site. In 16 years this site has fledged a total of 10 young. Four of the years the site has been monitored immature birds were present. This BA has more observations of immature birds than any other BA in the population (McKinney 1994). In 1998 an adult pair was observed on territory and performing courtship activities in mid-March. The territory was abandoned by mid-April and the site failed to produce any young. A adult pair produced one young in 1999, the eyass may have died of unknown causes or was taken by a predator. A pair was on territory in March and performing courtship activities. The territory was abandoned by mid-April and the site failed to produce young. In 1999 the site produced one young, and the eyass was either taken by a predator or died in the scrape. The nesting attempt failed in the incubation stage in 2000.

Table 22. Reproductive history of eyrie/BA # 59, 1990-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1990	AP	2	2
1991	AP	1	1
1992	AP	1	1
1993	AP	NF	0
1994	AP	1	1
1995	1A, 1I	NF	0
1996	1A	0	0
1997	AP	2	2
1998	AP	NF	0
1999	AP	1	0
2000	AP	1	1
	TOTALS	9	8

This BA has been monitored for 10 years and fledged a total of 8 young. In 1995, the site was occupied by an adult female, and an immature male. In 1996 the site was occupied by a lone adult (R. Skiles pers. comm.). During 1998 a pair was on territory and a scrape had been selected, by mid-April the pair had abandoned the site. The site produced one young in 1999, the eyass did not fledge and died of unknown causes. One young was produced and fledged in 2000.

Table 23. Reproductive history of eyrie/BA # 222, 1985-1987.

Year	Status	Total # Young Observed	Total # Young Fledged
1985	AM	0	0
1986	AF	0	0
1987	AF, IM	0	0
	TOTALS	0	0

This BA was located in 1985 (McKinney 1985, Swernigen, Peregrine Fund), an adult male was defending the territory. In the following two years, an adult female was on the territory in 1986, and in 1987 an adult female was pared with an immature male (McKinney 1987). During the field season in 1987 the adult female from this site was

drove the intruding female away from the site. Hogan (1988) did not monitor this site and deleted this BA from the annual report. NPS at BBNP has not monitored this site since 1987 (McKinney 1987). The site is located southwest of the small village of Santa Elena, Chihuahua, Mexico. It is on private land, and the owner is unknown. No efforts have been made to monitor this remote site because of access logistics and unknown landowners.

Table 24. Reproductive history of eyrie/BA # 19, 1989-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1989	AP	2	2
1990	AP	NF	0
1991	AP	NF	0
1992	AP	NF	0
1993	AF, IM	NF	0
1994	AP	1	1
1995	AP	NF	0
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	3	3

This BA was discovered by the author, and has been closely monitored for 12 years. The first four years an adult pair was present. In 1989 the pair fledged two young, followed by three consecutive years of nest failures in the early incubation stages. In 1993 the old tiercel did not return, and was replaced by an immature male. Courtship and copulation were observed and the falcon began incubation. After one week she was on the cliff face hole-hopping and wailing. The site did not produce young. In 1994 the adult female, and an adult male (possibly the immature male from the previous year) returned to the cliff. One young fledged prematurely from this site. The eyass was located on the floodplain of the Rio Grande, incapable of flight on June 2, 1994. She was hand-captured, weighed, measured, photographed, and banded on the right leg with a standard lock-on USFWS band (Band #877-01266). She was banded on the left leg with a USFWS peregrine falcon black lock-on band #V02H. She was the first peregrine to be banded in the west Texas population and was named "Solo." She was observed near the eyrie vicinity flying with the adult female until late July when she dispersed from the area. The adults returned to this site in early February 1995, the nest failed late in incubation and the adults deserted the site in early June. The site has remained deserted since 1995. This BA has been monitored for 12 years and fledged only 3 young. After the breeding season ended in September 1995 eggshell fragments ($\leq$ 1/2 tsp.), molted feathers and prey remains were

removed from the scrape. All items were sent to the TPWD/USFWS laboratory at San Marcos, Texas for analysis of heavy metal contaminants, as well as organochlorine pesticides (Appendix D. and E.).

Table 25. Reproductive history of eyrie/BA #28, 1996-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1996	AP	NF	0
1997	Deserted	---	---
1998	AP	No nesting attempt	0
1999	Deserted	---	---
2000	Deserted	---	----
	TOTALS	0	0

This BA was located in 1996, the nest failed in the incubation stage and no young were produced. In 1997 the site was deserted. An adult pair was on territory in March 1998, but did not attempt to nest. The site has been deserted for the past two years.

Table 26. Reproductive history of eyrei/BA # 28.

Year	Status	Total # Young Observed	Total # Young Fledged
1997	AP	3	3
1998	AP	2	0
1999	Deserted	---	---
2000	AP	1	1
	TOTALS	6	4

This BA was located in 1997 by NPS at BBNP (R. Skiles pers. comm.). This new site is between BA #99 and #44 historical sites, with a couple of river miles separating the sites. This site fledged three young in 1997. An injured adult female "Helecha" was picked up in this area, and consequently died from her injuries (R. Skiles, pers. comm.). Both adults from this territory were in the eyrie vicinity in early June, therefore it is safe to assume that the injured adult female was not from this site. In 1998 an adult pair was on territory and produced 2 young, both died of unknown causes, or were taken by predators before they fledged. This site has been monitored for 4 years and fledged a total of 4 young.

Table 27. Reproductive history of eyrie/BA # 45, 1993-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1998	AP	NF	0
1999	AP	No nesting attempt	0
2000	Deserted	---	---
	TOTALS	0	0

This BA was located in March 1998 on the Black Gap Wildlife Management Area (McKinney 1998). An adult pair was on territory and the falcon was incubating in April. Late April revealed the pair had abandoned the site. The 1999 season failed to produce young, the adults did not attempt to nest, and in 2000 the site was deserted.

Table 28. Reproductive history of eyrie/BA #01, 1993-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1993	AP	2	2
1994	AP	ID	ID
1995	Deserted	---	---
1996	Deserted	---	---
1997	Deserted	---	---
1998	Deserted	---	---
1999	Deserted	---	---
2000	Deserted	---	---
	TOTALS	2	2

This BA is located in the Serranias Del Burro in northern Coahuila, Mexico, and has been monitored by McKinney and Elizabeth Sellers for 8 years. This site fledged 2 young in 1993. Our 1994 data was insufficient to determine the status of the site, two young were observed flying in a nearby canyon in late July, however we were unable to confirm if they were actually from BA #01. In 1995 this BA was taken over by a pair of golden eagles. A pair of very rare solitary eagles also nest close by. The presence of the eagles probably prevents the peregrines from nesting in the area. The site has been deserted since 1995.

Table 29. Reproductive history of eyrie/BA # 02, 1994-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1994	AF	0	0
1995	ND	---	---
1996	ND	---	---
1997	ND	---	---
1998	AP	1?	1?
1999	ND	---	---
2000	Deserted	---	---

This BA is located in the Serranias Del Burro of northern Coahuila, Mexico. An adult female was located on territory in late April 1994. However, a nesting pair was not confirmed at this site until 1998. This site is in a very remote area, and the cliff is massive. McKinney and Elizabeth Sellers observed one fledged female young in this area in late July 1998. Heavy rains from April through July in this area prevented access in 1999. This year the site was deserted, and a pair of golden eagles are nesting on the south end of the cliff face.

Table 30. Reproductive history of eyrie/BA # 03, 1993-2000.

Year	Status	Total # Young Observed	Total Young Fledged
1993	AP	ND	---
1994	AP	ND	---
1995	ND	---	---
1996	ND	---	---
1997	AP	2?	2?
1998	AP	1	1
1999	AP	ND	---
2000	AP	1	1
	TOTALS	4	4

This BA is located in the Sierra Del Carmen in northern Coahuila, Mexico. Access is limited. Aerial surveys revealed an adult pair on territory in 1993 and 1994. No young were observed on later flights. This site is in a very remote area in the backcountry of the Sierra Del Carmen and the property owner could not be located. This area would best be surveyed by helicopter drop off, once landowner permission and the appropriate permits

have been obtained from Mexico. On April 14, 1997 an adult female was observed incubating and the tiercel was very territorial In June 2 young were observed flying nearby. One young fledged from this site in 1998, and in 1999 access could not be gained due to heavy rains. The site fledged one young in 2000.

Table 31. Reproductive history of eyrie/BA #04, 1993-2000.

Year	Status	Total # Young Observed	Total # Young Fledged
1993	AP	ND	---
1994	AP	1 (unconfirmed)	1?
1995	ND	---	---
1996	ND	---	---
1997	AP	ND	---
1998	ND	---	---
1999	AP	1	1
2000	Deserted	---	---
	TOTALS	2	2

This BA is located in the Sierra Del Carmen in Coahuila, Mexico on private land. The best access is by helicopter to the ridges adjacent to the BA. The lands recently changed owners, and the new owners have granted permission to monitor this site. This site was deserted in 2000.

Table 32. Reproductive history of eyrie/BA # 05, 2000.

Year	Status	Total # Young Observed	Total # Young Fledged
2000	AP	1	1
	TOTALS	1	1

This BA was located by the author in the Maderas Del Carmen of northern Coahuila, Mexico in April 2000. Subsequent checks revealed that one young was produced and one young fledged. This is a very remote site, with a large fresh water supply and abundant prey. The site is on a private ranch, access has been granted to check this site in future years.

KEY:

A=Adult
AP=Adult pair
NF=Nest failure
D=Deserted
I=Immature
IM=Immature male
IF=Immature female
AF=Adult female
AM= Adult male
ND=No data

(Enderson 1985, Hill and Schaetzel 1977, Hogan 1988, Hunt 1975, Hunt and Johnson 1976, 1982, Key 1978, Lawson and Faxla 1979; McKinney 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, Moore 1989, 1990, 1994, Neighbor, et al. 1992, Netherton, et al 1978, NPS, BBNP file 1994, Roberson 1996, Sharp 1983, 1984, Skiles 1991, 1993, 1994, 1995, 1996, 1997, 1999, Swetpson 1981, Wesson et al 1978.)

Spacing of Territorial Pairs

Newton (1979) found in continuously suitable habitat raptor nests were often separated from one another by roughly equal distance. Such spacing is consistent with the idea that breeding density is limited by the behavior of territorial adults, but other factors may also play a part in the spacing. Food availability, nest sites, poor recruitment rates, weather, and human disturbances should all be considered contributing factors to limiting breeding density. Pesticides and other contaminants may still pose threats, and cannot be ruled out. Local, geographically isolated peregrine falcon populations such as the Trans-Pecos, and adjacent northern Mexico, which consistently produce insufficient young to offset mortality, can only be maintained by immigration. Locally, immigration into the lower Big Bend Region may be from the adjacent mountains in northern Mexico. Spacing of pairs in this population is erratic along the RGC and many areas of excellent habitat remain unoccupied (Table 33.). The Chisos Mountains in BBNP has a cluster of peregrines in pine-oak woodland habitat which average 2.5 miles apart. Average spacing is 13 river miles between BA's along the RGC in western Texas and adjacent northern Mexico (Table 33.).

Table 33. Spacing of peregrine falcon territories along the RioGrande corridor.

BA#/eyrie	River Miles
#99 to #28	3
#28 to #44	4
#44 to #12	49
#12 to #11	4
#11 to #11b	3
#11b to #89	26
#89 to #66	13
#69 to #19	30
#19 to #55	15
#55 to #59	8
#79 to #398	2
#398 to #30	6
#30 to #40	2.5

Pesticides and Contaminants

In 1985 the Peregrine Fund collected and measured several eggshell fragments from 2 eyries in the study area (#55 and #11), (McKinney 1986). Enderson (1985) found the shells to be 15 to 16 percent thinner than pre-1947 Rocky Mountain eggshells. Where thinning is 13 to 14 percent less, hatchability has been reported not to be seriously effected (Enderson 1985). When thinning reaches 17 to 20 percent, reproductive failure increases markedly (Anderson and Hickey 1972). Hogan (NPS contract 1988) collected an addled egg from eyrie #11b in 1988. This egg was reportedly sent to Enderson at the Peregrine Fund for anlayses on the degree of thinning. Moore (1989) disclosed in her annual report that the eggshells were reported by Hogan to be 21 percent thinner than pre-1947 Rocky Mountain eggshells.

Roy Irwin (USFWS 1989) reported that the presence of DDE in aquatic insects in the Rio Grande at BBNP was a concern since insectivorous birds feed on the insects, thus biomagnifying the effect when peregrines feed on these birds. Elevated levels of DDE were found in several songbirds inhabiting the Big Bend Region, and in mourning doves, which feed primarily on grains.

TPW continues to make opportunistic prey collections to determine the levels of organochlorines in the study area. In 1994 mourning doves, brown-headed cowbirds, and western pipistrelle bats (Pipistrellus hesperus) were collected and sent to the TPW lab for analyses of organochlorines and heavy metal contaminants (Appendix D.). Feather samples were collected in 1995 and sent to the lab for heavy metal contamination

analyses, particularly mercury (Appendix D.). In February 1996, the NPS at BBNP (Skiles and Koepp) released the bodies of two peregrines found dead in BBNP. One specimen was from BA#99 in 1994, and the second was an adult male that was observed by several tourists for a week long period. This adult male was observed walking on a sandbar near the Boquillas Canyon overlook. Later this male was found dead in the same general location by tourists, and taken to BBNP headquarters. Selected feather samples from both birds, as well as liver and brain samples were removed from both specimens and prepared for laboratory analysis. The remainder of the specimens were prepared for homogenization and both samples were shipped to the USFWS//TPW, San Marcos lab for analyses of organochlorines, PCB's, and heavy metal contamination (Appendix C.). One sample was obtained in 1997, an adult female was observed on a sandbar incapable of flight. She was picked up by Skiles (NPS) and we decided to send this adult female to Las Chance Forever, Inc. at San Antonio. That evening arrangements were made with John Karger and Dr. Melissa Hill to receive the falcon. She was transported to San Antonio by Skiles. Dr. Hill's diagnosis showed a stress fracture in the wing. The wing was set and taped. Several weeks later x-rays showed the break had not healed. A second surgery was performed using a plastic pin, with the same results. A third surgery was performed and the bone was scraped and pinned. The falcon recovered from the surgery and fed late that evening. Later that night the falcon experienced total dehydration and kidney failure. Feather samples, brain and liver tissue was obtained for analyses. Feather analyses revealed 2.94 to 3.39 whole parts per million (PPM) of mercury (hg). From Dr. Hill's report on this falcon it is apparent that this female was not producing enough calcium to heal a simple stress fracture, and was harboring an infection of some type. The orgaonchlorine scan was performed by the TPW/USFWS lab at San Marcos, Texas (Appendix F.). It is very interesting that this female was picked up injured near the #28 eyrie. An adult pair was on territory here until monitoring ceased in mid-June. The injured female may have been unable to attract a mate and was injured in a fight with the peregrines from this territory.

Evidence shows the Rio Grande and surrounding areas a s well as prey items in the peregrine diet contain traces of elevated levels of DDT and DDE. However, prey items, water and sediment samples, peregrine feathers, eggshell fragments and prey remains all need to be collected periodically for analyses. This will provide data with a sample size large enough to detect trends in contaminant levels. Logistically it is very expensive, and the added inconvenience of inaccessible eyrie sites tends to hamper collections.

The five samples that have been collected represent 21% of the adult population (n=12 pair, 1998) have been analyzed for Hg contamination; the sample although small does represent different age classes and sex within the population (Table 34.). Concern for mercury (Hg) contamination from natural sources is a high priority. Mercury is a cumulative poison, and a heavy metal, it is also one of the 129 toxic pollutants listed by the Environmental Protection Agency (EPA) as a "priority pollutant" (EPA 1985). Mercury is one of the few metals that strongly bioconcentrates and biomagnifies. It also easily transforms from a less toxic inorganic form to a more toxic organic form in fish and wildlife tissues and in sediment. Mercury is also a carcinogen, mutagen and teratogen. Mercury should be of concern in the erratic reproduction of peregrines in the

study area. The lower Big Bend Region is literally sprinkled with old mercury mines, and mercury has been documented in areas of the Big Bend in the soil, water, and wildlife (Erwin 1989).

Table 34. Analyses of mercury in peregrine falcon feather, brain and liver samples.

