Ocelot distribution in the Lower Rio Grande Valley National Wildlife Refuge

Kevin James Shinn
University of Texas-Pan American

OCELOT DISTRIBUTION IN THE LOWER RIO GRANDE VALLEY NATIONAL WILDLIFE REFUGE

A Thesis

by

KEVIN J. SHINN

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Approved as to style and content by:

Frank W. Judd

Dr. Frank W. Judd
Chair of Committee

Robert I. Lonard

Dr. Robert I. Lonard
Committee Member

Timothy Brush

Dr. Timothy Brush
Committee Member

M. [illegible]

Dr. Mohammed Farooqui
Department Chair

May 2002

ABSTRACT

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Weaver hair-snaring surveys were conducted at 125 sites on 27 Refuge tracts to obtain information about the distribution and population status of the endangered ocelot (*Leopardus pardalis*) in the Lower Rio Grande Valley National Wildlife Refuge. The surveys resulted in 33.6% of the pads "hit", including 8 by ocelot and 29 by bobcat. There was no significant difference in the number of ocelot hits between warm and cool seasons or between the sexes. Preferred habitat consists of dense thornscrub brush. Four species, snake-eyes, granjeno, honey mesquite, and colima comprise 50% or more of the total cover at each site where ocelots were detected. The ocelot sites averaged 146% total cover and 58.7% community similarity, as well as showing a significant interaction between the presence of snake eyes and colima with that of ocelot.

ACKNOWLEDGEMENTS

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Finally, I thank my wife, Deborah, who not only tolerated many long hours apart, but also provided the encouragement and support needed to press on during this project. And, love to my baby, Mikayla, a source of so much joy and laughter.

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INTRODUCTION

The Lower Rio Grande Valley (LRGV) of Texas corresponds to the Matamoran District of the Tamaulipan Biotic Province of southern Texas (Fig. 1) (Blair 1950). The LRGV is not actually a "valley", but a delta gently sloping away from the Rio Grande. In the LRGV, Tamaulipan brushland, characterized by dense thornscrub vegetation, is considered a unique ecosystem found nowhere else in the United States. The combination of climate, geology, vegetation, and wildlife creates tremendous biological diversity (U.S. Fish and Wildlife Service 1997).

The northernmost population of ocelot (*Leopardus pardalis*) occurs in the LRGV (Blair 1950, Tewes and Everett 1986, US Fish and Wildlife Service 1990). Conversion of the thornscrub vegetation used by ocelots to cropland and urban development has fragmented and reduced native ocelot habitat by 95% (Purdy 1983, Jahrsdoerfer and Leslie 1988). This loss of habitat is the primary threat to the persistence of ocelot in Texas and has caused the ocelot to be listed as endangered by the U.S. Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) (Tewes and Everett 1986, Laack 1991).

This thesis follows the style of the Journal of Wildlife Management.

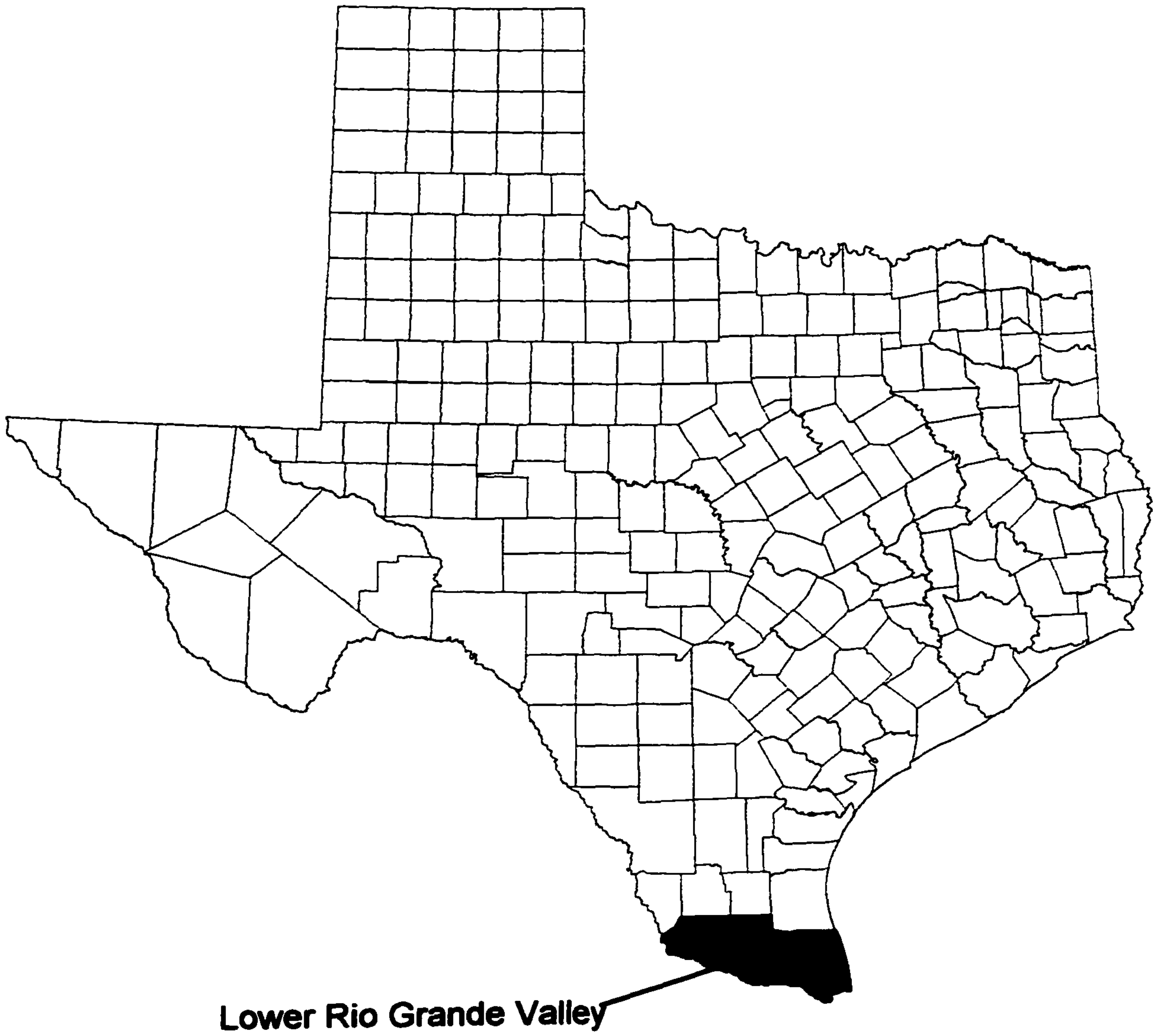

Figure 1. Map of Texas showing the Lower Rio Grande Valley.

In 1979, the USFWS initiated a long-term land acquisition program, forming the Lower Rio Grande Valley National Wildlife Refuge Complex (Refuge), which also includes Santa Ana National Wildlife Refuge. This land protection plan was designed to protect remnants of existing native habitat and to form a riparian corridor along the Rio Grande for native plants and wildlife. Additionally, the project called for the reclamation of acquired agricultural lands to re-establish native habitat for the benefit of the wildlife (U.S. Fish and Wildlife Service 1997). Of the 53,663 ha proposed for acquisition, approximately 40,500 ha have been acquired and are currently under management by the Refuge.

Shindle and Tewes (1998) suggested that the re-establishment of thornscrub species might accelerate ocelot use of an area. Except for a few searches on individual Refuge tracts, there has been little study of ocelot distribution on the Refuge. Similarly, corridor habitat use by ocelots, success of reforestation efforts for preferred ocelot habitat, and population dynamics of resident ocelots have not been studied.

The purposes of this study were to obtain data on the endangered ocelot that will assist the Refuge staff in managing current Refuge lands, acquiring additional lands, identifying critical habitat needed for the establishment or recovery of ocelots in a fragmented ecosystem, and discovering locations of ocelots for future translocations and studies. The specific objectives were to:

(1) determine the presence or absence of ocelot on Refuge lands,

(2) test the hypothesis that ocelot use the fragmented habitat of the Refuge corridor,

(3) identify species, gender, and individual identity of felids on the Refuge using DNA analyses of snared hairs, and

(4) determine the habitat characteristics associated with the presence of ocelot.

REVIEW OF LITERATURE

Ecology and Life History

The ocelot is among the most beautiful feline species in the world (Tewes and Schmidly 1987). It is a spotted medium-sized cat ranging from northern Argentina to the southern United States (Navarro 1985). An average adult weighs 11.3-15.8 kg (Nowak 1999) and measures 80-136.7 cm from head to tail with males larger than females (Tewes and Schmidly 1987, Kitchener 1991). Body coloration is variable, with the upper parts gray or buff and decorated with dark brown or black spots, small rings, blotches, and short bars. Its long tail is ringed or marked with dark bars on the upper surface (Guggisberg 1975, Hall 1981). The known U.S. historical geographic range extended from southern Texas north and east to Arkansas and Louisiana (Navarro et al. 1993), but the species is now confined to southern Texas and possibly Arizona (Tewes and Everett 1986).

In the tropics, ocelots breed throughout the year (Ewer 1973), but fall breeding has been noted for ocelots in temperate parts of their range (Petrides et al. 1951, Leopold 1959). Gestation is estimated to last 70-80 days (Ewer 1973, Hatfield and Hatfield 1973). Litter size of wild ocelots usually is one or two (Hall and Dalquest 1963, Mondolfi 1982, Davis 1994). Eaton (1977) reports the average size of 151 captive-born litters is 1.4 kittens, with only three litters having three kittens.

Ocelots are thought to be crepuscular and nocturnal. Activity increases sharply at sunset and remains high with intermittent peaks throughout the night until shortly after sunrise (Navarro 1985, Tewes and Everett 1986, Caso 1994). They feed mainly on terrestrial, nocturnal rodents (IUCN--The World Conservation Union 1996), but a variety of small to medium-sized prey, including armadillos (*Dasypus sp.*), opossums (*Didelphis sp.*), birds, fish, amphibians, and reptiles are included in the diet (Almeida 1976, Konecny 1989).

Home ranges of males are generally larger than those of females. In southern Texas, Navarro (1985), Tewes (1986), and Laack (1991) reported the mean home range size of males was 2.5 km^2, 12.3 km^2, and 6.3 km^2, respectively. The home ranges of female ocelot were 2.1 km^2, 7.0 km^2, and 2.9 km^2, respectively.

Cats have a relatively poor sense of smell compared with other carnivores, but still rely heavily on scent marking to convey a wealth of information (Kitchener 1991). Kitchener (1991) states that cats use scent marking in maintaining home ranges and conveying information on sex, age, reproductive status, and individual identity. In felids, the most conspicuous scent-marking behavior is performed by spraying urine against vertical objects (Leyhausen 1979, Mellen 1993).