Sample #	Age	Sex	Location	Hg (ppm)
001	34 days	F	Rio Grande	0.664 to 0.724
002*	34-36 days	F	Rio Grande	0.104 to 5.43
003	4+ years	M	Rio Grande	0.017 to 1.90
004	25-50 days	F	Rio Grande	0.802 to 2.559
005	4+ years	F	Rio Grande	2.94 to 3.39

*002 sample contained 4.87 ppm DDE at 34 to 36 days old.

CONCLUSION

The 2000 field season data showed an increase in production of the number of young fledged per adult pair from the 1999 field season. A total of 18 BA's were checked, and 9 adult pairs of peregrine falcons were on territories. No immature birds were observed in the population. Twelve young were observed in eyrie scrapes and 12 young fledged. Early in the season peregrines were observed at several historic sites, however no nesting attempts were made and the birds abandoned the sites. In addition, 2 BA's were checked in the Sierra Del Carmen, Coahuila, Mexico, one site was abandoned and one site produced and fledged one young. One new eyrie site was located in the Maderas Del Carmen, Coahuila, Mexico (contiguous with the Sierra Del Carmen), and this site produced and fledged one young. Two territories remain deserted in the Serranias Del Burro, Coahuila, Mexico. One site was taken over by golden eagles and, a pair of solitary eagles are in the general area of the second BA. Several other reports were received from areas of northern Mexico, however the status of these sites has not been evaluated at this time.

Reproduction is still erratic in this population, nest failures are common and problems do exist. **This population should remain on the state of Texas endangered species list with no take west of the Pecos River.**

RECOMMENDATIONS

1. Continued monitoring along the Rio Grande corridor, in the Chisos Mountains of Big Bend National Park, and the adjacent mountains of Coahuila, Mexico.

2. Extend surveys further into Coahuila and Chihuahua, Mexico to determine population numbers.

3. Develop cooperative research with counterparts in Coahuila and Chihuahua, Mexico facilitate monitoring of active sites in northern Mexico.

4. Feather samples need to be obtained from control areas in northern Mexico for mercury analyses (e.g. museum specimens, collection of feathers from active eyrie sites after the breeding season).

5. Satellite telemetry on 3-4 juveniles to determine dispersal destinations from natal a areas.

6. Collection of egg (s) from mercury analyses.

7. Genetic analysis of blood samples from the Rio Grande corridor peregrine falcons and from falcons further south in Mexico to determine subspecies and origin.

8. Collection of water, sediment, prey birds and insects from the Rio Grande corridor and Terlingua quicksilver district for analyses.

9. Maintain a strict "no take" policy on all peregrine falcons in the Trans-Pecos ecological region of western Texas.

10. Continue to keep the peregirne falcon as a state of Texas endangered species.

LITERATURE CITED

Enderson, J.H. 1985. Peregrine survey, Big Bend National Park and Rio Grande River. USFWS, OES, Albuquerque, New Mexico.

EPA. 1980. Ambient water quality criteria for mercury. Environ. Prot. Agency Rept. 440/5-80-058. Springfield, Virginia.

EPA. 1985. Ambient water quality criteria for mercury. Environ. Prot. Agency Rept. 440/84-026. 136 pp. Springfield, Virginia.

Hickey, J.J. (ed.) Peregrine falcon populations: their biology and decline. Univ. Wisc. Press. Madison, WI.

Hill, K.B. and L.J. Schaetelel. 1977. Peregrine falcons in the Big Bend National Park, 1977 breeding season. in W.G. Hunt and B.S. Johnson (eds.) CDRI #37, Alpine, Texas.

Hogan, K.M. 1988. Peregrine falcon monitoring program, historic eyrie survey; Big Bend National Park and Rio Grande Wild and Scenic River. CDRI and NPS, Alpine, Texas.

Hunt, W.G. and B.S. Johnson. 1982. Nesting peregrine falcons and pesticides in west Texas. Prep. for NPS, Big Bend National Park and USFWS, Albuquerque, New Mexico.

Irwin, Roy J. 1989. Toxic chemicals in fish and wildlife at Big Bend National Park, Texas. USFWS, Fort Worth Field Office, Fort Worth, Texas.

Johnson, B.S. and W.G. Hunt. 1976. Continuing studies of raptors in two national parks in west Texas. CRRI, Alpine, Texas.

Lawson, P.W. and G.A. Faxla. 1979. Peregrine falcon breeding status in Texas National Parks. #82, CDRI, Alpine, Texas.

McKinney, Bonnie R. 1985. The breeding status of Falco peregrinus anatum in the Big Bend National Park and Lower Canyons. Rept. to SW Reg. Offi. USFWS, Albuquerque, New Mexico.

_____. 1986. The status of Falco peregrinus anatum in the Big Bend Region of Texas. Rept. to SW Offi. of NPS and OES, USFWS, Albuquerque, New Mexico.

_____. 1987. The status of Falco peregrinus anatum in the Big Bend Region of Texas. Rept. to SW Reg. Offi. of NPS and OES, USFWS, Albuquerque, New Mexico.

_____. 1992. Peregrine falcon survey on Black Gap Wildlife Management Area. Rept. prep. for Wildlife Division, Texas Parks and Wildlife, Austin, Texas.

_____. 1993. Peregrine falcon survey on Black Gap Wildlife Management Area. Rept. prep. for Wildlife Division, Texas Parks and Wildlife, Austin, Texas.

_____. 1994. Black Gap Wildlife Management Area peregrine falcon, 1994 field survey. Nongame Program, Texas Parks and Wildlife, Austin, Texas.

_____. 1995. The status of the American peregrine falcon in western Texas and adjacent northern Mexico. Technical rept. Nongame and Urban Program, Texas Parks and Wildlife, Austin , Texas and Secretaria De Medio Ambiente Recursos y Naturales, y Pesca (SEMARNAP) Mexico City, Mexico.

_____. 1996. The status of the American peregrine falcon in western Texas and adjacent northern Mexico. Technical rept. Nongame and Urban Program, Texas Parks and Wildlife, Austin, Texas and Secretaria De Medio Ambiente Recursos y Naturales, y Pesca (SEMARNAP) Mexico City, Mexico.

_____. 1997. The status of the American peregrine falcon in western Texas and adjacent northern Mexico. Technical rept. Resource Protection Branch, Texas Parks and Wildlife, Austin, Texas and Secretaria De Medio Ambiente Recursos y Naturales, y Pesca (SEMARNAP) Mexico City, Mexico.

_____. 1998. The status of the American peregrine falcon in western Texas and adjacent northern Mexico. FWS Agreement No. 1448-20181-97-G932. Ecological Services Office of the United States Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1999. Surveying, monitoirng, and managing select endangered/ threatened species of concern in the Trans-Pecos Ecoregion of Western Texas. Rept. prep. for USFWS, Albuquerque, New Mexico and Texas Parks and Wildlife, Austin, Texas. Section 6 project, WER39.

Moore, Betty. 1989. Peregrine falcon monitoring program, historic eyrie survey; Big Bend National Park and Rio Grande Wild and Scenic River. Unpubl. rept. to Big Bend National Park, Texas.

Newton. Ian. 1979. Population ecology of raptors. Buteo Books, Vermilion, South Dakota.

Ratcliffe. D.A. 1980. The peregrine falcon. Buteo Books, Vermilion, South Dakota.

Sharp. Devorah. 1983. Peregrine falcon breeding status in Big Bend National Park. Prep. for NPS at Big Bend National Park, Texas and OES. USFWS, Albuquerque. New Mexico.

Skiles, Raymond , D. Neighbor et al. 1991. Peregrine falcon monitoring program, BBNP and RGWSR. Unpubl. rept. Big Bend National Park, Texas.

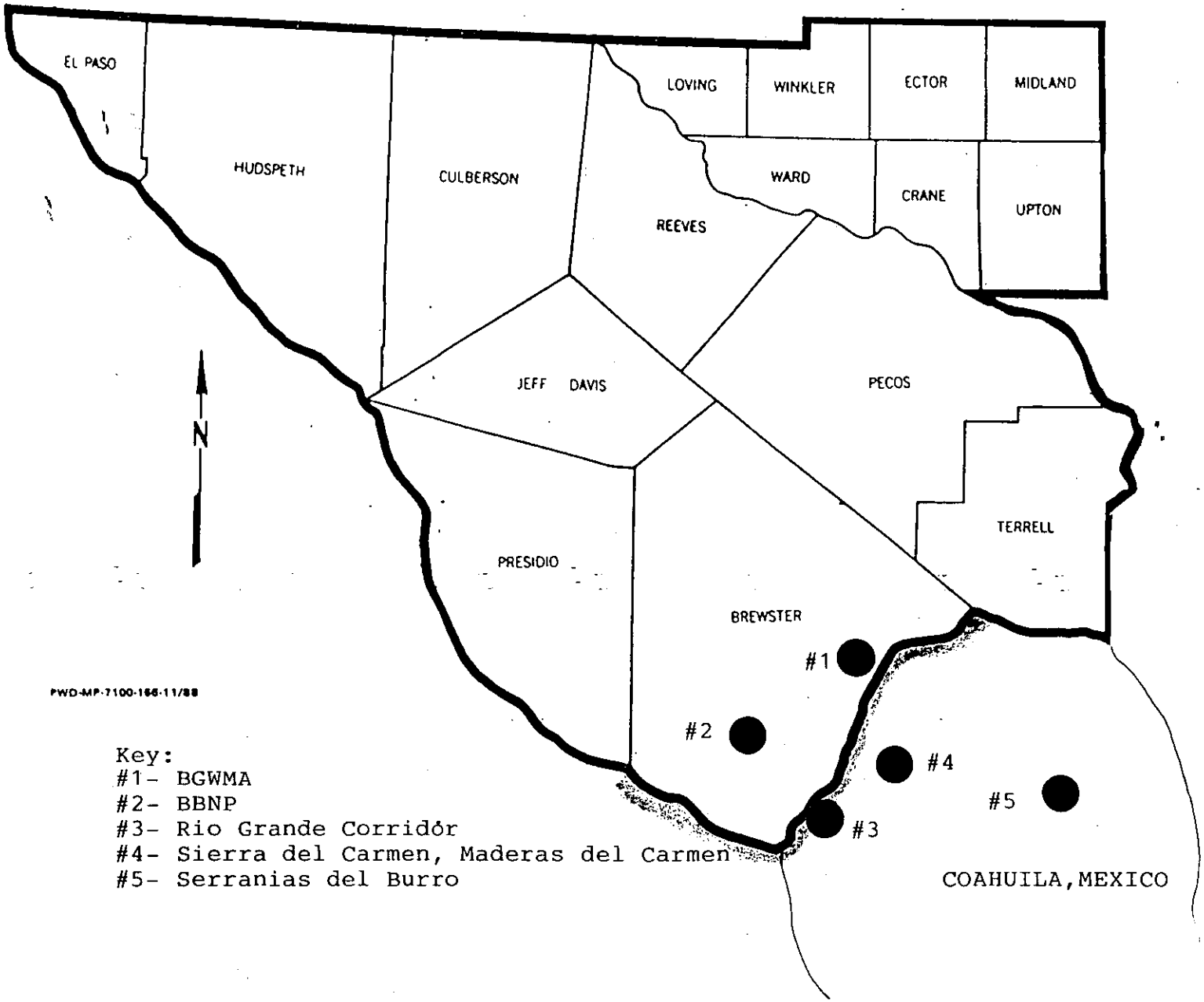
_____. et al. 1996. Peregrine falcon monitoring program, BBNP and RGWSR. Unpubl. rept. Big Bend National Park, Texas.

Sweptson, D.A. 1981. Performance report required by Federal Aid in Wildlife Restoration Act, Nongame Wildlife Investigations, American Peregrine Falco Survey. Texas Parks and Wildlife, Austin, Texas.

USFWS, 1993. Draft Addendum to the Pacific Coast and Rocky Mountain/Southwest American peregrine falcon recovery plan. Portland, Oregon.

APPENDIX A.

APPENDIX A. MAP OF STUDY AREA



Key:
#1- BGWMA
#2- BBNP
#3- Rio Grande Corridór
#4- Sierra del Carmen, Maderas del Carmen
#5- Serranias del Burro

APPENDIX B.

BREEDING AREA DATA FORM
PEREGRINE FALCON SURVEY
TEXAS PARKS AND WILDLIFE

Date: _____ **Time Obsv. Began** _____ **Time Obsv. End.** _____

Topo: _____ **Eyrie # and Name:** _____

Ownership: _____

Weather: _____

Description of Nest Site: _____

_____

Reproductive Stage: _____

_____

Disturbance Potential : (Type, Distance, Duration) _____

_____

Potential Prey in Area: _____

_____

Other Raptors in Area: _____

_____

Behavior Notes: _____

_____

_____

_____

_____

_____

_____

_____

Band Numbers: Standard USFWS _____ **Color + #** _____

Other Pertinent Info: (# PF'S OBSV., YNG., #Fledg.)

_____

_____

APPENDIX C.

CUSTOM REPORT FOR : C:\HPCHEM\1\DATA\ SIMOCP

Method Name: SIMOCP
File Name: K9OC65.D
Sample name: Falcons 965
Misc Info:
Vial #: 21

Becky Walch
07/31/98

Last update: Tue Jul 30 09:50:51 1998

	Ret time	Conc (ng/mL)	Blank Values	MDL w/o wt, (ng)	MDL w/ wt, (ng/g)	Final Value wt (g)= 5.00 (ng/g)
1 Dichlorvos	0.00	0	0	90	18	<MDL
2 alpha-BHC	0.00	0	0	90	18	<MDL
3 Hexachlorobenzene	0.00	0	0	158	31	<MDL
4 beta-BHC	0.00	0	0	159	32	<MDL
5 gamma-BHC	16.53	21	0	159	32	<MDL
6 delta-BHC	0.00	0	0	112	22	<MDL
7 Heptachlor	0.00	0	0	158	31	<MDL
8 Aldrin	0.00	0	0	132	26	<MDL
9 Heptachlor epoxide	24.59	185	0	218	44	<MDL
10 gamma-Chlordane	0.00	0	0	201	40	<MDL
11 Endosulfan 1	0.00	0	0	181	36	<MDL
12 alpha-Chlordane	0.00	0	0	112	22	<MDL
13 Dieldrin	26.02	24382	0	134	26	4872
14 DDE	28.16	24382	0	71	14	4872
15 Endrin	0.00	0	0	253	51	<MDL
16 Endosulfan 2	0.00	0	0	206	41	<MDL
17 DDD	0.00	0	0	110	22	<MDL
18 Endrin aldehyde	30.84	55	0	238	48	<MDL
19 Endosulfan sulfate	0.00	0	0	129	26	<MDL
20 DDT	0.00	0	3	107	21	<MDL
21 Methoxychlor	0.00	0	0	100	20	<MDL
22 Mirex	0.00	0	0	107	21	<MDL

CUSTOM REPORT FOR : C:\HPCHEM\1\DATA\ SIMOCP

Method Name: SIMOCP
File Name: K9OC66B.D
Sample name: Falcons , 966B
Misc info:
Vial #: 24

Becky Walch
07/31/98

Last update: Tue Jul 30 09:50:51 1996

	Ret time	Conc (ng/mL)	Blank Values	MDL w/o wt, (ng)	MDL w/ wt, (ng/g)	Final Value (ng/g)	wt (g)= 5.21
1 D12-Chrysene	30.31	2200	[illegible]	[illegible]	[illegible]	[illegible]	
2 alpha-BHC	0.00	0	0	90	17	<MDL	
3 Hexachlorobenzene	0.00	0	0	156	30	<MDL	
4 beta-BHC	0.00	0	0	106	20	<MDL	
5 gamma-BHC	0.00	0	0	159	31	<MDL	
6 delta-BHC	0.00	0	0	112	21	<MDL	
7 Heptachlor	0.00	0	0	160	30	<MDL	
8 Aldrin	22.19	6242	0	132	25	1198 Confirmation ions negate this value.	
9 Heptachlor epoxide	24.60	1631	0	218	42	313 Confirmation ions negate this value.	
10 gamma-Chlordane	25.96	[illegible]	[illegible]	[illegible]	[illegible]	<MDL	
11 Endosulfan 1	0.00	0	0	181	35	<MDL	
12 alpha-Chlordane	0.00	0	0	112	21	<MDL	
13 Dieldrin	28.03	29165	0	144	28	5029 Confirmation ions negate this value.	
14 DDE	28.19	932	0	71	14	178	
15 Endrin	0.00	0	0	253	49	<MDL	
16 Endosulfan 2	29.63	106	0	289	55	<MDL	
17 DDD	0.00	0	0	110	21	<MDL	
18 Endrin aldehyde	30.93	10782	0	238	48	2070 Confirmation ions negate this value.	
19 Endosulfan sulfate	0.00	0	0	134	26	<MDL	
20 DDT	0.00	0	3	107	21	<MDL	
21 Methoxychlor	36.03	6	0	100	19	<MDL	
22 Mirex	0.00	0	0	147	28	<MDL	

CUSTOM REPORT FOR : C:\HPCHEM\1\DATA\ SIMOCP

Method Name: SIMOCP

File Name: K9OC66A.D

Sample name: Falcons . 966A

Misc Info:

Vial #: 22

Becky Walch
07/31/96

Last update: Tue Jul 30 09:50:51 1996

	Ret time	Conc (ng/mL)	Blank Values	MDL w/o wt, (ng)	MDL w/ wt, (ng/g)	Final Value (ng/g) wt (g)= 4.87
1 [illegible]	35.42	200	[illegible]	[illegible]	[illegible]	[illegible]
2 alpha-BHC	0.00	0	0	90	18	<MDL
3 Haxachlorobenzene	0.00	0	0	158	32	<MDL
4 beta-BHC	0.00	0	0	10[illegible]	22	<MDL
5 gamma-BHC	16.54	29	0	159	33	<MDL
6 delta-BHC	0.00	0	0	112	23	<MDL
7 Heptachlor	0.00	0	0	158	32	<MDL
8 Aldrin	22.08	2769	0	132	27	569 Confirmation ions negate this value.
9 Heptachlor epoxide	24.59	2448	0	218	45	503 Confirmation ions negate this value.
10 gamma-Chlordane	25.85	[illegible]	0	99	20	<MDL
11 Endosulfan 1	0.00	0	0	181	37	<MDL
12 alpha-Chlordane	0.00	0	0	112	23	<MDL
13 Dieldrin	28.03	[illegible]	0	13[illegible]	28	[illegible] Confirmation ions negate this value.
14 DDE	28.18	1170	0	71	15	240
15 Endrin	0.00	0	0	253	52	<MDL
16 Endosulfan 2	27.63	10	0	286	59	<MDL
17 DDD	0.00	0	0	110	23	<MDL
18 Endrin aldehyde	30.93	6832	0	238	49	1403 Confirmation ions negate this value.
19 Endosulfan sulfate	0.00	0	0	13[illegible]	28	<MDL
20 DDT	0.00	0	3	107	22	<MDL
21 Methoxychlor	0.00	0	0	100	21	<MDL
22 Mirex	0.00	0	0	147	30	<MDL

Sample Calculations for Trace Metal Analysis

Digestion Factor:

Density=Specific Gravity=(Measured Weight 1mL digest solution)/(Average Measured Weight 1mL water)=(1.0585g Digest solution)/(0.9895g water)= 1.07
Assume at a given temperature Density = Specific Gravity

Digest Factor = (Bottle Full Wt-Bottle Tare Wt)/Density/Sample Wt

966 B Digest (46.82g-8.26g)/(1.07g/mL)/(2.3267g)= 15.49 mL solution/g sample

Elemental Concentration As, Cd, Cr, Cu, Ni, Pb and Se

Elemental Conc.=(Digestion Factor)*(Dilution at GFAA)*(Concentration at GFAA)*(1ug/1000ng)

966 B Cd Conc.=(15.49mL solution/g sample)*(0.5mL sample+diluent/0.5mL sample)*(4.406 ng Cd/mL solution)*(1ug/1000ng)= 0.068 ug Cd/g sample
OR 0.068 ppm Cd

Elemental Concentration Zn

Elemental Conc.= (Digestion Factor)*(Dilution at FAA)*(Absorbance at FAA)*(Slope of Conc/absorbance)

966 B Zn Conc.=(15.49mL solution/g sample)*(0.5mL sample+diluent/0.5mL sample)*(311 abs.)*(2ug Zn/mL solution/387 abs)= 24.9 ug Zn/g sample
OR 24.9 ppm Zn

Elemental Concentration Hg

Elemental Conc.= (Final Vol/Sample Wt)*(Dilution at CVAA)*(Peak Height)*(Slope of Conc/Peak Height)*(1ppm/1000ppb)

966 B Hg Conc.= (40.0mL solution/1.1269g sample)*(5.0mL sample+diluent/5.0mL sample)*(77645 peak ht)
(5ng Hg/mL solution/63000 peak ht)(1ug/1000ng)= 0.203 ug Hg/g sample OR 0.203 ppm Hg

Detection Limits and Significant Figures

Significant figures are limited to 3 or less due to the measurement process, this is irrespective of where the decimal point is.
Sensitivities of each individual analysis dictate the detection limit and the number of decimal points that can be reported.
For this sample set the Detection Limits are:

	As	Cd	Cr	Cu	Ni	Pb	Se	Zn	Hg
Tissue	0.25	0.010	0.20	0.30	0.20	0.20	0.20	3.0	0.060
Sediment	0.35	0.030	2.2	2.3	0.20	0.60	0.20	2.0	0.015

Final Data Peregrine Falcon Samples Received 4/30/96

Submit ID	Lab ID	Sample Wt	Hg Wt	As ppm	Cd ppm	Cr ppm	Cu ppm	Ni ppm	Pb ppm	Se ppm	Zn ppm	Hg ppm
1	943	0.2528	0.1943	0.55	0.318	2.71	10.1	4.85	0.74	0.46	118	4.68
2	944	0.4872	0.2584	0.94	0.156	3.69	7.20	2.58	0.68	0.62	104	3.93
3	945	0.3236	0.1887	1.81	0.134	3.79	7.48	4.29	2.45	0.57	115	4.69
4	946	0.2457	0.2318	1.38	0.079	1.87	6.21	3.97	0.51	1.38	144	4.17
5	947	0.7777	0.2431	< 0.25	0.047	0.87	4.89	6.96	0.37	1.58	102	3.06
6	948	0.3752	0.2490	< 0.25	0.045	0.42	8.12	3.56	0.34	1.76	118	2.85
7	949	1.0985	0.2464	0.27	0.055	0.65	3.33	2.75	0.25	1.81	108	3.94
8	950	0.3433	0.1719	0.33	0.057	0.44	8.86	2.12	0.40	1.49	128	5.43
9	951	0.3395	0.1944	1.08	0.104	1.27	7.96	2.71	0.75	2.22	130	2.12
10	952	0.5905	0.2326	0.56	0.027	0.60	5.38	1.59	0.74	2.19	100	2.51
11	953	0.2433	0.2449	0.48	0.024	0.24	2.82	1.18	0.28	0.86	37.5	1.72
12	954	0.2723	0.2158	1.32	0.080	1.89	8.73	3.83	1.38	2.17	137	1.90
13	955	1.0436	0.2510	0.52	0.031	0.79	3.08	1.26	0.25	2.33	93.2	1.94
14	956	0.5813	0.2382	0.67	0.033	1.22	4.39	4.81	0.38	2.72	120	2.05
15	957	1.1128	0.2474	0.38	0.028	0.82	2.99	3.10	0.37	2.22	93.5	1.75
16	958	0.1686	0.1037	1.67	0.057	3.44	8.63	5.25	0.76	3.24	159	4.85
17	959	NA	1.1219									2.00
18	960	NA	1.3533									0.314
19	961	NA	1.0269									0.543
20	962	NA	0.9892									0.104
21	964	0.4801	1.1073	0.26	0.081	1.08	6.43	3.32	0.64	1.03	98.7	0.625
21 Feathers	964 F	2.7144	0.2436	< 0.25	0.041	0.69	2.85	0.37	< 0.20	0.33	35.0	3.42
22	965	0.5761	1.3221	0.58	0.040	1.76	6.04	1.98	0.74	1.90	97.7	0.179
22 Feathers	965 F	1.8932	0.2558	< 0.25	0.011	1.22	2.47	0.61	< 0.20	0.45	37.6	1.90
24	966 A	2.3108	1.0768	< 0.25	0.067	1.09	1.80	0.58	0.38	0.24	29.2	0.181
24	966 B	2.3267	1.1269	< 0.25	0.088	0.80	1.42	0.44	0.33	0.41	24.9	0.203
23	963	5.4095	7.4207	2.22	0.088	4.83	2.33	3.44	3.30	< 0.20	35.3	0.017

APPENDIX D.

Peregrine Falcon Feathers from Eyrie #19 Submitted by Bonnie Mckinney

Lab ID	Feather length in cm.	Sample Wt		Hg
				ppm
602-Large	18.5	0.4866		2.559
602-2	10.0, 11.2	0.1017		1.910
602-3	7.0, 7.5, 8.5, 7.0, 7.5, 8.0	0.1100		1.031
602-4	6.5, 6.2, 5.8, 6.4, 5.3, 5.1	0.0687		0.927
602-Down		0.0423		0.802
Quality Control Samples				
Certified Reference Materials				
Certified Value NIST1566a				0.062
NIST-511		0.2339		0.068
% Recovery				109.7
Matrix Spikes				
602-3	7.0, 7.5, 8.5, 7.0, 7.5, 8.0	0.11		1.031
602-3 spk	8.0, 8.0, 8.2, 8.0, 8.0, 7.0	0.1013		3.251
Theoretical Increment				1.97
% Recovery				118.0
Blank Spikes Recovery				
Spike Concentration				1.0
LCS-511		0.2		0.932
% Recovery				93.2
Method Blanks				
Blank-511		1		0.002

APPENDIX E.

Black Gap samples submitted by Bonnie Mckinney

LAB #	Sample type	Tissue Type	Ni ppm	Pb ppm	Se ppm	Zn ppm	Hg ppm
MDL			0.4	0.35	0.6	6	0.025
112	Morning Doves Balmorhea	Breast & Viscera	0.49	13.84	0.78	12.8	<0.025
112 DUP	Morning Doves Balmorhea	Breast & Viscera	0.42	8.02	1.04	12.3	<0.025
112 F	Morning Doves Balmorhea	Feathers	1.17	1.62	8.55	60.8	<0.025
*113	Falcon	Feathers	2.37	0.52	3.71	59.1	0.664
*113 DUP	Falcon	Feathers	9.54	0.56	4.23	64.5	0.724
114	Morning Doves Black Gap	Breast & Viscera	1.33	0.43	3.01	13.3	<0.025
114 DUP	Morning Doves Black Gap	Breast & Viscera	1.28	0.47	2.87	11.8	<0.025
114 F	Morning Doves Black Gap	Feathers	1.38	0.82	9.83	80.8	<0.025
115	Western Bats Big Bend	Whole	0.63	1.05	5.63	22.5	0.152
115 DUP	Western Bats Big Bend	Whole	0.62	0.87	5.02	21.4	0.106
116	Brownhead Cow Bird Black Gap	Breast & Viscera	0.54	0.39	2.17	14.5	<0.025
116 DUP	Brownhead Cow Bird Black Gap	Breast & Viscera	0.55	0.49	2.93	13.6	<0.025
116 F	Brownhead Cow Bird Black Gap	Feathers	1.86	1.22	8.12	151.8	0.242

APPENDIX F.

Peregrine Falcon Feathers (Adult ♀)
Received June 11, 1997

Sample	Size	Hg Concentration ppm
Large Feather	12-14 cm	3.39
Bag A	5-8 cm	2.94
Bag B	2-6 cm	3.32
Blank A		< 0.1
Blank B		< 0.1

Post-it® Fax Note 7671	Date	# of pages ▶
To BONNIE McKINNEY	From BLEIN	
Co./Dept.	Co.	
Phone #	Phone #	
Fax #	Fax #	

Peregrine liver & kidney -Analyzed January 1998

Pesticide and PCB Report Total

Lab ID Number	1325 Peregrine Liver	1326 Peregrine Kidney
Compound (ppb)		
a-BHC	<200	<25
Hexachlorobenzene	<200	<25
Pentachloroanisol	<200	<25
b-BHC	<200	<25
g-BHC	<200	<25
d-BHC	<200	<25
Heptachlor	<200	<25
Aldrin	<200	<25
Dacthal	<200	<25
Heptachlor Epoxide	<200	<25
gamma-Chlordane	<200	<25
o,p-DDE	<200	<25
alpha-Chlordane	trace	<25
t-Nanachlor	trace	<25
Dieldrin	<200	<25
p,p'-DDE	420	<25
o,p'-DDD	<200	<25
Endrin	<200	<25
c-Nonachlor	<200	<25
p,p'-DDD	<200	<25
o,p'-DDT	<200	<25
p,p'-DDT	<200	<25
p,p'-Methoxychlor	<200	<25
Mirex	<200	<25
PCB total	<800	<50

Note : Trace= trace determined using SIM but unconfirmed full scan

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 2

To Bonnie McKinney	From David Klein
Co. TPWD	Co. LAB
Dept.	Phone # 512 353 3486
Fax # 915-376-2746	Fax # 512 353 7329

Peregrine Falcon Samples Submitted 6-29-97
From Kirby Animal Hosp., Melissa Hill D. V. M.
Concentrations given in ppm WET weight as received.

	Lab ID	Hg ppm	Average Hg ppm
Kidney	1325-A	0.204	0.180
	1325-B	0.157	
Liver	1326-A	0.096	0.096
	1326-B	0.097	
	1326-C	0.095	

Attachment B.

Final Report: The Black-capped Vireo (Vireo atricapillus)
at Black Gap Wildlife Management Area, western Texas
and selected areas in northern Coahuila, Mexico.

INTRODUCTION

The black-capped vireo (Vireo atricapillus) Woodhouse, reaches the peripheral edge of their western range in the United States in the lower Big Bend Region of western Texas. The historical range in this area began with a suspected breeding record in the Glass Mountains, 97 kilometers (km) north of the Black Gap Wildlife Management Area (BGWMA) (Van Tyne and Sutton 1937). Cruickshank (1950) reported the black-capped vireo from the Chisos Mountains in Big Bend National Park (BBNP). Three additional sightings were recorded in the Chisos Mountains from 1956 to 1966 (Wauer 1985). On 5 May 1966, Jon Barlow found a black-capped vireo nest in Campground Canyon located in the Chisos Mountains (J. Barlow pers. comm.). Since that time, nests, and scattered sight observations have been reported each year from parklands. However, population numbers continue to remain small, and isolated pockets in canyons appear to be the preferred habitat. Joe Marshall and Roger Clapp (1985) surveyed for vireos in the park lands and found 9 birds in three major canyon drainage's and estimated 8 to 18 pairs in the lower portion of five canyons in BBNP.

In 1986 a formal survey was not conducted in BBNP, Scott, Bellamy, Simmons, Davin and McKinney searched for vireos and found a total of 4 birds in two canyons in the Chisos Mountains complex.

In 1987, I surveyed areas of suitable habitat in the Chisos Mountains in BBNP, and added Brushy Canyon (BGWMA) and Texas Nature Conservancy (TNC) lands adjacent to BGWMA, and portions of adjacent private ranches to the survey area. These lands were added because they contained areas of potential habitat. A total of 9 territorial males were located in BBNP, and 1 male was observed in Brushy Canyon (BGWMA). In addition, one nest was located in an evergreen sumac (*Rhus virens*) in BBNP.

Dr. Joe Marshall and I surveyed Brushy Canyon (BGWMA) in early March 1988, and located two previously used black-capped vireo nests. During April through June 1988, I made periodic trips to this area and located 2 adult pairs, and 1 lone male (n=5). Three birds were located on lands owned by TNC and a private ranch, and 1 pair was on BGWMA. One nest on the TNC property fledged 1 brown-headed cowbird (*Molothrus ater*) and no vireos.

BBNP lands held a total 10 males and 6 females (n=16) in 1989 (Griffin 1989). Surveys were not conducted on TNC or BGWMA in 1989.

The 1990 survey in BBNP yielded a total of 13 black-capped vireos and the same number was estimated in 1991 (D. Neighbor pers. comm.). No surveys were conducted on BGWMA in 1990 or 1991.

The 1992 field surveys yielded 14 birds in BBNP and 2 lone males on BGWMA. In 1993 field surveys in BBNP a total of 19 black-capped vireos was recorded, and on BGWMA a total of 3 males and 2 female (n=5) was observed. In 1994 the survey on BGWMA

totaled 5 black-capped vireos (2 pair and 1 lone male). No data was available from BBNP.