Another form of olfactory communication is scent rubbing. The scent rubbing behavior transfers scent substances from the environment onto the animal's body (Reiger 1979). Reiger (1979) found that felids prefer cranial body areas for scent rubbing. The cheeks especially are regularly scent-rubbed, but chin, neck, shoulder and back are scent-rubbed too. Most of the small cats studied by Mellen (1993), including ocelots, cheek-rubbed and the rate at which cheek-rubbing occurred was about equal for both males and females. However, reproductively active felids display at a higher rate. Wemmer and Scow (1977) describe head rubbing, including recumbent head rubbing, to be evoked by strong, novel odors such as carrion, vomit, feces of strange animals, and catnip. In fact, cat mint or catnip is particularly attractive to felids as a scent source (Reiger 1979). Mellen (1993) claims that cheek-rubbing serves three functions: to deposit a scent (saliva), to pick up scent (by cheek-rubbing against urine marks), and as a visual display (males frequently oriented to estrous females and repeatedly cheek-rubbed).

Habitat Characteristics and Use

Dense cover seems to be an important characteristic of ocelot habitat (Tewes and Schmidly 1987, Fischer 1998). Although habitat destruction is thought to be the main reason for the ocelot decline in the United States, ocelots are capable of using altered habitats and have been reported near large towns in places where dense cover still remains (Koford 1973). Caso (1994) reports that ocelots avoid open areas except on moonless nights, and Shindle (1995) found 12 of 15 ocelots tracked in southern Texas preferred dense thornscrub. Fischer (1998) stated that ocelots avoid early successional, wetland, agricultural, and developed land habitats, which are common in the LRGV.

Ocelots use narrow strips of dense vegetation as travel corridors between tracts of dense thornscrub habitat (Navarro 1985, Tewes 1986). Corridor types in the LRGV include: resaca, river, irrigation canal, irrigation drain, natural drainages, shoreline, fenceline, road, and other man-made corridors (Tewes et al. 1995). Habitat fragmentation and interpatch barriers have reduced ocelot populations in the LRGV. They have created conditions where most ocelot use more than one corridor type during their daily movements and many use multiple corridor types for different ecological activities (intra-territorial and extra-territorial movements, foraging, resting, dispersal, and for placement of natal dens) (Tewes et al. 1995).

Shindle (1995) compared habitat components of two ocelot populations in southern Texas and one in northern Mexico. He found that the re-establishment of thornscrub species may accelerate ocelot use of an area, but a minimal structural density (>85% vertical cover), canopy height (>2 m), and horizontal coverage (>97%) must be achieved before an area is characterized as suitable for ocelot use in southern Texas. He also reported that based on relative cover, the predominant shrub species were granjeno (*Celtis pallida*), snake-eyes (*Phaulothamnus spinescens*), crucita (*Eupatorium odoratum*), desert olive (*Forestiera angustifolia*), colima (*Zanthoxylum fagara*), whitebrush (*Aloysia gratissima*), brasil (*Condalia hookeri*), and lotebush (*Ziziphus obtusifolia*).

DNA Analyses

Advances in genetic technology are making DNA methods accessible at the field level (Parker et al. 1998). Whole blood and tissue biopsies obtained from captured animals have been routinely used as a source of DNA. (Woods et al. 1999). Several recent studies have obtained DNA from free-ranging animals using alternative tissue sources: skin samples from humpback whales, *Megaptera novaeangliae* (Palsboll et al. 1997); feces from brown bears, *Ursus arctos* (Hoss et al. 1992), and black bears, *Ursus americanus* (Wasser et al. 1997); and hair from American marten, *Martes americana* (Foran et al. 1997), brown bears (Taberlet and Bouvet 1992, Taberlet et al. 1993, Taberlet et al. 1997), and chimpanzees, *Pan troglodytes* (Morin et al. 1994,Woods et al. 1999). Roots of mammalian hair contain sufficient DNA for analysis when genetic material at specific loci is amplified using the polymerase chain reaction (PCR) (Huguchi et al. 1988, White et al. 1989).

Typically, hair is identified to genera or species by macro- or microscopic examination (Foran 1997). However, molecular biologists use PCR to amplify a portion of the cytochrome b gene and D-loop region of mitochondrial DNA (mtDNA) (Kocher et al. 1989, Lopez et al. 1996) to identify species. Species identification based on mtDNA provides a rapid screening that consumes only 2.5% of the DNA extraction and reduces reading error for similar sympatric species (Woods et al. 1999).

Sex determination is completed by identifying loci on the X and Y-chromosomes. Aasen and Medrano (1990) used the PCR to amplify a ZFY/ZFX fragment from male and female genomic DNA to identify gender in humans, cattle, sheep and goats. Restriction fragment length polymorphism (RFLP) analysis of the fragments yielded specific banding patterns between the two sexes in these species. Griffiths et al. (1998) found RFLP was not needed to separate the PCR products in birds using two primers that anneal to conserved exonic regions but then amplify across an intron in both CHD-W and CHD-Z (chromobox-helicase-DNA-binding gene). Because the introns are noncoding they are less conserved and their lengths usually differ between the genes resulting in PCR products revealing one band in males and two in females. Woods et al. (1999) reports that the ideal sex determination test for hair analyses would amplify short regions of genes that were present on the X and Y chromosomes using the same PCR primers and would discriminate between sexes by way of a length of polymorphism that caused the Y chromosome amplification product to be shorter.

The identification of individuals has been accomplished through microsatellite analysis of nuclear DNA and minisatellite DNA fingerprinting. Menotti-Raymond and Obrien (1995) used short tandem repeat polymorphisms or microsatellites of nuclear DNA to distinguish individuals. Typically, 5-15 different loci were needed. Woods et al. (1999) also used microsatellite analysis. However, they used a suite of six microsatellite loci to identify individuals. To a certain extent, increasing the number of loci used can offset lower levels of variation. However, in populations with low genetic variability, such as the brown bears of Kodiak Island (Paetkau et al. 1998), the number of genetic loci required to make individual identifications could make identification prohibitively difficult and expensive. Foran et al. (1997) used a different technique, minisatellite DNA fingerprinting, to distinguish individual marten. They believed that although DNA microsatellites would be equally effective, DNA fingerprints allow individual identification within a single experiment.

METHODS

Study Area

Data were collected during 2000 and 2001 on 27 Refuge tracts. A total of 40.51 km^2 of Refuge lands representing all 11 Tamaulipan Biotic Province communities occurring on the Refuge were surveyed for ocelot using the Weaver hair-snaring technique.

Refuge lands are located in Cameron, Hidalgo, Starr, and Willacy Counties of southernmost Texas (Fig. 2). The Refuge boundary extends approximately 442 river km from the Gulf of Mexico west to Falcon Dam on the Rio Grande. Figure 3 is a graphic representation of the Tamaulipan Biotic Communities of the Lower Rio Grande Valley and includes all surveyed Refuge tracts for comparison of distribution among the communities. A description of the biotic community designations for the LRGV (U.S. Fish and Wildlife Service, 1997) includes:

(1) Clay Loma/Wind Tidal Flats. This community includes a matrix of clay dunes interspersed within the saline flats, marshes and shallow bays bordering the Gulf of Mexico. Typical plants are sea ox-eye (*Borrichia frutescens*), saltwort (*Batis maritima*) and glasswort (*Salicornia sp.*) on the vegetated portions of the flats, and gulf cordgrass (*Spartina spartinae*), Berlandier's fiddlewood (*Citharexylum berlandieri*), Texas ebony (*Chloroleucon ebano*) and yucca (*Yucca treculeana*) on the higher lomas.

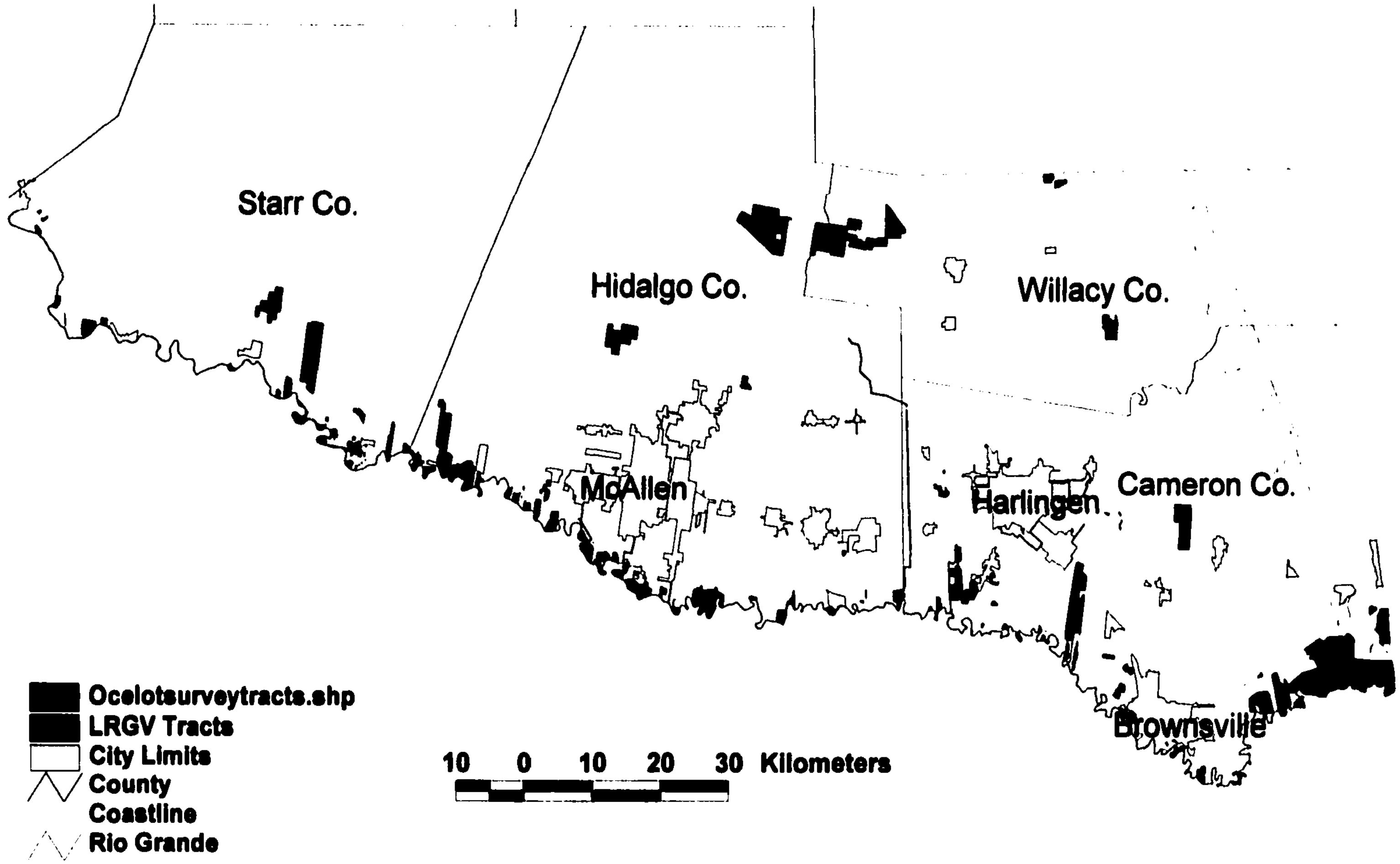

Figure 2. Lower Rio Grande Valley National Wildlife Refuge, Lower Rio Grande Valley, Texas. Ocelot survey tracts shown.