Field surveys on the BGWMA in 1995 totaled 7 vireos, and BBNP recorded an all time high of 32 individuals, and 2 nests. No cowbird parasitism was reported (M. Fleming, BBNP, pers. comm.).

Extended drought conditions persisted in west Texas in 1996, and only 2 pairs of black-capped vireos were located on private lands, and 2 territorial males were located on BGWMA. Surveys in BBNP yielded a total of 24 black-capped vireos, a decrease of 8 individuals from the 1995 survey (R. Skiles, BBNP, pers. comm.).

In 1997, 4 black-capped vireos were located on BGWMA and private lands. Drought conditions were extreme. No report was available from BBNP.

Severe drought conditions prevailed in west Texas in 1998 and only 2 black-capped vireo males were located on the BGWMA. The traditional area of use in Brushy Canyon was unoccupied; the 2 vireos that were located were approximately 6 miles south of the traditional site. This area is within the Brushy Canyon complex (Appendix A.). No report was available from BBNP.

Scattered reports on black-capped vireo occurrence in northern Mexico range from the sate of Tamaulipas to Chihuahua (Graber 1961). Marshall reported vireos from the Serranias Del Burro lower elevations, and from the Sierra Encantada in northern Coahuila (Marshall and Clapp 1985). Populations have been estimated from 3,139 to 9,463 pairs of black-capped vireos for northern Coahuila (Benson and Benson 1990). However, only 28 individuals were actually observed (Benson and Benson 1991, Scott and Garton 1991).

While conducting work on "*Proyecto De Las Aves De Coahuila, Mexico,*" from 1993 to 1997, Sellers and I documented populations of breeding black-capped vireos in the Serranias Del Burro on three ranches. Black-capped vireo observations were incidental to other fieldwork. In July 1998, two areas on one private ranch in the SDB were surveyed for presence/absence of black-capped vireos. A total of 46 singing males was documented. Both survey areas were located in valleys containing extensive grasslands bordered by oak motts and other deciduous vegetation on the edge of pine-oak woodlands. Survey Area #1 contained an estimated 4 hectares, a total of 26 males were heard singing or observed. Survey Area #2 contained an estimated 6 hectares and 20 males were either heard or observed. In addition black-capped vireos were heard or seen at six other locations on this particular ranch, and two additional ranches at lower elevations. The habitat is different from that found in typical black-capped vireo habitat in western and central Texas. The Serranias Del Burro southeast side has a mixture of vegetation representing the high Chihuahuan desert, mid-elevational Chihuahuan Desert, Tamaulipan thorn-scrub and eastern Piedmont. Territories were located in a mixture of habitats ranging from the typical shrubby growth of irregular height, to pine-oak woodland with dogwood (*Cornus florida*), with Chihuahuan Desert yucca species

growing alongside ponderosa pine (*Pinus ponderosa*), and prickly pear cactus (*Opuntia* spp.) However, the bird's presence in this type habitat dictates which habitat is suitable, and the observer must be able to discard preconceived ideas of what black-capped vireo habitat is. The highest elevation black-capped vireos were located in was 1820 m and the lowest elevation was 975 m. Brown-headed cowbirds are present in small numbers and are found in cattle corrals, and in pastures with grazing livestock. Rainfall is more abundant on the southeast side of the Serranias Del Burro than on the western side, or in adjacent lands in western Texas. During the field season 2000 black-capped vireos were heard at six locations on one ranch in the Serranias Del Burro. Additionally, later in the season vireos were heard in the Sierra Del Carmen in desert scrub and oak brush habitat. During the survey we sampled only a small portion of the available suitable habitat located in the Serranias Del Burro in northern Coahuila. The area is extensive and the surrounding Sierra Encantada, Maderas Del Carmen, Sierra Del Carmen, and Sierra Rositas all contain excellent black-capped vireo habitat. As part of the survey effort in northern Mexico, 50 copies of the TPW/USFWS leaflet on black-capped vireo ecology was distributed to ranchers and interested individuals.

HABITAT AND SURVEY AREAS

The BGWMA is located in southeastern Brewster County, 93 km south of Marathon. Over 100,000 acres in extent, the BGWMA is the largest wildlife management area owned by TPW. The BGWMA joins BBNP on its western boundary, and to the south shares the international boundary with northern Coahuila, Mexico, along a 40-km stretch of Rio Grade. The landscape of the area is typical Chihuahuan Desert scrub/grassland with rugged mountains and dry canyons.

The black-capped vireo habitat on BGWMA is very distinct, consisting of small numbers of trees scattered about clumps of bushes. The bushes and shrubs are in the open and their foliage reaches the ground (McKinney 1987). The vegetation occurs in clumps, and is separated by rocks, cactus and patches of native grasses. Water is scarce to non-existent in some areas. On the BGWMA and adjacent private properties the vireos are located in a broad vegetation zone of mixed broadleaf bush-cactus areas with scattered junipers and sandpaper oak (*Quercus pungens*). The highest elevation that black-capped vireos have been located is 1126 m and the lowest is 916 m. All territories have been located in, or on the rim of dry washes in the Brushy Canyon complex. This canyon is extensive, meandering for over 17 km in a southerly direction, and is considered an extension of the Sierra Del Carmen range of northern Mexico.

In adjacent Mexico, the Serranias Del Burro lies directly east, and is separated by a large valley, from the Sierra Del Carmen. The Serranias Del Burro is located on what was earlier known by geologist as the "Coahuila Platform" (F. Daughtery pers. comm.). This area consists of limestone mountains with alluvium filled valleys, which run northwest as a connecting chain from the Rocky Mountains to the Sierra Madre Oriental of Mexico. The Serranias Del Burro is a 201-km long anticline of low topographic relief, which broadens to the south from its northern edge at the Rio Grande. The vegetation is very diverse; being influenced by both Tamaulipan thorn scrub and high Chihuahuan Desert

vegetation associations (Table 1.). Average rainfall for 16 years at one ranch located in the Serranias Del Burro averaged 760 mm annually, whereas the BGWMA is more arid, averaging around 150 to 235 mm annually (McKinney 1995). Associated bird species were documented for survey areas in Texas and northern Mexico (Table 2.) Average rainfall for 16 years at one ranch located in the Serranias del Burro averaged 760 mm annually, whereas the BGWMA and other areas of adjacent habitat in western Texas is more arid. .

Table 1. Dominant vegetation in black-capped vireo habitat on Black Gap Wildlife Management Area in western Texas, and in the Serranias Del Burro (SDB) in Coahuila, Mexico.

Plant Species	BGWMA	SDB
Rhus virens	X	X
Rhus trilobata	X	X
Rhus microphylla	X	
Cornus florida		X
Cercis canadensis	X	X
Chilopsis linearis	X	X
Juniperus ashei		X
Juniperus deppeana		X
Juniperus flaccida		X
Juniperus erythorcarpa v. Coahuilensis		X
Disopyros texana	X	X
Juglans microcarpa	X	X
Pinus ponderosa		X
Prunus serotina v. virens		X
Fraxinus greggii	X	X
Celtis reticulata		X
Leucaena retusa	X	X
Dasylirion leiophyllum	X	X
Dasylirioin texanus		X
Cercocarpus montanus	X	X
Ungnadia speciosa	X	X
Yucca carneosana	X	X
Yucca rostrata	X	X
Yucca torreyi	X	
Quercus pungens	X	X
Quercus glaucoides		X
Quercus intricata		X
Quercus gravesii		X
Quercus emoryi		X
Sapindus saponaria		X
Mahonia trifoliata	X	X

Pistacia mexicana		*X*
Agave lechuguilla	*X*	*X*

Table 2. Associated bird species on Black Gap Wildlife Management Area in western Texas, and Serranias Del Burro, Coahuila, Mexico.

Species	BGWMA	SDB
Cathartes aura	*X*	*X*
Callipepla squamata	*X*	*X*
Colinus virginianus		*X*
Zenaida asiatica	*X*	*X*
Zenaida macroura	*X*	*X*
Geococcyx californianus	*X*	*X*
Bubo virginianus	*X*	*X*
Otus kennicotti		*X*
Micrathene whitneyi	*X*	*X*
Otus asio		*X*
Phalaenoptilus nuttallii	*X*	*X*
Cordeiles minor	*X*	*X*
Archilochus alexandri	*X*	*X*
Aphelocoma ultramarina		*X*
Picoides scalaris	*X*	*X*
Tyrannus verticalis	*X*	*X*
Tyrannus vociferans		*X*
Myiarchus cinerascens	*X*	*X*
Sayornis saya	*X*	*X*
Corvus corax	*X*	*X*
Parus bicolor		*X*
Auriparus flaviceps	*X*	*X*
Catherpes mexicanus	*X*	
Thryothorus ludovicianus		*X*
Salpinctes obsoletus	*X*	
Polioptila caerulea	*X*	*X*
Polioptila melanura	*X*	*X*
Mimus polyglottos	*X*	*X*
Vireo bellii	*X*	*X*
Vireo huttoni		*X*
Vireo vicinior	*X*	*X*
Vireo olivaceus		*X*
Cardinalis cardinalis	*X*	*X*
Cardinalis sinuatus	*X*	*X*

Guiraca caerulea	*X*	*X*
Passerina veriscolor	*X*	*X*
Passerina ciris	*X*	*X*
Pipilo fuscus	*X*	*X*
Amphispiza bilineata	*X*	*X*

(A.O.U. 1983)

METHODOLOGY

Surveys in Texas and Mexico were conducted following the protocol set forth by the USFWS Ecological Field Services Offices at Austin, Texas. Vireos were not mist-netted or banded, and no attempt to trap cowbirds was performed. Because of the large numbers of Mexican jays in the Serranias Del Burro in Coahuila, Mexico, recorded playbacks of vireo songs was not utilized.

SURVEY RESULTS AND DISCUSSION OF THE 2000 FIELD SEASON

The BGWMA was surveyed in April and May for nesting black-capped vireos. A total of 4 singing males were located in April on adjacent private property. No vireos were located on the BGWMA. Nests were not observed, nor females. Big Bend National Park did not have a report available at this time.

Drought conditions were severe in western Texas, and in adjacent northern Mexico. Cursory surveys were conducted in the Serranias Del Burro in mid April. Vireos were heard singing at six locations on one private ranch. In June while conducting other fieldwork in Mexico, black-capped vireos were heard in patches of oak-scrub in the vicinity of the Sierra Del Carmen protected area.

The vireo populations in western Texas continue to remain small, and appear to be confined to the lower Big Bend Region. These two small populations may represent the edge of a much larger population in northern Coahuila, Mexico. The populations in western Texas are located where the Mexican mountains enter the lower Big Bend Region, and form a natural corridor for songbirds. Extensive presence/absence surveys need to be conducted in northern Mexico to determine the extent of the range and distribution of black-capped vireos.

MANAGEMENT RECOMMENDATIONS

1. Continue surveys on an annual basis in western Texas.
2. Obtain landowner permission and funds to conduct a cooperative project with a Mexican university and TPW to formally survey for presence/absence of black-capped vireos in Coahuila, and portions of the state of Nuevo Leon, Mexico.
3. Continue to provide black-capped vireo information and recommendations on habitat management to landowners.
4. Obtain funding to produce and publish a brochure on black-capped vireos in Spanish for use in northern Mexico.

LITERATURE CITED

Barlow, Jon C. 1967. Nesting of the black-capped vireo in the Chisos Mountains, Texas. Condor 69: 605-608 pp.

Benson, R.H. and K.L.P. Benson. 1990. Estimated size of black-capped vireo populations in northern Coahuila, Mexico. Condor 92: 777-779 pp.

Cruickshank, A.D. 1950. Records from Brewster County, Texas. Wilson Bull. 62: 217-219 pp.

Graber, J.W. 1957. A bioecological study of the black-capped vireo (*Vireo atricapillus*) Ph.D. Diss., Univ. Okklahoma, Norman, Okla. 203 pp.

Griffin, B.G. 1988. Survey of the status of the black-capped vireo in Big Bend National Park, Brewster County, Texas. Office of Resource Mgmt. BBNP.

Marshall, J.T. Jr., R.B. Clapp, and J.A. Grzybowski. 1985. Status report: (*Vireo atricapillus*) Woodhouse, black-capped vireo. Report, Office of Endangered Species, U.S. Fish and Wildl. Serv., Albuquerque, New Mexico. 26 pp.

McKinney, Bonnie R. 1987. Population status of the black-capped vireo (*Vireo atricapillus*) Woodhouse, in the Big bend Region of Texas. Report submitted to Office of Endangered Species, U.S. Fish and Wildl. Serv. Albuquerque, New Mexico.

_____ 1988. The status of *Vireo atricapillus* Woodhouse, in Brushy Canyon Preserve, TNC. Report submitted to Texas Nature Conservancy and Office of Endangered Species, U.S. Fish and Wildl. Serv., Albuquerque, New Mexico.

_____ 1992. Status report on black-capped vireo (*Vireo atricapillus*) Woodhouse, on Black Gap WMA, Brewster County, Texas. Report to: Texas Parks and Wildlife Department, Austin, Texas. (WNBBKFK ESECC6)

_____ 1994. Status report on the black-capped vireo (*Vireo atricapillus*) on the Black Gap WMA, Brewster County, Texas. Report submitted to Texas Parks and Wildlife Department, Austin, Texas. WNBKFK ESEC6.

_____ 1995. Status report on the black-capped vireo (*Vireo atricapillus*) Woodhouse on the Black Gap WMA, Brewster County, Texas. Report submitted to Texas Parks and Wildlife Department, Austin, Texas. WNBKFK ESEC6.

_____1996. Status report on the black-capped vireo (*Vireo atricapillus*) Woodhouse, on the Black Gap WMA, Brewster County, Texas. Report to Texas Parks and Wildlife Department, Austin, Texas. WNBKFK W125R

_____, and Elizabeth Spence de Sellers. 1998. Proyecto de las aves de Coahuila, Mexico. (Unpubl. ms.).

_____. 1998. Proyecto de las aves de Coahuila, Mexico. P. 312 in Cross Border Waters: Fragile treasures for the 21st century. Ninth U.S./Mexico Border Conference on Recreation, Parks and Wildlife. 1998 Proceedings. RMRS-P-5. Fort Collins, Colorado. U.S. Dept. of Agric., Forest Sercice, Rocky Mountains Research Station. 341 pp.

_____. 1998. Status report on black-capped vireo (Vireo atricapillus) in: Surveying, monitoirng and managing select endangered/ threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Grant Agreement No. 1448-20181097 G932.

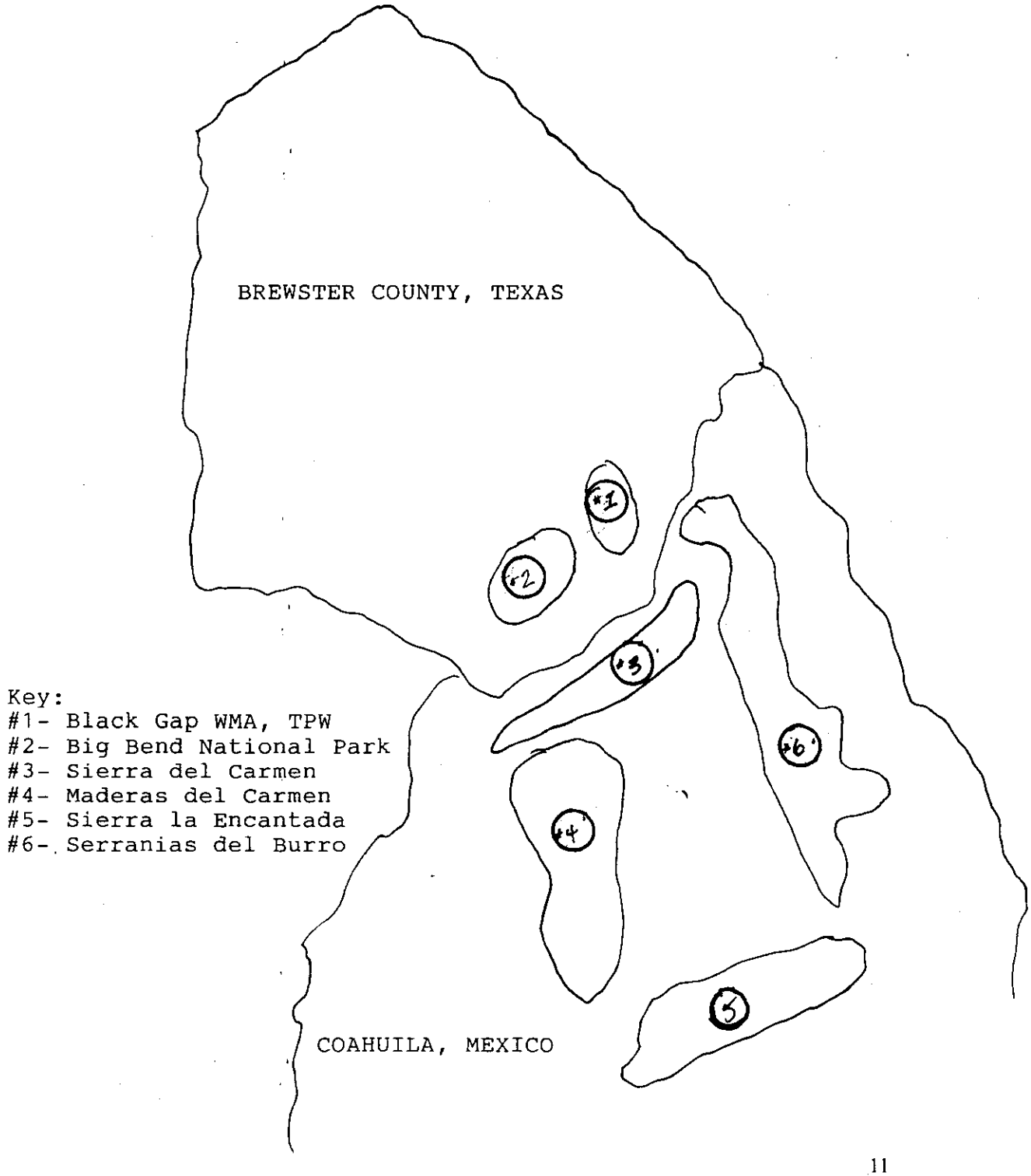
_____. 1999. Status report: The black-capped vireo at Black Gap Wildlife Management Area, western Texas and Serranias Del Burro, Coahuila, Mexico. in Surveying, monitoring and managing select endangered/ threatened species of concern in the Trans-Pecos ecoregion of western Texas. Rept. prepared for USFWS, Albuquerque, New Mexico and Texas Parks and Wildlife, Austin, Texas. Section 6 project: WER39 ESEC6.

Neighbor, Douglas. 1990-91. Survey status report: Vireo atricapillus Woodhouse, prepared for NPS at Big Bend National Park, Texas.

VanTyne, J.V. and George M. Sutton. 1937. The birds of Brewster County, Texas. Misc. Publ. Zool. Univ. Mich. No. 3

APPENDIX A.

Appendix A. General Locations of Black-capped Vireos in Western Texas and Adjacent northern Mexico.



Key:
#1- Black Gap WMA, TPW
#2- Big Bend National Park
#3- Sierra del Carmen
#4- Maderas del Carmen
#5- Sierra la Encantada
#6- Serranias del Burro

Attachment C:

Final Report: Terlingua Creek cat's eye.

INTRODUCTION

The Terlingua Creek cat's-eye (Cryptantha crassipes) was Federally listed as endangered on September 30, 1991 (USFWS 1991). Critical habitat was not designated.

Known only from a small area in Brewster County, Texas (Figure 1.), this species is reported as endemic to a unique geological area (USFWS 1993). This formation is composed of silty limestone with dull yellow platelets. Vegetation is scarce, and bentonite hills dot the landscape. The Recovery Plan (USFWS 1993) lists ten sites containing $\geq$ 5,000 individual plants. All populations are located on private land in an area with many absentee landowners, unclear land titles, and property development.

Threats to the Population

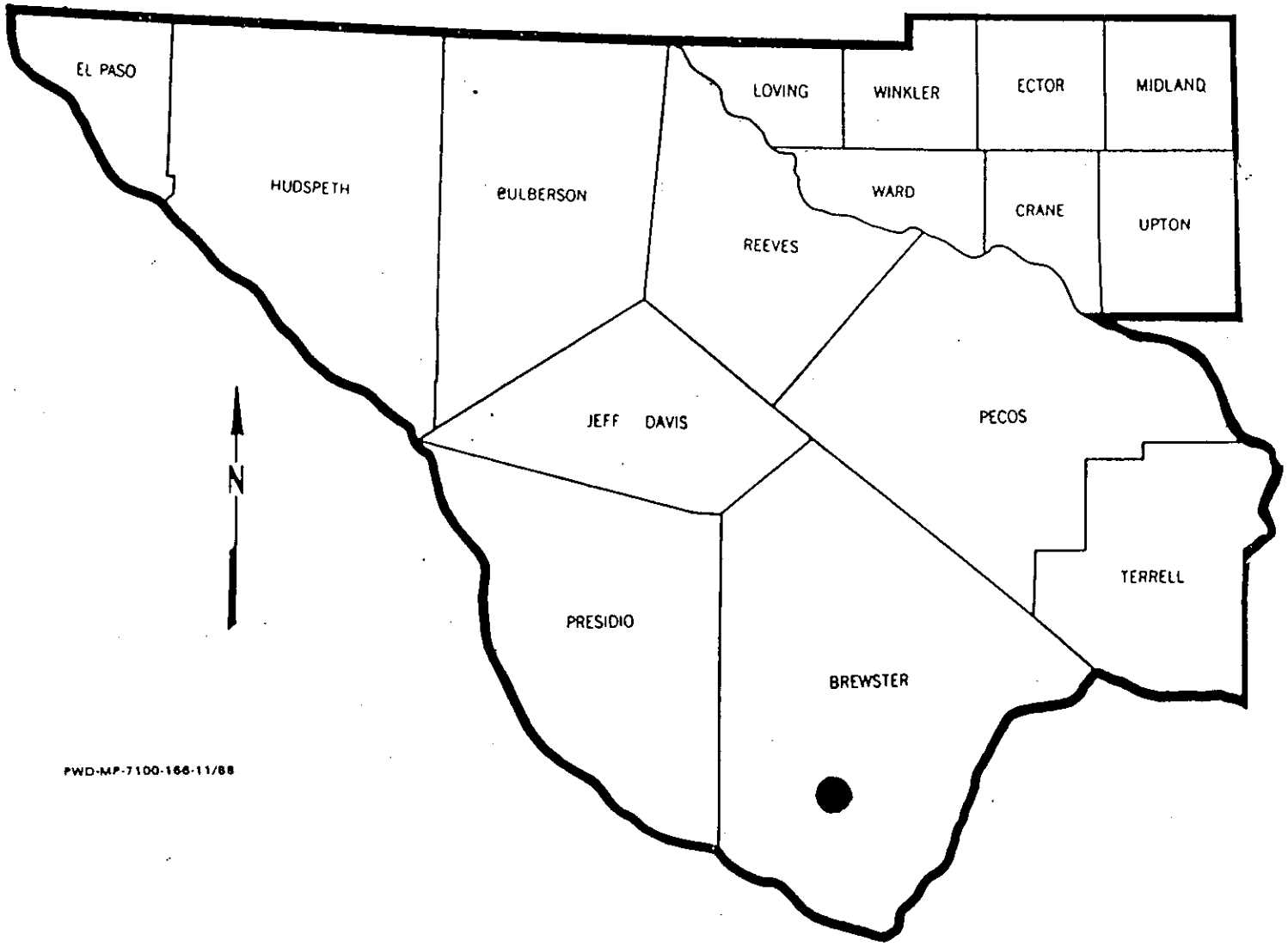
The biggest threat to Cryptantha crassipes is habitat destruction. The unique geologic features of this area combined with the habitat specific requirements of cat's-eye and the low number of plants in this population magnify the threat of habitat destruction. There are many small tracts of land, as well as several large parcels, and several ranches also surround the area. With the high number of absentee landowners and few fences or gates, the area is impacted by trespassers using dune buggies and ATV's. In addition there is a maze of roads in the area where the population occurs. Currently there are over 200 lawsuits pending on these properties. Title to land is unclear, one individual has purchased many of the warranty deeds to property, and individuals who thought they actually owned the lands now are involved in court cases over the properties. Several bentonite mining companies are very active in the area.

TAXONOMY AND MORPHOLOGY

Terlingua Creek cat's-eye is a member of the Borage (Boraginaceae) family. The silvery stems of this erect perennial rise from a mound of hairy, gray leaves, and are topped with clusters of white flowers with yellow centers. The species was first discovered by V.R. Cory in the late 1930's, and described by I. M. Johnston (Johnston 1939).

Poole (1994) describes the morphology of this species as; "a silvery perennial 15-25 centimeters (6-10 inches) tall. A dense mound of leaves develops on top of a woody base. The leaves are narrowly lance-shaped, more or less pointed, and covered with a copious amount of tiny white hairs and bristles. The lower leaves are up to 6 centimeters (2.5 inches) long and 7 millimeters (0.3 inches) wide, becoming smaller up the slender stems. The erect stems are hairy, bristly, and as tall as the plant. At the tips of the unbranches stems are flower clusters up to 2.5 centimeters (1inch) in diameter. The bristly hairy calyx increases to 11 millimeters (about 0.5 inch) in fruit. The slender cylindrical corolla tube is 8-9 millimeters (about 0.3 inch) long and abruptly expands into a flat five-lobed limb, which is about 2 millimeters (about 0.1 inch) wide. The corolla is white with bright yellow knobs arising amongst the laid-back lobes. The flowers are dimorphic and

Figure 1. Map of general distribution of Terlingua Creek cat's-eye.



heterostylic; that is, there are two forms of flowers: one with short stamens and long stles, and the other with long stamens and short styles. The fruit is composed of four seeds (nutlets). The gray nutlets are egg-shaped , shiny, and almost smooth. Each nutlet is 2.8-3.8 millimeters (0.1-o.15 inch) long and 2.5-3 millimeters (about 0.1 inch) wide.

LIFE HISTORY

Terlingua Creek cat's eye occurs in the arid lands located in southern Brewster County, Texas. The area has cool dry winters, and very hot summers. Most annual precipitation occurs in mid to late summer with annual rainfall averaging around 23 cm (Bomar 1983). This rainfall average was taken from Presidio, Texas where the nearest weather station with similar climate is located. Precipitation levels may vary somewhat for the two areas.

All known sites of cat's-eye are located on what is called "Fizzle Flat," which is a crusty, creamy yellow limestone which breaks down into small angular uniform fragments (Moon 1953). The Soil Conservation Service (SCS 1973) maps all known sites as the Badlands-Vieja association. The "Badlands" are locally referred to as a "moonscape." This area is very dry, barren, and desolate with low rounded hills of bentonite dotting the landscape. Vegetation is sparse, consisting mainly of desert scrub and shrubby woody plants (Table 1.).

Table 1. Associated plant species.

Common Name	Scientific Name
Schott's acacia	*Acacia schottii*
Shaggy stenandrium	*Stenandrium barbatum*
Creosotebush	*Larrea tridentata*
Damianita	*Chrysactinia mexicana*
Range ratany	*Krameria glandulosa*
Rough tiquilia	*Tiquilia hispidissima*
Gyp machaeranthera	*Machaeranthera wrightii*
Havard wild buckwheat	*Eriogonum havardii*
Dog pear cactus	*Opuntia grahamii*
Chihuahua ringstem	*Anulocaulis leiosolerus v. lasianthus*

DISTRIBUTION AND SURVEYS

The known sites of *Cryptantha crassipes* are found within a 10 km radius in the Terlingua Creek drainage in southern Brewster County, Texas. Several unconfirmed reports exist for the Lajitas area, and from Big Bend National Park.

During the past three years visits were made to this area in April, May and June to survey known populations. One large parcel of land previously surveyed by Poole (1987) was

located and landowner permission obtained to survey on this property. On this particular site, an estimated total of >400 individual plants was observed. This tract of land is afforded some protection because it is part of a private ranch (McKinney 1998). However, there is a lawsuit pending for legal title to this property. Over 200 lawsuits in this area are pending, and compound the problems of surveys. The person living on the land, or the absentee landowner may give permission for surveys to be conducted, but because of the pending lawsuits over legal title and ownership the issues are clouded and the true owner of the land may not be aware of surveys being conducted, or may not want surveys conducted. Attempts were made to contact the individual that has filed the lawsuits, however, he declined to discuss the issues.

Due to the xeric conditions cattle do not graze the area. Nontraditional use continues in the form of trespass vehicles, dune buggies, ATV's and mining activities.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS

1. Seeds should be collected during years of high production and propagated in facilities in western Texas such as the Chihuahuan Desert Research Institute at Alpine, Texas or in Arizona at the Desert Botanical Garden.
2. Sites with similar geologic, vegetation and climatic conditions such as the Big Bend Ranch State Park should be evaluated as areas for potential establishment of new populations that could be monitored and protected with continuity.
3. Continue monitoring when possible.

LITERATURE CITED

Bomar, G.W. 1983. Texas weather. Univ. of Texas Press, Austin, Texas.

Johnston, I. M. 1939. Studies in the Boraginaceae, XIII. New or otherwise noteworthy species chiefly from the western United States. J. Arn. Arb. 20: 375-402.

McKinney, Bonnie R. 1998. Status report on Terlingua Creek cat's-eye (*Cryptantha crassipes*). Report prepared for Texas Parks and Wildlife, Austin, Texas and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Grant Agreement No. 1448-20101097 G 932.

_____. 1999. Status report on Terlingua Creek cat's eye (*Cryptantha crassipes*) in: Surveying, monitoring and managing select endangered/ threatened species of concern in the Trans-Pecos ecoregion of western Texas. Rept. prep. for USFWS, Albuquerque, New Mexico and Texas Parks and Wildlife, Austin, Texas. Section 6 project: WER 39 ESEC6.

Poole, J.M. 1987. Status report on *Cryptantha crassipes*. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Soil Conservation Service. 1973. General soil map of Brewster County, Texas. U.S. Dept. of Agriculture.

U.S. Fish and Wildlife Service. 1993. Draft: Terlingua Creek cat's eye (*Cryptantha crassipes*) Recovery Plan. U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico. 69 pp.

Attachment D.

Final Report: Nellie Cory Cactus

INTRODUCTION

The Nellie Cory Cactus (*Coryphantha minima*) was listed as endangered on November 7, 1979, by the U.S. Fish and Wildlife Service (44FR64740); it is listed as endangered in the state of Texas.

TAXONOMY

A.R. Davis first collected the Nellie cory cactus in 1931 near Marathon, Texas in Brewster County (Benson 1982). Ralph O. Baird (1931) originally described this cactus, and his description did not include a Latin account. In 1934, Croizat described the same plant as *Coryphantha nellieae*, obviously not aware that this tiny cactus had been described three years earlier (Croizat 1934). Backeberg moved the species from *Coryphantha* to *Escobaria nellieae* (Backeberg 1961), and Weniger (1970) refers to this cactus as *Mammillaria* nellieae. This miniature cactus is named after Nell Davis, a long time resident and ranch woman from the Marathon Basin. She was affectionately known as "Aunt Nell," and to this day the cactus is locally referred to as "Aunt Nell's cactus."

MORPHOLOGY

Heil (1984) described the morphology of *Coryphantha minima* as; "plants simple or branching, ovoid, 1.2-2.5 cm long, 1.2 cm I diameter; tubercles subcylindroid, 1.5-2.3 mm vertically, 1.5-2.3 mm borad, protruding 3 mm; areoles somewhat wooly; spines dense, about 20 per areole, ashy gray or pinkish, in 2 or 3 series, those of the inner series longer and thicker especially in the upper part of the areole, up to 4.5 mm long, bulbous basally, cylindroidal with an abruptly acute apex, circular in cross section (Benson 1970); floers rose-purple, about 2 cm tall and up to 2.5 cm in diameter; filaments green; anthers pale orange; fruit ovoid, green, up to 7 mm long; seed about 0.5 mm long, black.

PHENOLOGY

Buds began forming in April, and flowers appear in May. The flowers completely cover the top of this tiny cactus. The magenta blooms last two or three days, opening in mid-morning. In June the fruits form and are green and ovoid. The dehiscence of fruits appears to be slow and the ovary walls do not break down. It would take heavy rains to dislodge the fruits from the plants.

HABITAT AND DISTRIBUTION

This miniature cactus grows in the semi-desert grasslands of the Chihuahuan Desert and is restricted in distribution to the Caballos-Novaculite geological formation in the Marathon Basin of Brewster County, Texas. This Novaculite formation is extensive, covering an estimated 155 km^2 area on private ranches (McKinney 1998). Nellie cory cactus is found growing among the Novaculite chips on hillsides and ridgetops (Figure 1.)