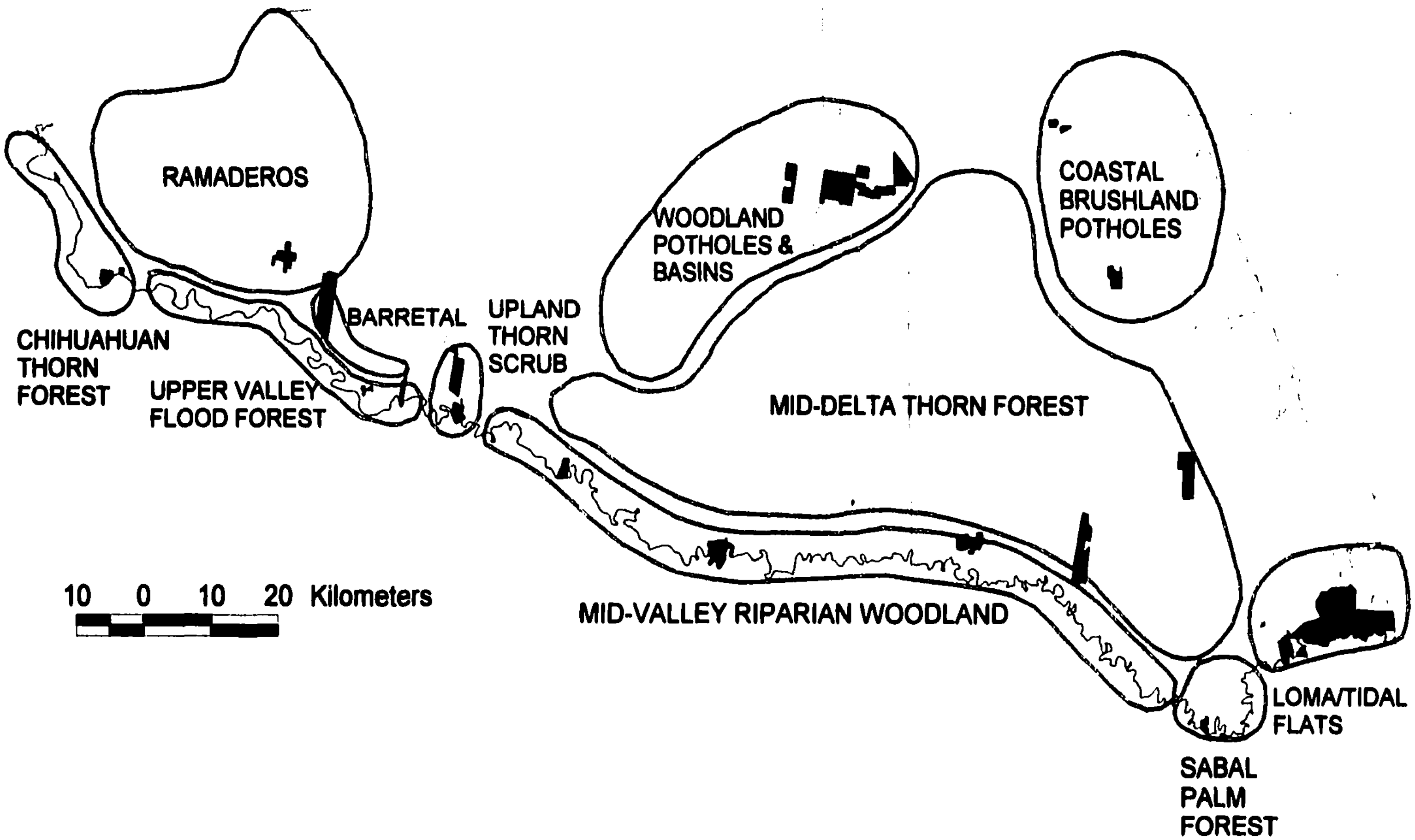

Figure 3. Map of survey tracts representing the Tamaulipan Biotic Communities of the Lower Rio Grande Valley.

(2) Coastal Brushland Potholes. The community comprises an area of dense brushy woodland surrounding freshwater ponds and shifting to low brush and grasslands around brackish ponds and saline estuaries near the Gulf of Mexico. Areas of both active and stable sand dunes are found here. Typical plants are honey mesquite (*Prosopis glandulosa*), granjeno (*Celtis pallida*), barbed-wire cactus (*Acanthocereus pentagonus*), and gulf cordgrass. These wetlands receive heavy use by migratory waterfowl.

(3) Sabal Palm Forest. A diverse riparian forest located along the Rio Grande in Texas occurs in the southmost area (south and east of Brownsville). The forest is dominated by Texas sabal palm (*Sabal texana*) with Texas ebony, tepeguaje (*Luecaena pulverulenta*), David's milkberry (*Chiococca alba*), anacua (*Ehretia anacua*), brasil (*Condalia hookeri*) and granjeno among many other important plants. The original palm forest has been reduced to less that 20.25 ha from an estimated original total of 16,200 ha or more. Several tropical plant and animal species occur here.

(4) Mid-Valley Riparian Woodland. This community is essentially a tall, dense, canopied bottomland hardwood forest comprised mainly of Rio Grande ash (*Fraxinus berlandieriana*), sugar hackberry (*Celtis laevigata*), black willow (*Salix nigra*), cedar elm (*Ulmus crassifolia*), Texas ebony and anacua. This habitat is particularly favored by chachalacas and green jays.

(5) Mid-Delta Thorn Forest. This plant community once covered much of the Rio Grande Delta, but has been reduced to a few tracts of less than 40.5 ha and remnant strips along fencerows, canals and ditch banks. Honey mesquite, Texas ebony, coma (*Bumelia celastrina*), anacua, granjeno, colima (*Zanthoxylum fagara*) and many other shrubs and

small trees form a dense thicket, which provides excellent wildlife habitat. This is a favored site for white-winged dove nesting colonies.

(6) Woodland Potholes and Basins. Lighter soils and numerous small seasonal fresh water wetlands and playa lakes characterize this region. Also, here are the unique large hypersaline lakes of La Sal Vieja, La Sal Blanca, and La Sal del Rey which host thousands of migrating shorebirds as well as nesting terns and black skimmers (*Rynchops niger*). All the wetlands are set in low woodlands of honey mesquite, granjeno, prickly pear (*Opuntia engelmannii*), lotebush (*Ziziphus obtusifolia*), elbow bush (*Forestiera angustifolia*) and brasil. Ocelots occur here in the denser thickets.

(7) Upland Thorn Scrub. This is the most widespread habitat type in the Tamaulipan Biotic Province and occurs on high and dry sites to the north and west of the Rio Grande Delta. Typical woody plants are anacahuita (*Cordia boissieri*), cenizo (*Leucophylum frutescens*) and palo verde (*Cercidium texanum*).

(8) Barretal. Barreta (*Helietta parvifolia*) is a small tree related to citrus which occurs in the U.S. only on gravely caliche hilltops along the Bordas Escarpment. Other plants typical of this unique ecotone are palo verde, guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), anacahuita, yucca and many species of cacti.

(9) Upper Valley Flood Forest. The Rio Grande floodplain becomes narrow above Mission, Texas, with riverbank stands of Rio Grande ash, cedar elm, sugar hackberry and black willow often shifting to honey mesquite, prickly pear and granjeno within a short distance from the river. This area is excellent habitat for many species of USFWS management concern.

(10) Ramaderos. Arroyos and smaller drainages extend for kilometers away from the river through arid lands. These areas with higher moisture and deeper soils are corridors of much more mesic vegetation which serve wildlife as travel lanes and as refuges of food and cover, particularly during times of drought.

(11) Chihuahuan Thorn Forest. This area below Falcon Dam includes a very narrow riparian zone and a desert shrub community on the uplands. Several endangered or rare plants occur in this area such as Montezuma baldcypress (*Taxodium mucronatum*) and Johnston's Frankenia (*Frankenia johnstonii*). Several uncommon birds such as the brown jay (*Cyanocorax morio*), ringed kingfisher (*Ceryle torquata*) and red-billed pigeon (*Columba flavirostris*) are often seen here.

Tamaulipan brushlands provide important feeding, nesting, and cover habitats for many plants and animals. Diversity of habitat types in the LRGV results in a diverse fauna, including species of subtropical, southwestern desert, prairie, coastal marshland, eastern forest, and marine affinities (IBWC, 1982). About 700 vertebrate species have been found within the LRGV (U.S. Fish and Wildlife Service, 1997).

The climate of the area is semi-arid and subtropical. Mean annual rainfall in the eastern LRGV (Cameron Co.) is 64.5 cm with a mean July high temperature of 34 degrees Celsius and a mean January low temperature of 11 degrees Celsius. The western LRGV (Starr Co.) has a mean annual rainfall of 52.3 cm, a mean July high of 37 degrees Celsius and a mean January low of 7 degrees Celsius. Some years are frost-free, and hard freezes are rare (Kingston, 1992-93). Tropical storms and hurricanes periodically strike the area during the summer and fall months. Storms of hurricane force may be expected at a frequency of about 1 every 10 years (Morton et al., 1983).

Weaver Hair-Snaring Survey

I followed protocol used by Weaver et al. (in review) and Weaver et al. (in prep) in conducting surveys. Eight hair-snaring stations were established for each 2.59 km^2 area. I grouped up to 10 stations that were geographically close together into a cluster. There were 19 of these clusters across the LRGV (Table 1). The Weaver survey is run for a minimum of a 6-day sampling period, so I ran each cluster for 7 days. On day 1 of the 7-day sampling period, I set all the posts per cluster. After 7 days, I removed each pad and camera/Trail Master unit if present. Because of the habituality of wild cats to these scent posts and the seasonality of movements, I ran a sampling period once each season. South Texas can be grouped into two seasons, a warm season from mid-March to mid-October and a cool season from mid-October to mid-March (Dr. F. Judd, pers. comm.). I ran two sampling periods per biotic community, the first during the warm season of 2000 and the second during the cool season of 2001.

The hair-snaring stations were set according to a standardized method (Fig. 4). A scent pad, made of shag carpet with a series of roofing nails protruding out of the carpet in the same direction as the shag, was secured to a suitable tree approximately 0.6 meters above the ground. A dose of scent paste, formulated by Dr. John Weaver and obtained from him, was spread across the surface of the carpet with a sprinkle of catnip. A pie tin (hung approximately one meter high from a supporting branch with a steel leader, swivel, and monofilament line) was located in front of the scent pad no more than 1.5 meters

Table 1. Survey cluster number, tract name, biotic community, area, and number of posts on the Lower Rio Grande Valley National Wildlife Refuge, Texas. Biotic communities are the same until a new community is introduced.

Cluster	Tract Name	Biotic Community	Area (sq km)	Posts
1	Schalaben	Woodland Potholes & Basins	2.59	8
2	Teniente-Rudman		1.82	6
3	Teniente-Beasley/Ring Ranch		2.85	9
4	Payne		2.33	7
5	East Lake		1.42	4
6	Willamar	Coastal Brushland Potholes	2.33	7
7	San Perlita		1.11	3
	El Jardin		0.85	3
8	La Selva Verde	Mid-Delta Thorn Forest	2.33	7
9	Ranchito		1.61	5
10	Mercedes		0.49	2
	Resaca Del Rancho Viejo	Mid-Valley Riparian Woodland	1.3	4
11	Santa Ana NWR		3.37	10
12	Boca Chica	Loma/Tidal Flats	2.07	6
13	Tulosa Ranch		1.4	2
	Palmito Hill		0.34	2
	Caja Pinta Banco		0.08	2
14	Boscaje De La Palma	Sabal Palm Forest	1.27	4
15	Arroyo Ramirez	Chihuahuan Thorn Forest	1.42	3
	Arroyo Los Negros		0.47	2
	Arroyo Morteros		0.41	2
16	Los Olmos	Ramaderos	2.33	7
17	La Puerta	Barretal	2.07	6
18	Guerra	Upper Valley Flood Forest	0.52	2
	Chicharra Banco-south		0.91	3
19	Yturria Brush-south	Upland Thorn Scrub	1.94	6
	Sam Fordyce-south/Havana-south		0.88	3
Totals:				
19	27 Tracts	11 Biotic Communities	40.51	125

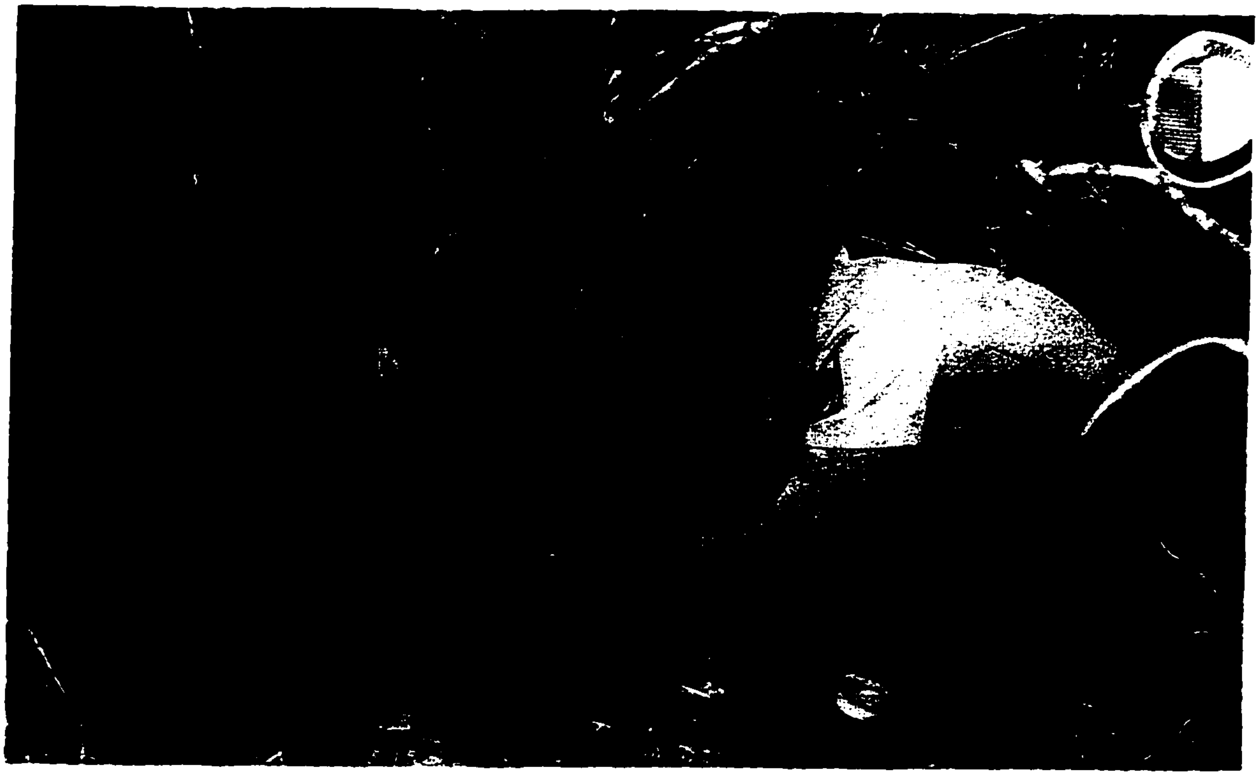

Figure 4. Demonstration of hair-snaring station.

away for a visual attractant. The ground below the scent pad was scraped of vegetation with the claw of a hammer and a duff pile created.

The camera/Trail Master units that were used at half of the stations also were set following a standardized method. The camera was hung to one side and in the front of the scent pad, and positioned to overlook the scent pad, scraped soil, and Trail Master unit. The Trail Master units, made of two box-like sensors, were set on wooden blocks or strapped to wooden stakes driven into the ground, one to each side of the scent pad, and monitored the entrance/standing area of the pad. All cords from the units were buried, stretched behind, or fastened to the supporting tree when possible. To avoid some of the problems reported in Rappole et al. (1985), the following precautions were taken: the sensors were placed in shaded areas away from direct sunlight to avoid sun misfires, the photo timers were set with a delay to avoid wasting film on "curious" raccoons (*Procyon lotor*), and the cameras were set close to the scent pad to ensure flash area coverage would be large enough to illuminate targets at night.

First, hair-snaring sites selected were from Refuge tracts with suspected suitable habitat that could support resident animals and transients, or they were sites that could be a stepping stone site from known population sites. Second, choices for sites were from areas that had been reported to support ocelot. Third, a criterion for site selection was that representatives of all 11 Tamaulipan Biotic Province communities were included. And, sites were placed along likely travel routes through suspected suitable habitat. Digital ortho-quads for each Refuge tract (Fig. 5) were used to identify dense thornscrub

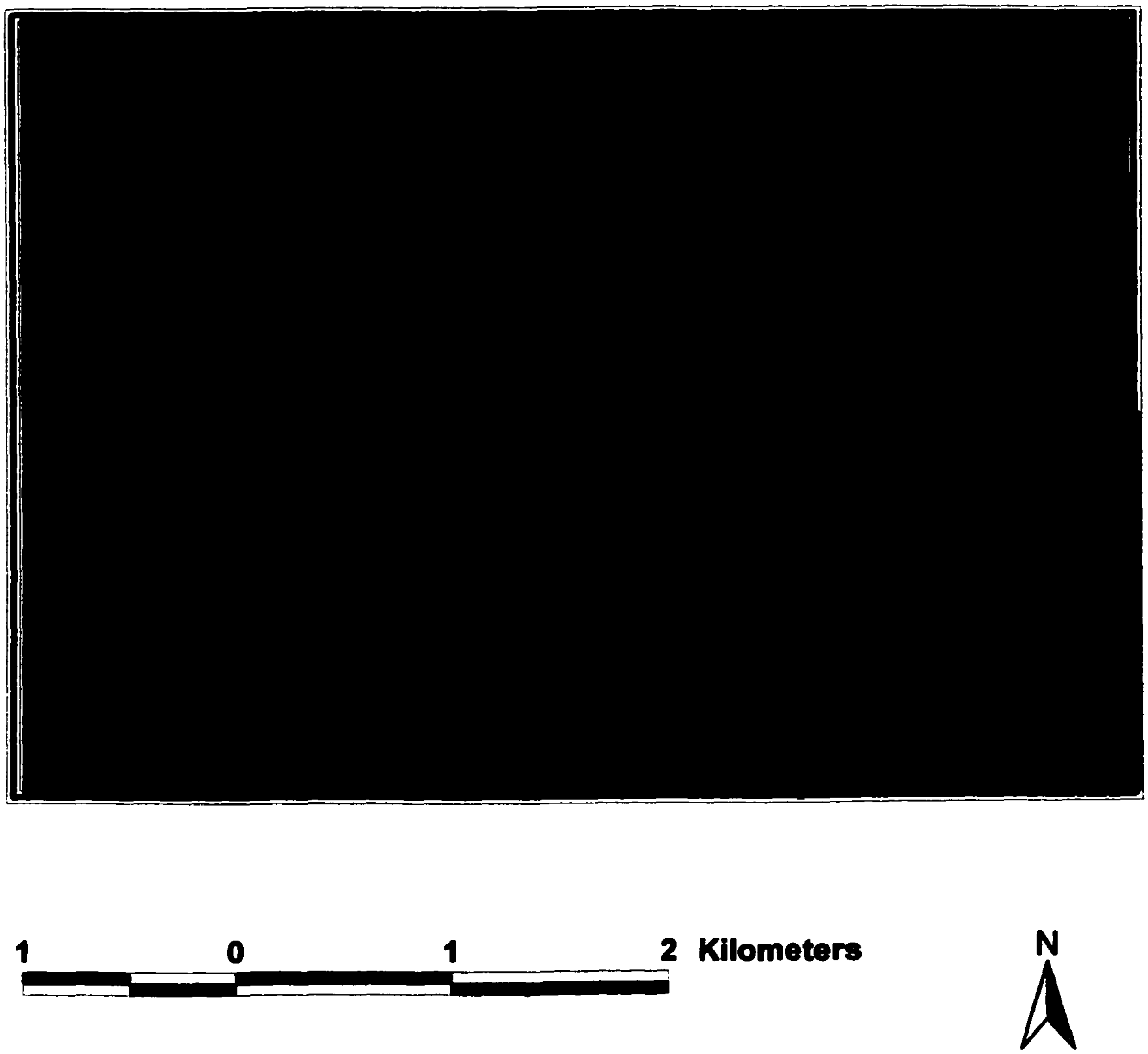

Figure 5. Example of Digital Ortho-Photo Quad indicating survey pad locations (stars) on Santa Ana National Wildlife Refuge, Texas.

brush suitable for use by cats and travel corridors through or between the brush locations. Visual inspection of the potential sites then determined final placement.