Figure 1. Typical habitat of Nellie Cory Cactus, Marathon Basin, Texas.

The Novaculite outcrops form ridges that are resistant to erosion and support perennial grasses and a variety of shrubby plants and cactus (Table 1.). Nellie Cory cactus is often found growing in association with a species of spikemoss (*Selaginella* spp.), and Davis' green pitaya (*Echinocereus virdiflorus* var. *davisii*) which is also federally and state listed as endangered. Hester's Cory cactus (*Coryphantha hesteri*) is very abundant in this same habitat. Nellie Cory cactus is most abundant in the fractured chips of Novaculite, and is seldom found growing in grasses. Elevation ranges from 1200 to 144 + m. The average annual precipitation is estimated at 36 to 41 cm (pers. comm. local ranch mgr.).

Table 1. Associated plant species.

Common Name	Scientific Name
Whitethorn acacia	*Acacia constricta*
Blackbrush acacia	*Acacia rigidiula*
Algerita	*Berberis trifoliata*
Woolygrass	*Erinoneuron pulchellum*
Soaptree yucca	*Yucca elata*
Mormon tea	*Ephedra nevadensis*
Purple prickly pear cactus	*Opuntia violacea*
Hester's cory cactus	*Coryphantha hesteri*
Davis' green pitaya cactus	*Echinocereus virdiflorus v. davisii*
Glory of Texas cactus	*Thelocactus bicolor v. flavidispinus*
Pitaya cactus	*Echinocereus stramineus*
Sea urchin cactus	*Coryphantha cornifera v. echinus*
Javelinabush	*Condalia ericoides*
Dogweed	*Dyssodida pentachaeta*
Spinyleaf zinna	*Zinna acerosa*
Chino grama	*Bouteloua breviseta*
Spanish dagger	*Yucca torreyi*
Beargrass, Basketgrass	*Nolina texana*
Sotol	*Dasylirion leiophyllum*
Bitterweed	*Tetraneuris scaposa*
Jimmyfern	*Cheilanthes villosa*
Spikemoss species	*Selaginella spp.*
Allthorn	*Koberlinia spinosa*
Redberry juniper	*Juniperus pinchotii*

The Caballos-Novaculite formation runs southeast, southwest and northeast, and covers a vast amount of private land. The Recovery Plan (USFWS 1984) stated the total population of Nellie Cory cactus was estimated to be 40 to 80,000 plants, with the total distribution being an area 11 km long by 50 m wide. This area appears to be the highway right of way, which is often manipulated by the Texas Department of Transportation (TXDOT), tourists and traffic. The Recovery Plan (USFWS 1984) did not report the true

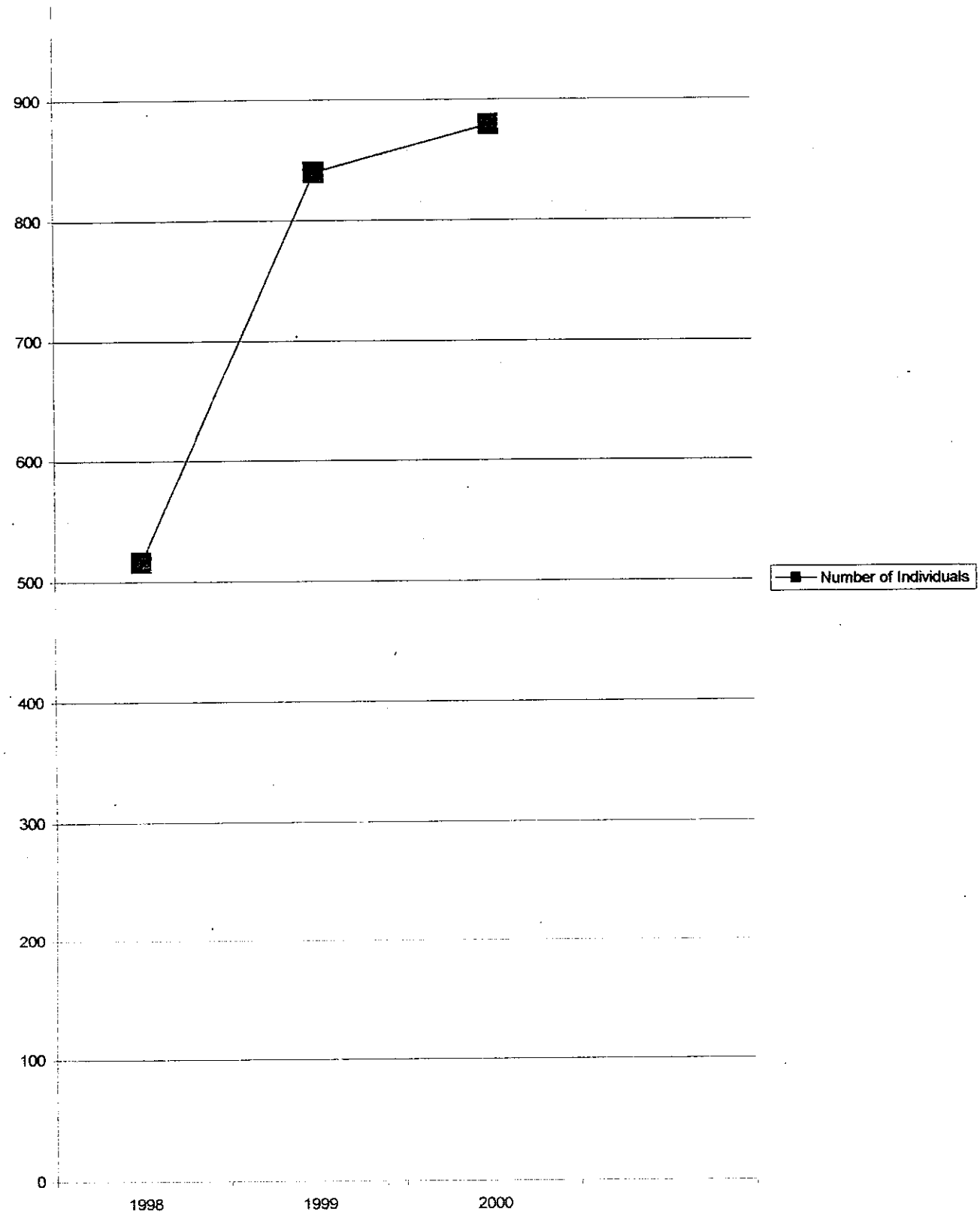
size of the population, as private lands were not surveyed. This cactus does have a clumped distribution, thousands of plants may be found in one area, and several meters away none will be found. However, it is very abundant, and the population covering more than a 155 km^2 area is estimated to be well over one million plants. Possibly the only limiting factor regarding population growth may be the actual extent of the Novaculite formation.

METHODS

Landowner permission was granted to survey for Nellie Cory cactus in 1998. Local ranches cooperating were the integral factor in documenting population and distribution of this species in Novaculite habitat.

A Novaculite ridge was randomly selected and a study plot established that could be monitored over a period of years. The study plot is located on a north-south ridge, close to the center of the Novaculite outcrops in the Marathon Basin. The plot is 35 x 20 m (= 700 m^2) located on a slope of Novaculite. This area had not been previously surveyed. A 15 $inch^2$ Dophmier frame was used because of the small size of the cactus. Condition of each plant was noted, as well as, buds, blooms or fruits. Each corner of the plot was marked with rebar and orange flagging tape, and each individual cactus was marked with red tape on a 10-penny nail driven into the ground alongside the cactus . The 1998 survey revealed a total of 516 individual plants in this plot. Even with the severe drought that west Texas has experienced the past seven years, and the ability of the Nellie Cory cactus to shrink to nearly subterranean depths, the population appeared healthy. Mature plants as well as seedlings were scattered throughout the plot. Seedlings appear to have a high survival rate; this was evident in all of the areas surveyed by the thousands of tiny Nellie's growing in the cracks of Novaculite. Winter and early spring rains in 1999 provided ideal conditions for cactus growth and bloom. Nellie Cory cactus was in full bloom in early May. The Novaculite hills and ridges were covered with magenta blooms. The survey plot yielded a total of 840 plants, most adult plants were in bloom or had buds. The plot increased by 324 individual plants (Figure 2.). The addition of juveniles is apparent, but many of the new individuals located were adults that were probably subterranean during the severe drought conditions in 1998. The 2000 field survey yielded a total of 879 plants, bloom was poor because of the severe drought conditions. The plot did increase by 39 juvenile plants even with the severe drought conditions. Total plants for this plot equals 879.

Figure 2. Annual growth rate of Nellie Cory cactus, 1998-2000 on one study plot.



IMPACTS AND THREATS

The Recovery Plan (USFWS 1984) lists three principal types of threats to Nellie Cory cactus; (a) direct collection of plants by commercial or private collectors, (b) destruction or modification of its habitat by livestock, and (3) natural threats.

The primary objective of the Recovery Plan is to manage the habitat of Nellie Cory cactus so that it can be sustained in its natural habitat at a level where this species can be removed from the Federal list of endangered and threatened species (USFWS 1984).

Recovery criteria for delisting are being met and are outlined below.

A. 1. Remove threats to *Coryphantha minima*. The large population of Nellie Cory cactus are scattered in a clumped distribution over an estimated 155 km^2 area of Novaculite ridges, outcrops and hills. The major population is located on private ranches, and the ranchers are aware of their presence and location. **All populations with the exception of the plants found along the highway right-of-way are located on private lands that have locked gates. "No trespassing" signs are posted on gates and fences, and the ranchers in the area do not allow any collecting of any type of cactus on their properties. Collecting is not a threat to *Coryphantha minima*.**

2. Obtain management rights for existing populations of *Coryphantha minima*. **Ranch owners and managers are already managing for this species by not allowing collection of plants on their property, by posting no trespassing signs, locking gates, and by making no major modifications in habitats. This area has been traditional ranch country since the late 1800's, and will continue to be used in this manner. Landowner permission was granted for surveys to be conducted by Texas Parks and Wildlife (TPW). Study plots were established so that monitoring could be conducted. Area wide surveys were also conducted to determine the presence/absence of Nellie Cory cactus on ranches scattered about the 155 km^2 area of Novaculite. The area ranchers are very aware of this species, as well as other species of endemic cactus on their property, and have been protecting these populations since they were placed on the endangered species list. The populations on the highway right of way is monitored by TPW game wardens, and J. Poole (TPW) previously surveyed the highway population.**

3. Initiate and support studies on population biology and ecology of Nellie Cory cactus. **Study plots have been established and monitored for three years on private ranches with landowner permission. New populations were discovered, and the population is estimated to contain over a million individual plants. The population is not restricted to a 11 km long by 50 m wide area (USFWS 1984).**

B. Destruction or modification of habitat by livestock. **Very seldom do livestock graze on the outcrops, steep hillsides and narrow ridges that support populations of Nellie Cory cactus. These areas are sparsely vegetated and do not contain grasses palatable to cattle for long term grazing. Cattle may occasionally wander onto the hillsides and ridgetops, the terrain is very rough, the Novaculite is razor sharp, and the cactus are so tiny and are found in the cracks and chips of Novaculite that threat of trampling by cattle would be minimal.**

C. Natural threats. **Nellie Cory cactus is found scattered over a vast area. There are no perceived natural threats to this species. This tiny cactus has thrived in this area and was probably quite abundant, and evidently not surveyed for properly at the time of federal listing. The limiting factor in the natural growth and expansion of this cactus may be the extent of the Novaculite habitat that it prefers.**

RECOMMENDATIONS

1. Formal delisting for this species is recommended, it is not endangered. It is protected by private landowners, and is not threatened by livestock or natural threats. Land use practices have not changed in over 100 years of ranching, and there are no plans to change them in the future.
2. Continue periodic monitoring and studies on the ecology of this species.

LITERATURE CITED

Backeberg, C. 1960. Cactaceae. 4: 2017.

Baird, R.O. 1931. American Bot. 37: 150.

Benson, L. 1982. The cacti of the United States and Canada. Stanford University Press, Stanford, California.

Croizat, L.O.M. 1934. Torreya. 34:15.

McKinney, Bonnie R. 1998. Status report on Nellie Cory cactus (*Coryphantha minima*). In: Surveying, monitoring, and managing select endangered/threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas, and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Grant Agreement No. 1448-20181097 G 932.

_____. 1999. Status report on Nellie Cory cactus (*Coryphantha minima*), in: Surveying, monitoring, and managing select endangered/threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas, and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Section 6 Project, WER39 ESEC6.

U.S. Fish and Wildlife Service. 1984. Nellie Cory Cactus Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Weniger, Del. 1984. Cacti of Texas and neighboring states. University of Texas Press, Austin, Texas.

Attachment E.

Final Report: Davis' Green Pitaya Cactus

INTRODUCTION

Davis' green pitaya cactus (*Echinocereus virdiflorus* var. *davisii*) was listed as endangered on November 7, 1979 by the U.S. Fish and Wildlife Service (44 FR 64740), it is also listed as endangered in the state of Texas.

TAXONOMY

Echinocereus virdiflorus var. *davisii* was first discovered in its type locality in the Marathon Basin area of western Texas, by Arthur Houghton in 1931, and was published as *Echinocereus davisii* (Houghton 1931). A type specimen was deposited in the United States National Herbarium. W.T. Marshall thought there were too many similarities with *E. virdiflorus*, and made it a var.- *E. virdiflorus* var. *davisii* (Marshall and Brock 1941). This new name was published without a Latin description, however this was validated in 1960 (Backeberg 1960).

MORPHOLOGY

Davis' green pitaya cactus stems are usually singular, turbinate to turbinate-ovoid; there are 6 to 9 ribs; and 8 to 13 radial spines; the upper ones are shorter, slender, and round, 4 to 7 mm long; the lateral spines are longer, usually flattened, and are 11 to 15 mm long; basally gray and tipped with red; the petaloid perianth parts are yellow-green, up to 2.5 cm long; the fruits are green (Benson 1982).

PHENOLOGY

The buds began forming in early March, and flowers appear in late March or early April. The flowers are conspicuous, and oftentimes are literally the only part of the plant that you see above ground. The blooms are yellowish-green and open mid-morning. The fruits are green and ripen in late April to early May.

HABITAT AND DISTRIBUTION

This small cactus grows in the semi-desert grasslands of the Chihuahuan Desert and is restricted in distribution to the Caballos-Novaculite geological formation in the Marathon Basin of Brewster, County, Texas. This Novaculite formation is extensive, covering an estimated area of 155 km^2 (McKinney 1998). The Novaculite outcrops form ridges that are resistant to erosion and support perennial grasses and a variety of shrubby plants and cactus (Table 1.). Davis' green pitaya grows among the Novaculite chips, and in grasses. It is often found growing in association with spikemoss (*Selaginella* spp.), Nellie Cory cactus (*Coryphantha minima*), and Hester's Cory cactus (*Coryphantha hesteri*). Elevation ranges from 1200 to 1400+ m. The average annual precipitation is 36 to 41 cm (pers. comm. local ranch).

Table 1. Associated plant species.

Common name	Scientific name
Whitethorn acacia	*Acacia constricta*
Blackbrush acacia	*Acacia rigidula*
Algerita	*Berberis trifoliata*
Woolygrass	*Erinoneuron pulchellum*
Soaptree yucca	*Yucca elata*
Spanish dagger	*Yucca torreyi*
Mormon tea	*Ephedra nevadensis*
Purple prickly pear	*Opuntia violaceae*
Hester's Cory cactus	*Coryphantha hesteri*
Nellie Cory cactus	*Coryphantha minima*
Glory of Texas cactus	*Thelocactus bicolor* var. *flavidispinus*
Pitaya cactus	*Echinocereus stramineus*
Sea-urchin cactus	*Coryphantha cornifera* var. *echinus*
Javelinabush	*Condalia ericoides*
Dogweed	*Dyssodia pentachaeta*
Spinyleaf zinna	*Zinna acerosa*
Bouteloua breviseta	*Chino grama*
Beargrass	*Nolina texana*
Sotol	*Dasylirion leiophyllum*
Bitterweed	*Tetraneuris scaposa*
Jimmyfern	*Cheilanthes villosa*
Spikemoss spp.	*Selaginella* spp.
Allthorn	*Koberlinia spinosa*
Redberry juniper	*Juniperus pinchotii*

The Caballos-Novaculite formation runs in a southeast, southwest, and northeast direction, and covers a vast amount of private land. The Recovery Plan (USFWS 1984) stated the total population of Davis' green pitaya as being 20,000 plants over its total know range, and that the area of total distribution was approximately 4 km long x 50 m wide on property owned by two individuals. The area that was surveyed for the Recovery Plan appears to be the highway right-of-way and what could be seen over the fence on private ranches. The highway right-of-way is manipulated by Texas Department of Transportation (TXDOT), tourists, and traffic. The Recovery Plan did not report the true size of the population because most private lands were not surveyed. This small cactus does have a clumped distribution; thousands of plants may be in one small area, and several meters away none may be located. However, it is very abundant, and the population is found in all areas of Novaculite. The population is estimated to contain $\geq$ 500,000 individual plants. The only limiting factor in the growth of this population may be the actual extent of the Novaculite habitat.