Two sites from which ocelot photographs were obtained during a test run of the Weaver survey on the Corbett Ranch in the warm season of 1999 and a site where an ocelot was captured on the Vista Del Mar Tract in 1998 were added to the study for vegetation comparisons.

All survey and photographic data were entered into SPSS, a statistical software program. Descriptive statistics, summary tables, and chi-square tests were conducted as part of the statistical processing. A Pearson Chi-square test was used to compare the summer and winter survey results. I used Yates correction factor for all two-category comparisons. Frequency comparisons were made between the number of hits per season, sex, and species. Chi-square tests were used to compare the number of sites with and without visits, hits, and photographs. Visitation was defined as the total number of sites with "hits" and/or photographs for all comparisons.

DNA Analysis

Survey pads collected in the field at the end of a sampling period that were "hit" with hair samples were placed in a zip-lock freezer bag labeled with location and date and stored in a freezer until completion of the survey. At the close of each survey, all "hit" pads were prepared for shipping to the genetics lab.

Hair samples were prepared for shipping following a strict sanitary protocol. To ensure samples were not tainted with non-survey hairs, I worked in a closed office, on a clean desk with light colored paper that could be changed when needed. I wore disposable gloves and used sterilized tweezers on each sample. I conducted all preparations myself and worked cautiously to keep my hairs out of the samples. Fifteen to 25 (or as many as could be found if less than 15) guard hairs with a root were removed from the pad and placed in a new 3" X 5" manila coin envelope labeled with location name, date gathered, my name, and Refuge address. All coin envelopes were then placed in a padded envelope and sent to the genetics lab via Federal Express mail.

Dr. David Paetkau of Wildlife Genetics International conducted the genetic analyses of the snared hairs. A polymerase chain reaction to amplify a portion of the cytochrome b gene and D-loop region of mitochondrial DNA was used to identify species (Paetkau and Strobeck 1996). The sex determination was done by identifying loci on the X and Y chromosomes using the P2 and P8 primers (or variations of) reported in Griffiths et al. (1998). As recommended by Woods et al. (1999), he used the same pair of primers to amplify both of the sex chromosomes. An attempt was made to test and find reliable markers that will amplify microsatellites of nuclear DNA to distinguish individuals. The arena on genetic research with ocelot is extremely limited, and the use of tissue from hair samples is a completely new field. Dr. Paetkau was unable to find the correct primers in the time frame I had given him, so individual data from genetic analysis were not included in this study. However, with further research they may soon be found.

The data from the genetic analyses were added to the photographic data and analyzed with the SPSS statistical software program.

Habitat Analysis

Habitat surveys were conducted once for each station. I centered one 25-meter line-transect on each hair-snaring station and divided the line-transect into 25 one-meter intervals for the vegetation survey. Cover and frequency of woody plants were measured along the entire length of transect using the line-intercept method described by Chambers and Brown (1983) and calculated using formulas described by Brower et al. (1990). Woody canopy measurements included all woody species >0.5 m tall occurring along each transect, as cover of this height could conceal an ocelot (Tewes, 1986; Bothma et al., 1994). Scientific and common names for woody species identified at each site followed Lonard et al. (1991) and Everitt and Drawe (1993).

For a given plant species, cover is the sum of the intercept lengths. The relative cover of a species is the sum of the intercept lengths for a species divided by the sum of the intercept lengths for all species. The frequency of a species is the number of line-intercept intervals containing a species divided by the total number of intervals on the transect. The relative frequency of a species is the frequency of a species divided by the sum of the frequencies of all species. The importance value of a species was calculated by adding the relative cover and relative frequency values for a species.

The vegetation data were entered into SPSS. Descriptive statistics and summary tables were conducted as part of the statistical computations. Differences in habitat characteristics in cover, frequency, relative cover, relative frequency, and importance value were compared within and among sites. T-tests were used to compare the total cover at sites with and without ocelot, hits, visits, and cats.

Coefficients of interspecific association and coefficients of community were calculated to compare the community structure. The coefficients of interspecific association were calculated according to Cox (1996) by using a 2 X 2 contingency table to determine co-occurrence and a contingency chi-square to determine the level of interaction. The contingency table is constructed as follows:

		Species B		
		Present	Absent	
Species A	Present	a	b	a + b
	Absent	c	d	c + d
		a + c	b + d	T

The sampling units are examined for presence or absence of both species (A and B), and the number of samples containing both species (a), only species A (b), only species B (c), and neither (d) are recorded. The numerical relationships of values in the contingency table for my sampling units called for use of the following equation:

$$\text{Coefficient of Association} = \frac{ad-bc}{(a+c)(c+d)}$$

where +1.0 for a condition of maximum possible co-occurrence of species, to −1.0 for a condition of minimum possible co-occurrence, is calculated. The contingency table values are then entered into the following goodness-of-fit test to determine the level of significant interaction between the two variables.

$$\text{Chi-Square} = \frac{(|ad - bc| - 0.5T)^2(T)}{(a+b)(a+c)(b+d)(c+d)}$$

Similarity of woody species composition between sites was quantified according to Brower et al. (1998) by using coefficients of community. I used the Sorensen coefficient:

$$CC_s = \frac{2c}{s_1 + s_2}$$

where s_1 and s_2 are the number of species in communities 1 and 2, respectively and c is the number of species common to both communities.

RESULTS

Weaver Hair-Snaring Survey

A total of 84 "hits" occurred during the two surveys of 2000 and 2001, 38 in the summer and 46 in the winter (Table 2). A Pearson chi-square test indicated there was no significant difference in the number of "hits" for all species between the summer and the winter surveys ($\chi^2 = 3.816$, $P = 0.873$). The majority (34.5%) of the "hits" were bobcat (*Felis rufus*). There were 8 ocelot "hits", 3 in the summer and 5 in the winter. Other "hits" were of coyote (*Canis latrans*), wild hog (*Sus scrofa*), dog (*Canis familiaris*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), and cougar (*Felis concolor*). An unknown category was the consequence of too small hair samples to identify species.

A total of 33.6% of the 125 pads were "hit" during the surveys (Fig. 6). Together, bobcats and ocelot made up 44% of the total "hits" (Fig. 6). A large unknown component made up 28.6% of the samples. Of the bobcat samples wherein gender was identified, 13 were female and 14 were male (Fig 7). The ocelot samples were identified as 3 females and 5 males (Fig 8). A chi-square test indicated that there was no significant difference between the number of female and male samples of bobcat ($\chi^2 = 0.037$, $P = 0.847$) and ocelot ($\chi^2 = 0.500$, $P = 0.480$).

Table 2. Summary of Weaver hair-snaring survey results by season.

Species	Summer	Winter	Total
Bobcat	13	16	29
Unknown	10	14	24
Coyote	4	6	10
Ocelot	3	5	8
Wild Hog	3	1	4
Dog	2	1	3
Striped Skunk	1	2	3
Gray Fox	1	1	2
Cougar	1	0	1
Total	38	46	84

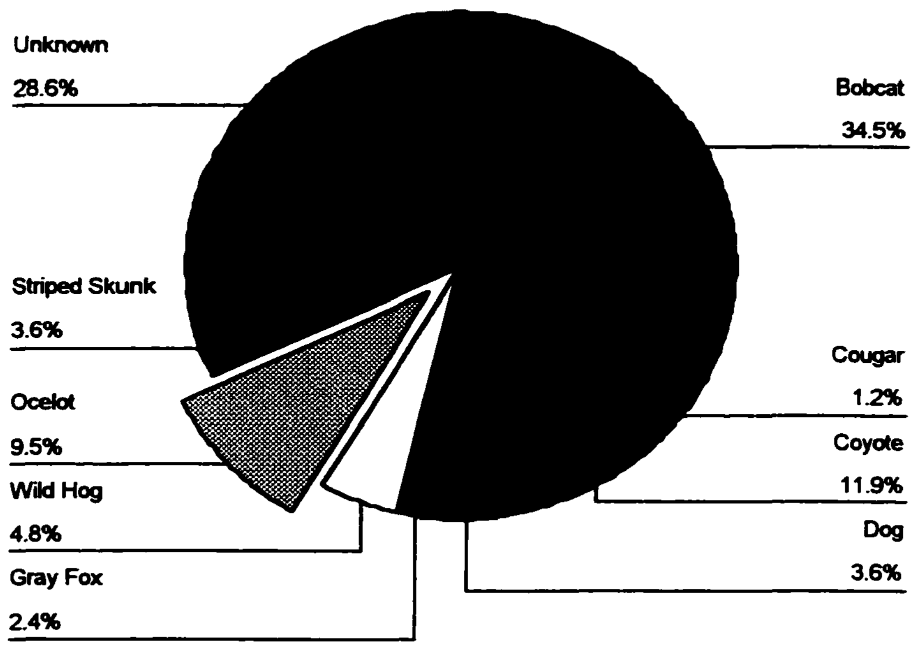

Figure 6. Pie chart displaying the Weaver hair-snaring survey results and showing the percentages of species identified on hair-snaring pads.

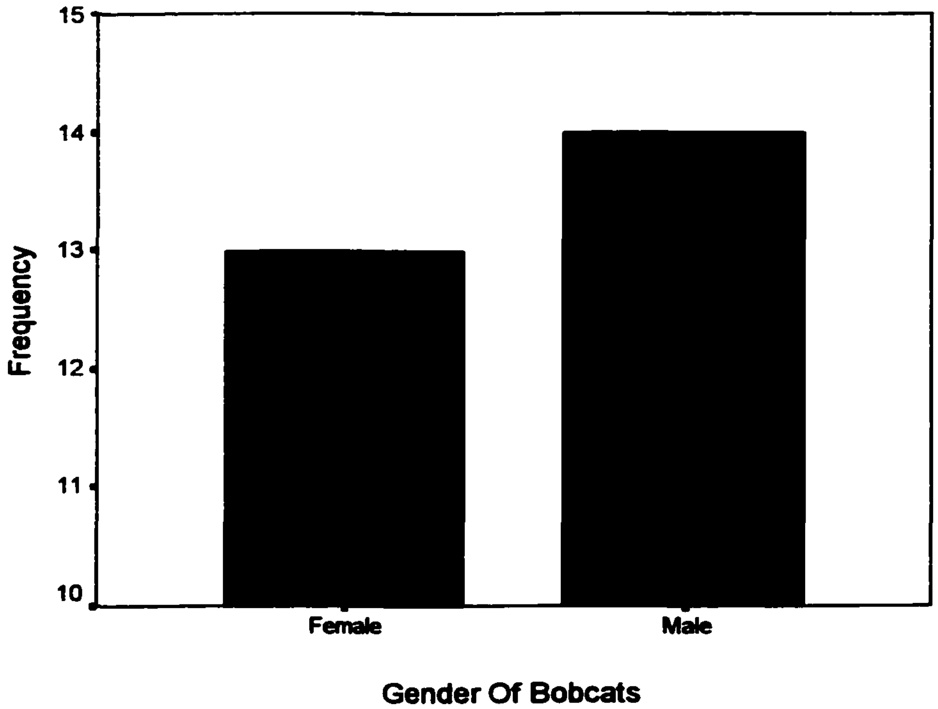

Figure 7. Comparison of gender in bobcat hair samples.

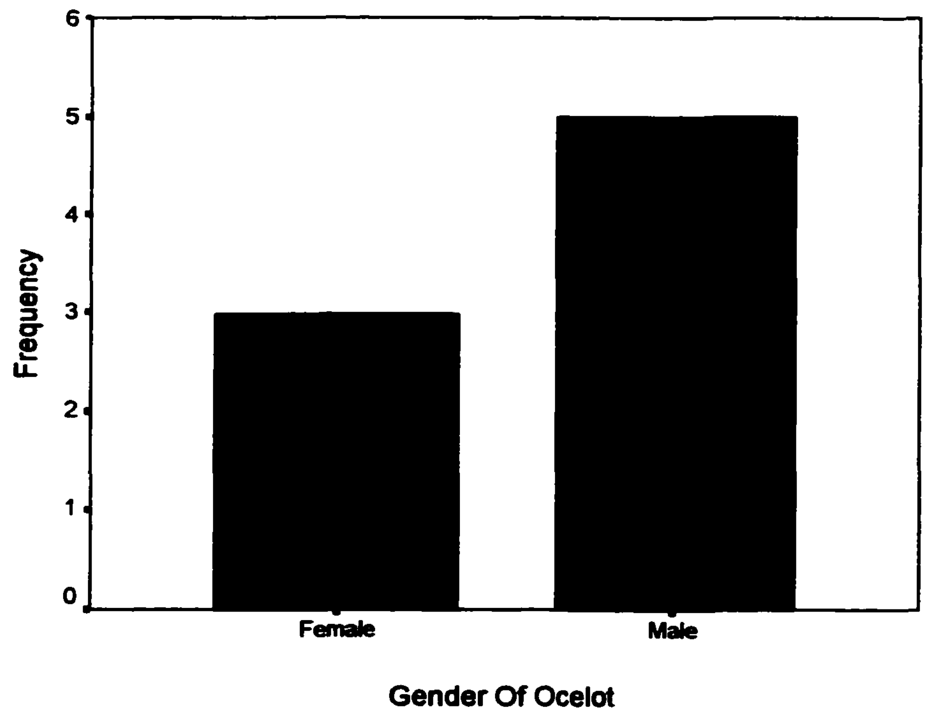

Figure 8. Comparison of gender in ocelot hair samples.

From the 69 sites that had Trail Master Cameral units, a total of 123 photographs of wildlife were taken (Table 3). Fifty-eight photographs were taken in the summer and 65 in the winter. Chi-square tests showed there was no significant difference between the number of photographs taken between the summer and the winter surveys ($\chi^2 = 0.292$, $P = 0.5$). The majority of the photographs were of raccoon (*Procyon lotor*)(57) and bobcat (24). Six photographs were of ocelot, 2 in the summer and 4 in the winter. The remaining photographs were of coyote, wild hog, striped skunk, opossum (*Didelphis virginiana*), greater roadrunner (*Geococcyx californiamus*), javelina (*Pecari tajacu*), eastern cottontail (*Sylvilagus floridanus*), nine-banded armadillo (*Dasypus novemcinctus*), domestic cattle (*Bos taurus*), Border Patrol agents, and gray fox. Raccoons made up 46.3% of the photos, and the cats (ocelot and bobcat) made up 24.3% (Table 3). Of the sites where cameras were set, there were 16 photographs of cats taken (ocelot and bobcat) where no "hits" occurred on scent pads. Two additional sites from the 1999 test run also produced ocelot photographs and scent pads were not "hit".

There were a total of 133 visits in the two surveys (Table 4). Chi-square tests show that there was no significant difference between the number of sites with and without visits ($\chi^2 = 1.024$, $P = 0.312$). However, there were significant differences between the number of sites with and without ocelot visits ($\chi^2 = 215.296$, $P = 0.001$), sites with and without "hits" ($\chi^2 = 26.896$, $P = 0.001$), sites with and without photographs ($\chi^2 = 35.344$, $P = 0.001$), and sites with and without bobcats ($\chi^2 = 104.976$, $P = 0.001$). Table 4 summarizes all hair-snaring survey data including pad "hits", photographs, season, and gender.

Table 3. Summary of survey photographs by season.

Species	Summer	Winter	Total	Percent
Raccoon	27	30	57	46.3
Bobcat	7	17	24	19.5
Ocelot	2	4	6	4.8
Coyote	3	2	5	4
Wild Hog	3	2	5	4
Striped Skunk	2	3	5	4
Opossum	2	2	4	3.2
Roadrunner	3	0	3	2.4
Javelina	2	1	3	2.4
Cottontail	1	2	3	2.4
Armadillo	3	0	3	2.4
Cow	2	0	2	1.6
Border Patrol Agent	1	1	2	1.6
Gray Fox	0	1	1	0.8
Total	58	65	123	100

Table 4. Summary table of survey visitation, which includes pad "hits" and photographs.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
San Perlita	1	Summer	Hit	Ocelot	Male	Ocelot
San Perlita	2	Summer	Empty			
San Perlita	3	Summer	Empty			
San Perlita	1	Winter	Hit	Ocelot	Male	Ocelot
San Perlita	2	Winter	Hit	Ocelot	Male	
San Perlita	3	Winter	Empty			Ocelot
El Jardin	1	Summer	Hit	Ocelot	Female	Ocelot, Hog, Raccoon
El Jardin	2	Summer	Hit	Ocelot	Female	
El Jardin	3	Summer	Empty			
El Jardin	1	Winter	Hit	Ocelot	Male	Ocelot, Raccoon
El Jardin	2	Winter	Hit	Ocelot	Female	Ocelot
El Jardin	3	Winter	Hit	Ocelot	Male	
Payne	1	Summer	Empty			
Payne	2	Summer	Empty			Raccoon
Payne	3	Summer	Empty			
Payne	4	Summer	Empty			Raccoon
Payne	5	Summer	Hit	Bobcat	Unknown	
Payne	6	Summer	Empty			
Payne	7	Summer	Empty			
Payne	1	Winter	Empty			
Payne	2	Winter	Empty			
Payne	3	Winter	Hit	Unknown	Unknown	Hog, Raccoon
Payne	4	Winter	Hit	Fox	Unknown	Raccoon
Payne	5	Winter	Empty			Raccoon
Payne	6	Winter	Hit	Skunk	Unknown	
Payne	7	Winter	Empty			
Schalaben	1	Summer	Empty			Raccoon
Schalaben	2	Summer	Hit	Unknown	Unknown	Raccoon, Roadrunner
Schalaben	3	Summer	Empty			
Schalaben	4	Summer	Empty			
Schalaben	5	Summer	Empty			
Schalaben	6	Summer	Empty			
Schalaben	7	Summer	Empty			Raccoon
Schalaben	8	Summer	Hit	Unknown	Unknown	
Schalaben	1	Winter	Empty			
Schalaben	2	Winter	Empty			
Schalaben	3	Winter	Empty			
Schalaben	4	Winter	Hit	Unknown	Unknown	
Schalaben	5	Winter	Empty			

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
Schalaben	6	Winter	Empty			
Schalaben	7	Winter	Empty			Bobcat, Raccoon
Schalaben	8	Winter	Hit	Bobcat	Male	Raccoon
Teniente (Rudman)	1	Summer	Empty			Javelina, Raccoon
Teniente (Rudman)	2	Summer	Empty			
Teniente (Rudman)	3	Summer	Empty			
Teniente (Rudman)	4	Summer	Empty			
Teniente (Rudman)	5	Summer	Empty			
Teniente (Rudman)	6	Summer	Empty			
Teniente (Rudman)	1	Winter	Empty			Javelina, Raccoon, Cottontail
Teniente (Rudman)	2	Winter	Empty			Bobcat, Raccoon
Teniente (Rudman)	3	Winter	Hit	Unknown	Unknown	Raccoon
Teniente (Rudman)	4	Winter	Empty			
Teniente (Rudman)	5	Winter	Empty			
Teniente (Rudman)	6	Winter	Empty			
Teniente (Ring)	1	Summer	Empty			
Teniente (Ring)	2	Summer	Empty			
Teniente (Ring)	3	Summer	Empty			
Teniente (Ring)	4	Summer	Empty			
Teniente (Ring)	5	Summer	Empty			
Teniente (Ring)	6	Summer	Hit	Bobcat	Female	
Teniente (Ring)	7	Summer	Empty			
Teniente (Ring)	8	Summer	Empty			Hog
Teniente (Ring)	9	Summer	Empty			Javelina
Teniente (Ring)	10	Summer	Hit	Cougar	Unknown	
Teniente (Ring)	1	Winter	Empty			
Teniente (Ring)	2	Winter	Empty			Bobcat, Raccoon, Skunk
Teniente (Ring)	3	Winter	Empty			
Teniente (Ring)	4	Winter	Hit	Skunk	Unknown	Gray Fox, Raccoon
Teniente (Ring)	5	Winter	Empty			
Teniente (Ring)	6	Winter	Hit	Bobcat	Female	
Teniente (Ring)	7	Winter	Empty			
Teniente (Ring)	8	Winter	Empty			Raccoon, Opossum, Skunk, Cottontail
Teniente (Ring)	9	Winter	Empty			Raccoon
Teniente (Ring)	10	Winter	Empty			
East Lake	1	Summer	Empty			Raccoon, Opossum
East Lake	2	Summer	Empty			
East Lake	3	Summer	Empty			
East Lake	4	Summer	Empty			Raccoon