METHODS

Landowner permission was granted to survey for Davis' green pitaya in 1998. Local ranchers cooperating in the survey effort were the integral factor in documenting population numbers and distribution of this species in specific Novaculite habitat.

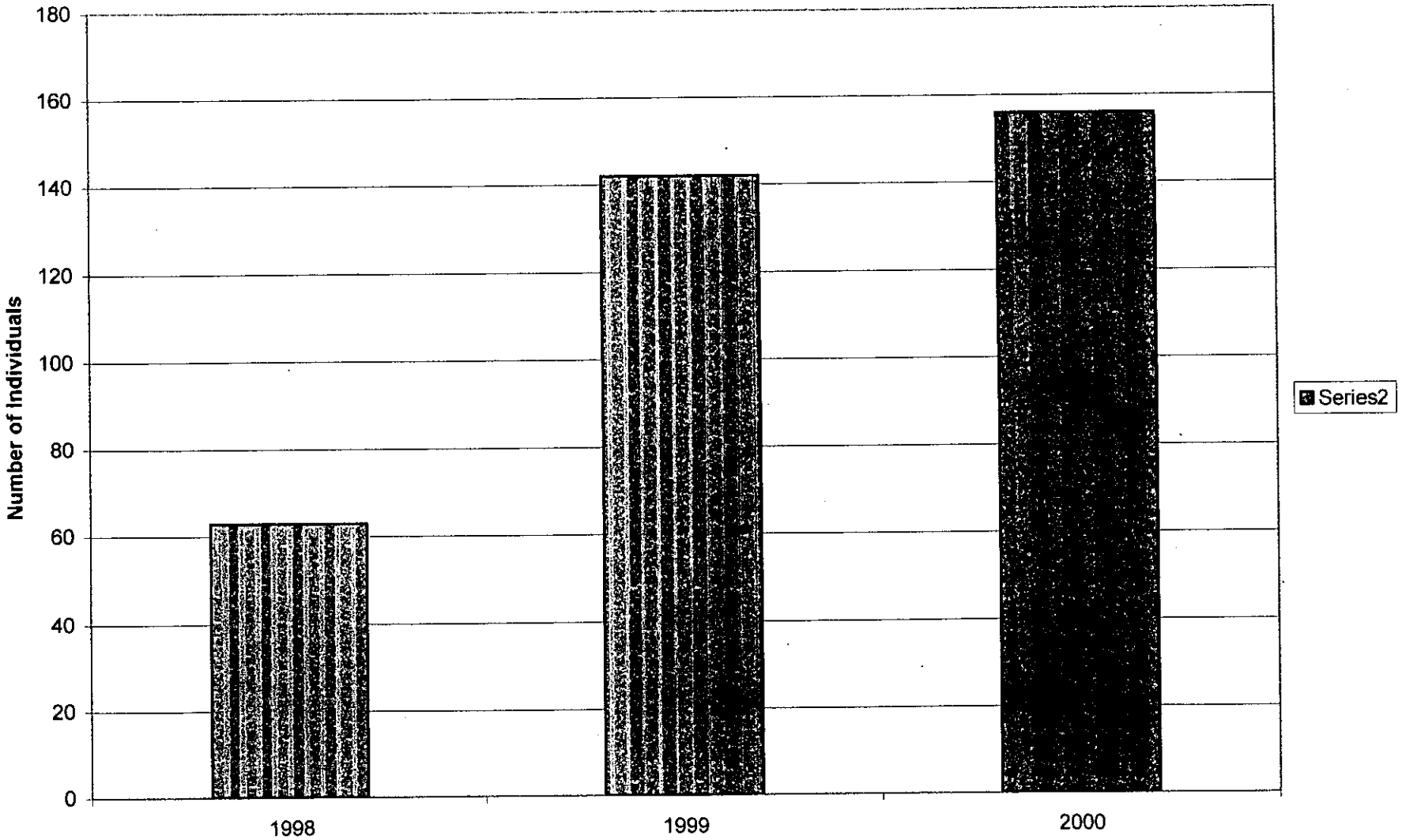
A Novaculite ridge was randomly selected, and a study plot was established in 1998. This plot has been monitored for three consecutive years. The study plot is located on a north-south ridge, close to the center of the Novaculite outcrops in the Marathon Basin. The plot is 35 m x 20 m (=700 m^2) located on a slope of Novaculite. The area had not been previously surveyed. A 15 $inch^2$ Dophmier frame was used because of the small size of the cactus. Condition of each plant was noted, as well as buds, blooms, or fruits. Each corner of the plot was marked with rebar and orange flagging tape. Each individual plant was marked by placing green tape on a ten-penny nail. The nail was driven into the ground beside the plant. The 1998 survey revealed a total of 63 plants in this plot. Drought conditions were severe in much of west Texas and the Davis' green pitaya were subterranean with only a few spines above the ground, and bloom was poor.

Winter and early spring rains in 1999 provided ideal conditions for cactus growth and bloom. Davis' green pitaya was in full bloom in mid-April. The Novaculite hills were sprinkled with the showy yellowish-green blooms. The survey plot had 142 individual plants. Most adult plants were in bloom, or had buds. The plot increased by 79 plants . Both adult and juvenile plants were observed in the plot. Because of the very severe drought conditions in 1998, the adult plants may have been completely subterranean. However, juveniles were present an indicate growth. Several of the most robust plants within the plot were located in the middle of a clump of grass. These plants could very easily be overlooked because of their ability to shrink to subterranean depths, and by growing in clumps of grass where they are concealed.

Drought conditions were severe in 2000, and a total of 156 individuals were counted. The increase in plants (n=14) were all juveniles. Some plants may have been missed because of the severe drought conditions and their ability to shrink underground.

The study plot has increased each year for three consecutive years (Figure 1.). Other areas that were surveyed showed Davis' green pitaya to be abundant all over the 155 km^2 Novaculite habitat.

Figure 1. Study plot, Davis' Green Pitaya, 1998-2000.



IMPACTS AND THREATS

The Recovery Plan (USFWS 1984) lists three principal types of threats to Davis' green pitaya cactus; (a) direct collection of plants by commercial or private collectors, (b) destruction or modification of its habitat by livestock, and (3) natural threats.

The primary objective of the Recovery Plan is to manage the habitat of Davis' green pitaya so that it can be sustained in its natural habitat at a level where this species can be removed from the Federal list of endangered and threatened species (USFWS 1984).

Recovery criteria for delisting this species has been met and is outlined below.

A. 1. Remove threat to *Echinocereus virdiflorus* var. *davisii.* **The large population of Davis' green pitaya cactus is scattered in a clumped distribution over an estimated 155 km^2 area of Novaculite ridges, outcrops and hillsides. The major population is located on private ranches, and ranchers are aware of their presence and location. All populations with the exception of those found along the highway right-of-way are located on private lands that have locked gates. "No Trespassing" signs are posted on gates and fences, and the ranchers in the area do not allow any collecting of any type/species of cactus on their properties. Collecting is not a threat to Davis' green pitaya.**

2. Obtain management rights for existing populations of *Echinocereus virdiflorus* var. *davisii.* **Ranch owners and managers are already managing for this species by not allowing any collecting of plants on their property, by posting no trespassing signs, locking gates, and by making no major modifications in habitats. This area has been traditional ranch country since the late 1800's, and will continue to be used for this purpose. Landowner permission was granted for surveys to be conducted by TPW to determine presence/absence of Davis' green pitaya in the Novaculite habitat in the Marathon Basin. Ranchers also allowed study plots to be established so this species could be monitored to learn more about the ecology and distribution. The area ranchers are aware of this species, as well as other endemic cactus found in this area, and have been protecting these populations since they were placed on the endangered species list. The population on the highway right-of-way was previously surveyed by J. Poole (TPW) and local game warden.**

Edward Anderson (publ. date 2001) had the following to say about private land owners protection of cactus in his book "*The Cactus Family:*" " Sometimes private owners encourage *in situ* conservation. The Trans Pecos Heritage Association was formed by ranchers of west Texas to enforce their strong beliefs in the rights of private landowners and to prevent government interference. This private land is fenced and posted, and trespassers may be either arrested—or shot! Several rare cacti such as *Echinocereus virdiflorous* var. *davisii* grows only on this private land, and though perhaps inadvertent, the association performs an important conservation function by prohibiting people from coming onto their

property. Cacti occurring on this private land are not disturbed, but unfortunately the landowners do not distinguish between those who would collect cacti from the wild and scientists, so the populations of plants often cannot be studied either. I have had the privilege of going onto private land near Sanderson to study *Coryphantha ramillosa*, however, and many ranchers are interested in knowing what they have. They also hope that further studies may show that presently designated threatened or endangered plants of west Texas may not be in as much danger as originally thought."

When TPW approached landowners, they were more than willing to have studies conducted, and helped facilitate the research in many ways. The plants are afforded total protection on the private lands where they grow, and this protection will continue.

3. Initiate and support studies on population biology and ecology of *Echinocereus virdiflorus* var. *davisii.* **Study plots have been established on private ranches with landowner permission. New populations were discovered, and the population is estimated to contain more than 500,000 individual plants. Distribution is scattered over the entire Novaculite habitat, and definitely not restricted to an area 4 km long x 50 m wide as reported in the Recovery Plan (1984).**

B. Destruction of habitat by livestock. **Very seldom do livestock graze on the outcrops, hillsides, and ridgetops that support populations of *Echinocereus virdiflorus* var. *davisii.* The Novaculite habitat is sparsely vegetated, and does not contain grasses palatable to cattle for long term grazing. The hillsides are also steep and cattle cannot negotiate the slopes. Cattle may occasionally wander onto the lower hillsides, but the terrain is rough, and the Novaculite is razor sharp. The threat of trampling by cattle is considered minimal.**

C. Natural threats. ***Echinocereus virdiflorus* var. *davisii* is found in a widely scattered area estimated to contain over 155 km^2 of suitable habitat. There are no natural perceived threats to this cactus. This small endemic cactus has thrived in this area for many years, and was probably quite abundant at the time surveys were conducted for the listing of this species. However, when the surveys were performed for the listing criteria most of the private lands were not surveyed, and a true population size and distribution were erroneously reported. The only limiting factor in the growth of this population may be the extent of the Novaculite habitat it prefers.**

RECOMMENDATIONS

1. Formal delisting for this species is recommended, it is not endangered. It is protected by private landowners, it is not threatened by livestock or natural threats. Land use practices have not changed in over 100 years of traditional ranching, and there are no plans to change land use practices for the future.

2. Continue periodic monitoring.

LITERATURE CITED

Anderson, E.F. 2001. The cactus family. Timber Press, Inc. Portland, Oregon.

Backberg, C. 1960. Cactaceae. 4:2017.

Benson, L. 1982. The cacti of the United States and Canada. Stanford University Press, Stanford, California.

Houghton, A.D. 1931. Echinocereus davisii sp. Nov. Cactus and Succulent Journal. 2: 466.

Marshall, W.T. and T.M. Bock. 1941. Cactaceae. Abbey Garden Press, Pasadena, California.

McKinney, Bonnie R. 1998. Status report on Davis' green pitaya (Echinocereus virdiflorus var. davisii. in: Surveying, monitoring, and managing select endangered/threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas, and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Grant Agreement No. 1448-20181097 G932.

_____. 1999. Status report on Davis' green pitaya (Echinocereus virdiflorus var.davisii. in: Sirveying, monitoring, and managing select endangered/threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas, and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Section 6 Project, WER39 ESEC6

U.S. Fish and Wildlife Service. 1983. Supplement to review of plant taxa for listing as endangered or threatened species. Federal Register 48 (229) (November 1983): 53640-53670.

_____. 1984. Davis' Green Pitaya Recovery Plan.U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Attachment F:

Final Report: Status of Lloyd's Mariposa Cactus

INTRODUCTION

The U.S. Fish and Wildlife Service listed Lloyd's mariposa cactus (*Neolloydia mariposensis*) as a threatened species, November 6, 1979 (USFWS 1987). Threatened status was attained in the state of Texas on April 29, 1983. This species is known from the lower Big Bend Region of western Texas and from several locations in Coahuila, and one location in Nuevo Leon, Mexico. The purpose of this study was to determine the status and distribution of this species, to report on new populations, and to identify any threats to the species.

TAXONOMY

The botanical classification of this small cactus has bounced from one genus to the next, several times. Lloyd's mariposa cactus was first collected by Mr. J. Pickney Hester at the Mariposa Mine in the Big Bend area of western Texas. He placed this species in the *Echinomastus* group (Hester 1945). In 1969, Dr. Lyman Benson described several new species of cactus and made a number of nomenclatural combinations, including placing Lloyd's mariposa cactus in the genus *Neolloydia*. Several cactus experts felt the original name; *Echinomastus mariposensis* best reflected the correct taxonomic placement (Glass and Foster 1975). Weniger (1970) also uses the name *Echinomastus mariposensis*.

E.F. Anderson (1985) published a study of the genus *Neolloydia*, and concluded that the plants called *Echinomastus* by Glass and Foster (1975) as well as other persons, should not be included in this genus. Further studies by "The Cactaceae Consensus Working Group of the International Organization for Succulent Plant Study (IOS), concluded that those plants placed in *Echinomastus* should probably be included in the genus *Sclerocactus* (Anderson and Schmalzel 1997).

Most federal documents refer to this species as *Neolloydia mariposensis*, to avoid confusion, this name will be used in this report.

MORPHOLOGY

Benson (1982) describes Lloyd's mariposa cactus as follows: "The stems are blue-green, ovoid, or obovoid-cylindroid, 6-10 cm long, 4-6 cm diameter; ribs none, the usual position shown by the tubercules; tubercules 6 mm long vertically, 6 mm broad, protruding 3 mm; areoles elliptic, 3 mm diameter, typically 6 mm apart; spines dull tan with chalky blue or partly brown tips, 2-4 per areole, lower central turned and curving downward, mostly 0.5-0.7 times as long as but similar to upper 1-3, these straight, turned upward, the longer 1.5-2 cm long basally, 0.6 mm diameter, acicular, nearly circular in cross section; radial spins white (ashy), 26-32 per areole, spreading evenly and parallel to stem, straight pectinate, the longer $\pm$ 6 mm long, basally 0.2 mm diameter, acicular; flower to 4 cm diameter, $\pm$ 2 cm long; sepaloids with green and reddish purple midribs and pink margins, largest elliptic-lanceloate, to 12 mm long, 3 mm

broad, rounded, marginally scarious and undulate; petaloids pink, largest oblanceolate, to 20 mm long, 3 mm broad, acute to rounded, entire; filaments ± 7.5 mm long; anthers ± 1 mm long; style 10 mm long, 1 mm greatest diameter; stigmas ± 5.2 mm long, green, rather broad; ovary in anthesis 3 mm broad."

Lloyd's mariposa cactus is one of the earliest blooming cactus species in the Chihuahuan Desert. It is not uncommon to see this small cactus blooming in mid-February. Flowers open during the warmest part of the day, and the bloom lasts about 3-4 days. Fruits began to form in late March. When ripe, the fruit splits open on one side and the seeds spill out. Ants and birds may disperse the seeds, as well as heavy rains.

HABITAT

Lloyd's mariposa cactus is found on hot limestone slopes, in the desert flats, and on ridgetops in the lower Big Bend Region of western Texas, and southward into the state of Coahuila, and Nuevo Leon, Mexico. The geology of the area in Texas is composed of various Cretaceous Age formations. These include Santa Elena, Sue Peaks, Del Carmen, Telephone Canyon, Boquillas, Del Rio Clay, Glen Rose, Aguja and Pen. The soils are shallow and rocky composed of crumbling limestone. Plants occur in full sun, mostly on hot south facing slopes. The light colored limestone rock raises the heat index to extremes.