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
East Lake	1	Winter	Empty			
East Lake	2	Winter	Empty			
East Lake	3	Winter	Hit	Unknown	Unknown	
East Lake	4	Winter	Hit	Coyote	Unknown	Bobcat, Opossum, Raccoon
Wilamar	1	Summer	Empty			
Wilamar	2	Summer	Empty			
Wilamar	3	Summer	Empty			Roadrunner
Wilamar	4	Summer	Empty			Coyote
Wilamar	5	Summer	Empty			Raccoon, Skunk
Wilamar	6	Summer	Empty			
Wilamar	7	Summer	Empty			
Wilamar	1	Winter	Hit	Coyote	Unknown	
Wilamar	2	Winter	Empty			Coyote, Raccoon
Wilamar	3	Winter	Empty			
Wilamar	4	Winter	Empty			
Wilamar	5	Winter	Empty			Bobcat, Raccoon
Wilamar	6	Winter	Empty			
Wilamar	7	Winter	Empty			
La Selva Verde	1	Summer	Empty			
La Selva Verde	2	Summer	Hit	Hog	Unknown	
La Selva Verde	3	Summer	Hit	Hog	Unknown	
La Selva Verde	4	Summer	Empty			Raccoon
La Selva Verde	5	Summer	Hit	Hog	Unknown	
La Selva Verde	6	Summer	Empty			Raccoon
La Selva Verde	7	Summer	Hit	Unknown	Unknown	Hog
La Selva Verde	1	Winter	Empty			
La Selva Verde	2	Winter	Empty			Raccoon
La Selva Verde	3	Winter	Hit	Coyote	Unknown	
La Selva Verde	4	Winter	Empty			
La Selva Verde	5	Winter	Hit	Hog	Unknown	
La Selva Verde	6	Winter	Empty			Raccoon
La Selva Verde	7	Winter	Empty			
Boca Chica	1	Summer	Hit	Bobcat	Male	
Boca Chica	2	Summer	Empty			
Boca Chica	3	Summer	Empty			
Boca Chica	4	Summer	Hit	Bobcat	Female	
Boca Chica	5	Summer	Empty			Bobcat, Raccoon
Boca Chica	6	Summer	Hit	Fox	Unknown	
Boca Chica	1	Winter	Hit	Bobcat	Male	
Boca Chica	2	Winter	Hit	Bobcat	Female	

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
Boca Chica	3	Winter	Hit	Bobcat	Unknown	
Boca Chica	4	Winter	Empty			Bobcat
Boca Chica	5	Winter	Empty			
Boca Chica	6	Winter	Hit	Bobcat	Male	Bobcat
Palmito Hill	1	Summer	Hit	Bobcat	Male	
Palmito Hill	2	Summer	Empty			
Palmito Hill	1	Winter	Hit	Bobcat	Female	
Palmito Hill	2	Winter	Empty			
Caja Pinta Banco	1	Summer	Hit	Unknown	Unknown	Raccoon, Cottontail
Caja Pinta Banco	2	Summer	Empty			
Caja Pinta Banco	1	Winter	Hit	Bobcat	Male	
Caja Pinta Banco	2	Winter	Hit	Bobcat	Male	
Tulosa Ranch	1	Summer	Hit	Bobcat	Male	Raccoon
Tulosa Ranch	2	Summer	Empty			
Tulosa Ranch	1	Winter	Hit	Unknown	Unknown	
Tulosa Ranch	2	Winter	Empty			
Boscaje De La Palma	1	Summer	Empty			Raccoon
Boscaje De La Palma	2	Summer	Empty			
Boscaje De La Palma	3	Summer	Hit	Bobcat	Female	Bobcat
Boscaje De La Palma	4	Summer	Empty			
Boscaje De La Palma	1	Winter	Hit	Unknown	Unknown	
Boscaje De La Palma	2	Winter	Empty			Raccoon
Boscaje De La Palma	3	Winter	Empty			
Boscaje De La Palma	4	Winter	Empty			Bobcat, Raccoon
Ranchito	1	Summer	Empty			
Ranchito	2	Summer	Empty			
Ranchito	3	Summer	Hit	Unknown	Unknown	
Ranchito	4	Summer	Hit	Coyote	Unknown	
Ranchito	5	Summer	Empty			
Ranchito	1	Winter	Empty			Bobcat, Raccoon
Ranchito	2	Winter	Empty			
Ranchito	3	Winter	Hit	Bobcat	Female	Bobcat, Hog, Raccoon
Ranchito	4	Winter	Hit	Bobcat	Female	
Ranchito	5	Winter	Empty			
Resaca Del Rancho Viejo	1	Summer	Empty			Raccoon
Resaca Del Rancho Viejo	2	Summer	Empty			
Resaca Del Rancho Viejo	3	Summer	Empty			
Resaca Del Rancho Viejo	4	Summer	Empty			Raccoon
Resaca Del Rancho Viejo	1	Winter	Empty			
Resaca Del Rancho Viejo	2	Winter	Hit	Unknown	Unknown	

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
Resaca Del Rancho Viejo	3	Winter	Empty			
Resaca Del Rancho Viejo	4	Winter	Empty			
Mercedes	1	Summer	Empty			
Mercedes	2	Summer	Hit	Bobcat	Female	Bobcat
Mercedes	1	Winter	Empty			
Mercedes	2	Winter	Empty			
Santa Ana	1	Summer	Empty			
Santa Ana	2	Summer	Empty			
Santa Ana	3	Summer	Hit	Unknown	Unknown	
Santa Ana	4	Summer	Empty			
Santa Ana	5	Summer	Hit	Dog	Unknown	Bobcat, Raccoon
Santa Ana	6	Summer	Empty			
Santa Ana	7	Summer	Empty			
Santa Ana	8	Summer	Empty			Raccoon, Armadillo
Santa Ana	9	Summer	Hit	Bobcat	Male	Bobcat, Armadillo
Santa Ana	10	Summer	Empty			
Santa Ana	1	Winter	Empty			
Santa Ana	2	Winter	Empty			Bobcat, Skunk, Raccoon
Santa Ana	3	Winter	Hit	Dog	Unknown	
Santa Ana	4	Winter	Empty			
Santa Ana	5	Winter	Hit	Bobcat	Female	Bobcat, Raccoon
Santa Ana	6	Winter	Empty			
Santa Ana	7	Winter	Empty			
Santa Ana	8	Winter	Empty			
Santa Ana	9	Winter	Hit	Bobcat	Male	Bobcat, Raccoon
Santa Ana	10	Winter	Empty			
Sam Fordyce/Havana	1	Summer	Empty			BP Agent
Sam Fordyce/Havana	2	Summer	Empty			
Sam Fordyce/Havana	3	Summer	Hit	Unknown	Unknown	
Sam Fordyce/Havana	1	Winter	Empty			
Sam Fordyce/Havana	2	Winter	Empty			
Sam Fordyce/Havana	3	Winter	Hit	Unknown	Unknown	
Yturria Brush	1	Summer	Hit	Skunk	Unknown	
Yturria Brush	2	Summer	Empty			
Yturria Brush	3	Summer	Empty			
Yturria Brush	4	Summer	Empty			Raccoon
Yturria Brush	5	Summer	Empty			Raccoon, Opossum
Yturria Brush	6	Summer	Empty			
Yturria Brush	1	Winter	Hit	Unknown	Unknown	
Yturria Brush	2	Winter	Empty			

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
Yturria Brush	3	Winter	Empty			Raccoon
Yturria Brush	4	Winter	Hit	Bobcat	Male	
Yturria Brush	5	Winter	Empty			Bobcat
Yturria Brush	6	Winter	Hit	Unknown	Unknown	
Chicharra Banco	1	Summer	Empty			Raccoon, Roadrunner
Chicharra Banco	2	Summer	Hit	Bobcat	Female	
Chicharra Banco	3	Summer	Empty			
Chicharra Banco	1	Winter	Empty			Bobcat, Coyote
Chicharra Banco	2	Winter	Hit	Unknown	Unknown	
Chicharra Banco	3	Winter	Hit	Coyote	Unknown	
Guerra	1	Summer	Empty			
Guerra	2	Summer	Empty			
Guerra	1	Winter	Hit	Bobcat	Female	Bobcat
Guerra	2	Winter	Hit	Bobcat	Female	
La Puerta	1	Summer	Empty			
La Puerta	2	Summer	Hit	Dog	Unknown	Raccoon, Armadillo
La Puerta	3	Summer	Hit	Unknown	Unknown	
La Puerta	4	Summer	Empty			
La Puerta	5	Summer	Empty			
La Puerta	6	Summer	Hit	Coyote	Unknown	
La Puerta	1	Winter	Empty			
La Puerta	2	Winter	Empty			Raccoon
La Puerta	3	Winter	Empty			
La Puerta	4	Winter	Hit	Coyote	Unknown	
La Puerta	5	Winter	Empty			
La Puerta	6	Winter	Empty			
Los Olmos	1	Summer	Hit	Unknown	Unknown	
Los Olmos	2	Summer	Empty			
Los Olmos	3	Summer	Empty			
Los Olmos	4	Summer	Hit	Unknown	Unknown	
Los Olmos	5	Summer	Hit	Coyote	Unknown	Coyote
Los Olmos	6	Summer	Hit	Coyote	Unknown	Cow, Coyote
Los Olmos	7	Summer	Empty			Cow, Raccoon
Los Olmos	1	Winter	Empty			
Los Olmos	2	Winter	Empty			
Los Olmos	3	Winter	Empty			
Los Olmos	4	Winter	Empty			
Los Olmos	5	Winter	Hit	Coyote	Unknown	
Los Olmos	6	Winter	Empty			
Los Olmos	7	Winter	Empty			

Table 4. Continued.

Survey Site	Pad	Season	Result	Species	Gender	Photograph
Arroyo Los Negros	1	Summer	Hit	Bobcat	Male	
Arroyo Los Negros	2	Summer	Hit	Bobcat	Male	Bobcat, Raccoon
Arroyo Los Negros	1	Winter	Empty			
Arroyo Los Negros	2	Winter	Hit	Unknown	Unknown	BP Agent, Raccoon
Arroyo Ramirez	1	Summer	Empty			Bobcat, Skunk
Arroyo Ramirez	2	Summer	Hit	Bobcat	Male	
Arroyo Ramirez	1	Winter	Empty			Raccoon
Arroyo Ramirez	2	Winter	Hit	Unknown	Unknown	
Arroyo Morteros	1	Summer	Empty			
Arroyo Morteros	2	Summer	Empty			Raccoon
Arroyo Morteros	1	Winter	Hit	Unknown	Unknown	
Arroyo Morteros	2	Winter	Empty			Bobcat, Raccoon

Habitat Analysis

Seventy woody species were documented along the transects (n = 128) at the survey sites, the two test run sites, and the capture site. Honey mesquite, granjeno, colima, and snake-eyes (*Phaulothamnus spinescens*) have a frequency of occurrence greater than 50% within the dense thornscrub brush sites (Table 5). There were no species common to all sites, but honey mesquite was present at 72.6% of the sites, granjeno at 63.2%, colima at 40.6%, and snake-eyes at 39.8%.