In Coahuila, Mexico in the Cima De La Muralla the habitat is much the same as western Texas (Figure 1.). There is insufficient data on the geological formations in Coahuila, Mexico, but personal observations suggest the limestone rock in the Cima De La Muralla is closely related to the Boquillas limestone. Santa Elena, Boquillas, and several other Upper Cretaceous limestone's extend southward from the lower Big Bend Region toward the Cuatrocienegas Basin (Anderson 1997).

The habitat in the state of Nuevo Leon, Mexico in Lampazos area is xeric, and similar in appearance and vegetation to the Presidio, Texas area of western Texas. Basalt rock, as well as limestone formations are found in this area. However, Lloyd's mariposa is reported from limestone formations in Nuevo Leon also (Jose Guadalupe Avalos Martinez pers. commun.)

Figure 1. Cima De La Muralla, Coahuila, Mexico.

ASSOCIATED PLANT SPECIES

Lloyd's mariposa cactus occurs in the Chihuahuan Desert scrub biotic community (Brown 1994). The habitat is semi-arid, having a small number of shrubby plants and more perennial xerophytes. The following plants were found in association with Lloyd's mariposa cactus.

Cacti:

Living rock cactus	*Ariocarpus fissuratus*
Sea-urchin cactus	*Coryphantha cornifera var. echinus*
Eagle claw cactus	*Echinocactus horizonthalonius*
Texas rainbow cactus	*Echinocereus dasycantha var. neomexicana*
Pitaya	*Echinocereus strammineus*
Cob cactus	*Escobaria tuberculosa*
Golf ball cactus	*Mammillaria lasiacantha*
Englemann prickly pear	*Opuntia englemannii*
Tasajillo cactus	*Opuntia leptocaulis*
Dog pear	*Opuntia schottii*
Warnock's neolloydia	*Neolloydia warnockii*

Vascular Plants:

Catclaw acacia	*Acacia greggii*
Lechuguilla	*Agave lechuguilla*
Purple threeawn	*Aristida purpurea*
Chino grama grass	*Boureloua gracilis*
Sotol	*Dasylirion leiophyllum*
Fluffgrass	*Erioneuron pulchellum*
Mormon tea	*Ephedra torreyana*
Candelilla	*Euphorbia antisyphilitica*
Ocotillo	*Fouquieria splendens*
Guayacan	*Guaiacum angustifolium*
Texas false agave	*Hechtia texensis*
Creosotebush	*Larrea tridentata*
Boquillas sage	*Leucophyllum candidum*
Cenizo	*Leucophyllum frutescens*
Resurrection plant	*Selaginella lepidophylla*
Spanish dagger	*Yucca torreyi*

DISTRIBUTION

Lloyd's mariposa cactus is reported in the Recovery Plan (USFWS 1987) as scattered individuals or occasionally as dense concentrations on hills and ridges in three parts of the Big Bend Region of Texas. One area occupies the southeastern corner of Brewster County, the second area occupies the northeastern portion of Big Bend National Park (BBNP), and the third occupies the eastern portion of Brewster County, north of the Black Gap Wildlife Management Area (BGWMA) (USFWS 1987). Herbarium specimens document the occurrence of Lloyds mariposa cactus in Coahuila, Mexico near the Cuatrocienegas Basin, and between Saltillo and Monclova (1987).

In 1992, I found Lloyd's mariposa cactus to be very abundant on the BGWMA, which is located on the eastern edge of BBNP, and shares a 40 km Rio Grande boundary with the state of Coahuila, Mexico. On the BGWMA, Lloyd's mariposa is found from 2.7 km east of the headquarters in a large band that runs southeast toward the Rio Grande, then eastward following the ridges and slopes of the lower BGWMA, and the area termed the "Rio Grande Wild and Scenic River, Lower Canyons." This band of plants continues to run eastward into Terrell County. Three private ranches north of the BGWMA also contain abundant populations of this cactus.

Adequate surveys were not conducted prior to listing this species as a federal and state threatened species. Only a small portion of BBNP was surveyed, and BGWMA, which probably contains the largest population of Lloyd's Mariposa cactus, was not included in the original survey. Lloyd's mariposa cactus is abundant on federal lands in BBNP, state lands on the BGWMA, and on private ranches north and east of the BGWMA.

In 1994, Anderson and Schmalzel (1997) began a study on this species in BBNP. They also made several trips to the BGWMA. They established study plots on lands within the BBNP, and also searched areas of Coahuila, Mexico for this species. Their conclusions form the study were that Lloyd's mariposa occurred in relatively high densities on suitable outcrops of late Creataceous limestone in the Big Bend area of western Texas, and in the Cuatrocienegas Basin, and Cima De La Muralla in the state of Coahuila, Mexico (Anderson and Schmalzel 1997). They also concluded that their study suggested that the conservation status of Lloyd's mariposa cactus should be reconsidered by the U.S. Fish and Wildlife Service, as "it does not appear threatened".

Two additional locations in Mexico have been documented; one location in the state of Nuevo Leon near Lampazos, and the second is near San Buenaventura, Coahuila (Jose Guadalupe Avalos Martinez pers. commun.).

IMPACTS AND THREATS

The Recovery Plan (USFWS 1987) lists quicksilver mining in the Terlingua-Lajitas area as the cause of major habitat destruction in the early 1900's. In the mid to late 1970's thousands of small cactus were dug for one penny each, and stockpiled in the Lajitas area for sale to commercial dealers as well as tourists; thousands sunburned and died (pers. obsv. McKinney). However, populations in BBNP, BGWMA, and the lower canyons as well as the private ranches north of BGWMA show no obvious signs of collecting, this is evident by the many old and very large specimens in these populations.

Due to present, and past land use in the Terlingua-Lajitas area, this population of Lloyd's mariposa cactus may never recover. However, populations are large enough at other locations in the lower Big Bend Region that the Terlingua population loss is not significant enough to impact the current population. Prior surveys did not indicate the population size in the Terlingua area, therefore the size of the original population remains unknown. The habitat in the Terlingua-Lajitas area is constantly subjected to off road vehicle use, ATV's, dune buggies, mountain biking, and motorcycles. The famous Terlingua Chili Cook-Off is located in an area that contains suitable habitat.

The Recovery Plan (USFWS 1987) also lists grazing as a threat. I do not perceive grazing as a threat to Lloyd's mariposa cactus. There is no livestock on federal lands in the BBNP, the BGWMA does not have livestock, nor do the private lands in the lower canyons of the Rio Grande Wild and Scenic River. One private ranch north of the BGWMA that has a large population of Lloyd's mariposa cactus is not stocked with any type of livestock, and the owners are absent much of the year. The other two private ranches both have cattle operations, because of the harsh habitat that Lloyd's mariposa prefers the threat of trampling by cattle is clearly minimal.

Collecting of plants is also listed as a threat in the Recovery Plan (USFWS 1987). Collecting appears to have diminished greatly in the Big Bend Region in the last twenty years. Lloyd's mariposa cactus is protected from collectors on both state and federal lands. All ranches have locked gates, and "no trespassing" signs. Most roads are privately owned, maintained by the ranches, and receive little use.

The largest concentration of Lloyd's mariposa cactus may be on the BGWMA in the area where desert bighorn sheep (*Ovis_ canadensis*) reintroduction is taking place. The sheep reintroduction area has locked gates, no admittance signs, and is closed to the public year round to hunters as well as tourists. Even in areas on BGWMA where public access is allowed there has been no noticeable disturbance to habitats or signs of collecting.

SURVEYS ON BLACK GAP WILDLIFE MANAGEMENT AREA

Lloyd's mariposa cactus was discovered on the BGWMA in 1992 (McKinney); this was the first documentation of this species occurrence on the management area. Monitoring the population began in 1992, and continues on an annual basis. In 1998 two study plots were established on the BGWMA.

At each study site Anderson and Schmalzel's (1997) methods were followed as closely as possible to provide continuity in data collection. Necessary equipment included camera, film, calipers, ruler, stainless steel round numbered tags, global positioning system (GPS), rebar and flagging tape. One random site was selected on the western end of this species range on the BGWMA, and the second site was randomly selected about midway of the $\geq$ 41 km band of plants in the southeast and eastern portion of the BGWMA.

Each plant was numbered with a stainless steel tag placed beside the plant; the tags were then covered with a small rock. This method is helpful in determining new plant growth, and if plants are missing from the plot. Diameter of each plant was measured in mm with calipers. Height was measured with a metric ruler placed beside the plant, and a wire was placed on top of the plant at a right angle to the ruler to obtain correct height measurement. General condition and reproductive information on each plant was noted.

Plot #1: Camp 7, east of BGWMA Headquarters:

The GPS reading on this plot is: N 29^0 25. 06, and W 102^0 54. 63. Elevation is 652 m. The plot is located on the right side of dirt road leading to Hunt Camp #7, and is 700 m^2 (35 m x 20 m). It is located in a flat of desert pavement composed of shale-like Boquillas limestone. The ground surface is covered with small to medium size (300 mm long) pieces of flat limestone rock. The associated vegetation is sparse, at least 90% of Lloyd's mariposa cactus are exposed to the sun all day, about 10% receive some shade from nearby creosotebushes, or grasses. All age classes of plants were observed in this plot.

1998, 1999 and 2000 Surveys

A total of 52 Lloyd's mariposa cactus was tagged, measured and photographed in this plot in early March 1998. Seedlings were numerous and all age classes were documented. Five plants were dead; 6 small juveniles were present, and 37 plants were in various stages of bloom, and two adult plants had no reproduction. Two plants were damaged with regrowth appearing at the top of the plants. One plant had regrowth on the top and side. It is speculated that javelina (*Dicotyles tajacu*) may occasionally feed on these cactus, particularly when drought conditions persist.

In 1999, Lloyd's mariposa was in full bloom on February 9th. Bloom period was scattered from early February to the second week in March. A small green beetle, much like a ladybug, a black gnat-like insect, and small ants all work the blossoms. This plot had a total of 14 plants in bloom, 18 were found dead, apparently eaten to the ground by javelina (?); 12 plants were not located and 13 new plants were located in the plot, of which 9 bloomed. There was no evidence of collecting, and it is possible the missing plants were overlooked because of their small size.

In 2000, blooms were observed on February 12th. This plot had a total of 26 plants in bloom, 6 were dead, apparently eaten by javelina (?). Twelve new plants, all juveniles were found in this plot.

Plot #2: Borrego Cimmaron, East of BGWMA Headquarters:

The GPS reading on this plot is: N 29^0 36. 02' and W 102^0 47.81'. The elevation is 809 m. The plot is located on a slope at the bottom of a limestone mountain, and is $700m^2$ (35m x 20 m). Vegetation is more diverse in this plot, and cover is heavier. Dominant plants are lechuguilla, sotol, candelilla, Spanish dagger, beaked yucca, purple threeawn, chino grama, fluff grass, and cenizo. Grasses were thicker in this plot and limestone rocks were larger and scattered over much of the plot. An estimated 30% of Lloyd's mariposa cactus was found growing in the shade of other plants or in clumps of grass.

1998, 1999 and 2000 Surveys

A total of 156 Lloyd's mariposa cactus were tagged, measured, and photographed in early March 1998. All age classes were noted as well as dead plants. A total of 8 plants were non-reproductive, 116 plants bloomed, 5 dead plants were observed, and 27 plants were juveniles. Drought conditions were severe in the area, yet the population appeared quite healthy. Little damage by wildlife trampling or feeding was noted (n=5).

In 1999 this plot increased by 49%. A total of 76 new plants were located bring the total number of plants in the plot to 234. Bloom equaled an estimated 45%. Four plants (.05%) were dead or dying and 22 plants were not located.

The 2000 survey showed a total of 261 plants. Bloom was estimated at 50% even though severe drought conditions persisted. The plot increased by 27 pants (juveniles).

DISCUSSION

Lloyd's mariposa cactus has a wide distribution in the Chihuahuan Desert region of western Texas, and portions of northern Mexico in the states of Coahuila, and Nuevo Leon. Anderson (1997) states that "its distribution does not seem to depend greatly on elevation, temperature, nor does it seem to have a close alliance with any species in the Chihuahuan Desert."

Confirmed localities of Lloyd's mariposa cactus in the United States and Mexico has been determined by actual observations, and examination of herbarium specimens (Anderson and Schmalzel 1997, Jose Guadalupe Avalos Martines pers. commun.). Known localities in western Texas include the Terlingua-Lajitas area, BBNP, BGWMA, the Lower Canyons of the Rio Grande Wild and Scenic River, private ranches north of the BGWMA, and east into Terrell County. All of these populations are very abundant and appear quite healthy with the exception of the Terlingua-Lajitas area. In Coahuila, Mexico this species is known from 3 areas; near the Cuatrocinegas Basin, the Cima De La Muralla which is located between Saltillo and Monclova, and near San Buenaventura (Jose Guadalupe Avalos Martinez pers. commun.). This species is known from one area in the state of Nuevo Leon, Mexico, near Lampazos (Jose Guadalupe Avalos Martinez pers. commun.).

This small cactus does occur in very high densities in suitable habitat of late Cretaceous Boquillas limestone. An estimated 41 km long band x $\geq$ 3.2 km wide on the BGWMA contains a very high density of plants. One canyon complex is estimated to contain more than 10,000 plants. In some areas a person cannot walk across an area without stepping on these plants. Lloyd's mariposa cactus is not threatened; the population is estimated at over a million plants and distribution is scattered over a vast area in western Texas and northern Mexico.

MANAGEMENT RECOMMENDATIONS

1. Formal delisting for this species is recommended. It is not threatened and is protected on federal, state and private lands. The populations are not threatened by livestock grazing, or collecting.
2. Work with Mexico's SEMARNAT agency to conduct research on the known populations of Lloyd's mariposa in Coahuila and Nuevo Leon to determing popoulation sizes.
3. Continue periodic monitoring.

LITERATURE CITED

Anderson, E.F. 1986. A revision of the genus *Neolloydia*. Britton and Rose (Cactaceae) Bradleya 4: 1-28.

_____, and Robert Schmalzel. 1997. Final report on Lloyd's mariposa cactus (*Sclerocactus* (*Neolloydia*) *mariposensis*). Prep. for Joint Task Force. Desert Botanical Garden, Phoenix, Arizona.

Benson, L. 1969. The cacti of the United States and Canada. New names and nomenclatural combinations. Cactus and Succulent Journal (U.S.) 41: 185-190.

_____. 1982. The cacti of the United States and Canada. Stanford Univ. Press. Stanford, California.

Brown, David E. (Ed.). 1994. Biotic communities: Southwestern United States and northwestern Mexico. Univ. of Utah Press, Salt Lake City, Utah. PP 169-179.

Glass, C. and R. Foster. 1975. The genus *Echhinomastus* in the Chihuahuan Desert. Cactus and Succulent Journal (U.S.) 47: 218-223.

Hester, J.P. 1945. *Echinomastus mariposensis* Sp. Nov. Desert Plant Life 17: 59-60.

McKinney, Bonnie R. 1992. The status of *Neolloydia mariposensis* on the Black Gap Wildlife Management Area, Brewster County, Texas. Prep. for Texas Parks and Wildlife Department, Austin, Texas.

_____. 1998. Status report on Lloyd's mariposa cactus (*Neolloydia mariposensis*) in: Surveying, monitoring and managing select endangered/ threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report to Texas Parks and Wildlife, Austin, Texas and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Grant Agreement No. 1448 20181097 G932.

_____. 1999. Status report on Lloyd's mariposa cactus (*Neolloydia mariposensis*) in: Surveying, monitoring and managing select endangered/ threatened species of concern in the Trans-Pecos ecoregion of western Texas. Report prep. for Texas Parks and Wildlife, Austin, Texas and U.S. Fish and Wildlife Service, Albuquerque, New Mexico.Section 6 Project, WER39 ESEC6.

U.S. Fish and Wildlife Service. 1985. Supplement to review for plant taxa for listing as endangered or threatened species. Federal Register 50 39526-3927 U.

U.S. Fish and Wildlife Service. 1987. Lloyd's Mariposa Cactus (*Neolloydia mariposensis*) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 47 pp.

Weniger, Del. 1970. Cacti of the southwest. Univ. of Texas Press, Austin, Texas.