Of the 128 sites compared in this study, honey mesquite was a dominant or co-dominant species at 57 sites, granjeno at 20 sites, huisache at 18 sites, and snake-eyes at 14 sites. Snake-eyes is a dominant or co-dominant at 6 sites where ocelot visits occurred, granjeno at 2 sites, honey mesquite at 2 sites, and Texas ebony at 2 sites (Table 6). Table 7 summarizes the community composition and structure for all the ocelot sites. Snake-eyes is the dominant species.

Table 8 shows the community composition and structure for the Coastal Brushland and Potholes Biotic Community. Honey mesquite and snake-eyes are of high importance here as they are at the ocelot sites, but the species richness is lower (16 species) than the ocelot sites (23 species). This community has a 56.4% community coefficient compared with the ocelot sites.

Table 9 shows the community composition and structure for the Woodland Potholes and Basins Biotic Community. Honey mesquite is the dominant species. The species richness is higher here (34 species) than at the ocelot sites (23 species). The community similarity with the ocelot sites is 63.1%.

Table 5. List of woody plant species documented, frequency of occurrence, and percent of total species occurrence at 128 survey sites.

Common Name	Scientific Name	Frequency	Percent
Honey mesquite	*Prosopis glandulosa*	93	72.6
Granjeno	*Celtis pallida*	81	63.2
Colima	*Zanthoxylum fagara*	52	40.6
Snake-eyes	*Phaulothamnus spinescens*	51	39.8
Huisache	*Acacia farnesiana*	44	34.3
Ebony	*Pithecellobium ebano*	36	28.1
Lotebush	*Ziziphus obtusifolia*	33	25.7
Coyotillo	*Karwinskia humboldtiana*	29	22.6
Brasil	*Condalia hookeri*	27	21.0
La coma	*Bumelia celastrina*	26	20.3
Hackberry	*Celtis laevigata*	20	15.6
Whitebrush	*Aloysia gratissima*	20	15.6
Snag		18	14.0
Guayacan	*Guaiacum angustifolium*	17	13.2
Berlandier's fiddlewood	*Citharexylum berlandieri*	16	12.5
Retama	*Parkinsonia aculeata*	14	10.9
Elbow bush	*Forestiera angustifolia*	14	10.9
Anacahuita	*Cordia boissieri*	13	10.1
Texas Persimmon	*Diospyros texana*	12	9.3
Blackbrush acacia	*Acacia rigidula*	10	7.8
Crucita	*Eupatorium odoratum*	10	7.8
Cenizo	*Leucophyllum frutescens*	9	7.0
Armagosa	*Castela texana*	9	7.0
Anacua	*Ehretia anacua*	9	7.0
Texas prickly pear	*Opuntia engelmannii*	9	7.0
Knife-leaf condalia	*Condalia spathulata*	8	6.2
Desert lantana	*Lantana macropoda*	8	6.2
Texas kidneywood	*Eysenhardtia texana*	7	5.4
Texas lantana	*Lantana horrida*	7	5.4
Dry-land willow	*Baccharis neglecta*	7	5.4
Allthorn	*Koeberlinia spinosa*	7	5.4
Tenaza	*Pithecellobium pallens*	6	4.6

Table 5. Continued.

Common Name	Scientific Name	Frequency	Percent
Chapotillo	*Amyris texana*	6	4.6
Indian mallow	*Abutilon fruticosum*	6	4.6
Catclaw	*Acacia greggii*	5	3.9
Tepaguaje	*Leucaena pulverulenta*	5	3.9
Tasajillo	*Opuntia leptocaulis*	5	3.9
Sabal	*Sabal texana*	5	3.9
Palo verde	*Parkinsonia texana*	5	3.9
Blue eupatorium	*Eupatorium azureum*	4	3.1
Wright acacia	*Acacia wrightii*	4	3.1
Berlandier's croton	*Croton humilis*	4	3.1
Manzanita	*Malpighia glabra*	3	2.3
Hogplum	*Colubrina texensis*	3	2.3
Blue salvia	*Salvia ballotaeflora*	3	2.3
Desert yaupon	*Schaefferia cunefolia*	3	2.3
Chilipiquin	*Capsicum annuum*	3	2.3
Spanish dagger	*Yucca treculeana*	3	2.3
Huisachillo	*Acacia schaffneri*	2	1.5
Bernardia	*Bernardia myricifolia*	2	1.5
Cedar elm	*Ulmus crassifolia*	2	1.5
Rio Grande ash	*Fraxinus berlandieriana*	2	1.5
Mexican trixis	*Trixis inula*	2	1.5
Resin-bush	*Viguiera stenoloba*	2	1.5
Black willow	*Salix nigra*	2	1.5
Berlandier wolfberry	*Lycium berlandieri*	2	1.5
Salt cedar	*Tamarix aphylla*	2	1.5
Rosval	*Croton dioicus*	1	0.7
Guajillo	*Acacia berlandieri*	1	0.7
Adelia	*Adelia vaseyi*	1	0.7
Chinaberry-tree	*Melia azedarach*	1	0.7
Mission fiddlewood	*Citharexylum brachyanthum*	1	0.7
Barbed-wire cactus	*Acanthocereus pentagonus*	1	0.7
Armed saltbrush	*Atriplex acanothocarpa*	1	0.7
Barreta	*Helietta parvifolia*	1	0.7

Table 5. Continued.

Common Name	Scientific Name	Frequency	Percent
Clapweed	Ephedra antisyphilitica	1	0.7
Broomweed	Gutierrezia sarothrae	1	0.7
Sea ox-eye	Borrichia frutescens	1	0.7
Mexican bastardia	Bastardia viscosa	1	0.7
Shorthorn zexmenia	Zexmenia brevifolia	1	0.7

Table 6. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value measured at each ocelot site.

Survey Site	Pad	Scientific Name	Cover	RelCov	Freq	RelFreq	ImpVal
San Perlita	1	*Phaulothamnus spinescens*	51.3	29.5	72.0	29.5	59.0
		Celtis pallida	46.9	27.0	56.0	23.0	50.0
		Eupatorium odoratum	22.1	12.7	32.0	13.1	25.8
		Prosopis glandulosa	23.8	13.7	24.0	9.8	23.5
		Zanthoxylum fagara	15.8	9.1	28.0	11.5	20.6
		Castela texana	13.6	7.8	28.0	11.5	19.3
		Aloysia gratissima	0.4	0.2	4.0	1.6	1.8
San Perlita	2	*Phaulothamnus spinescens*	45.4	34.1	64.0	36.4	70.5
		Prosopis glandulosa	52.4	39.4	56.0	31.8	71.2
		Zanthoxylum fagara	16.7	12.6	24.0	13.6	26.2
		Celtis pallida	10.5	7.9	20.0	11.4	19.3
		Eupatorium odoratum	8.0	6.0	12.0	6.8	12.8
San Perlita	3	*Phaulothamnus spinescens*	71.8	66.9	64.0	57.1	124.0
		Celtis pallida	13.7	12.8	20.0	17.9	30.7
		Zanthoxylum fagara	12.0	11.2	12.0	10.7	21.9
		Castela texana	6.5	6.1	8.0	7.1	13.2
		Prosopis glandulosa	1.7	1.6	4.0	3.6	5.2
		Aloysia gratissima	1.6	1.5	4.0	3.6	5.1
El Jardin	1	*Aloysia gratissima*	42.1	30.4	60.0	28.3	58.7
		Phaulothamnus spinescens	32.2	23.2	52.0	24.5	47.7
		Prosopis glandulosa	33.0	23.8	44.0	20.8	44.6
		Zanthoxylum fagara	17.9	12.9	24.0	11.3	24.2
		Celtis pallida	10.0	7.3	24.0	11.3	18.6
		Malpighia glabra	2.0	1.4	4.0	1.9	3.3
		Forestiera angustifolia	1.2	0.9	4.0	1.9	2.8

Table 6. Continued.

Survey Site	Pad	Scientific Name	Cover	RelCov	Freq	RelFreq	ImpVal
El Jardin	2	*Celtis pallida*	59.6	39.5	68.0	29.8	69.3
		Phaulothamnus spinescens	34.0	22.5	52.0	22.8	45.3
		Prosopis glandulosa	28.4	18.8	32.0	14.0	32.8
		Eupatorium odoratum	11.7	7.8	24.0	10.5	18.3
		Aloysia gratissima	9.1	6.0	32.0	14.0	20.0
		Zanthoxylum fagara	5.6	3.7	12.0	5.3	9.0
		Snag	2.7	1.8	8.0	3.5	5.3
El Jardin	3	*Acacia farnesiana*	54.9	71.3	76.0	63.3	134.6
		Prosopis glandulosa	22.1	28.7	44.0	36.7	65.4
Vista Del Mar	1	*Phaulothamnus spinescens*	52.2	25.6	68.0	22.1	47.7
		Pithecellobium ebano	47.9	23.5	52.0	16.9	40.4
		Forestiera angustifolia	21.8	10.7	36.0	11.7	22.4
		Citharexylum berlandieri	17.6	8.6	36.0	11.7	20.3
		Zanthoxylum fagara	15.4	7.5	28.0	9.1	16.6
		Ziziphus obtusifolia	13.3	6.5	20.0	6.5	13.0
		Opuntia engelmannii	9.8	4.8	12.0	3.9	8.7
		Castela texana	5.0	2.5	16.0	5.2	7.7
		Condalia hookeri	5.6	2.7	12.0	3.9	6.6
		Celtis pallida	6.0	2.9	8.0	2.6	5.5
		Bumelia celastrina	4.2	2.1	8.0	2.6	4.7
		Eupatorium odoratum	2.7	1.3	4.0	1.3	2.6
		Abutilon fruticosum	1.6	0.8	4.0	1.3	2.1
		Condalia spathulata	0.8	0.4	4.0	1.3	1.7

Table 6. Continued.

Survey Site	Pad	Scientific Name	Cover	RelCov	Freq	RelFreq	ImpVal
Corbett	6	*Prosopis glandulosa*	49.2	31.7	56.0	23.7	55.4
		Phaulothamnus spinescens	45.4	29.2	60.0	25.4	54.6
		Karwinskia humboldtiana	19.9	12.8	40.0	16.9	29.7
		Aloysia gratissima	17.2	11.1	28.0	11.9	23.0
		Pithecellobium ebano	8.8	5.7	16.0	6.8	12.5
		Zanthoxylum fagara	5.4	3.5	12.0	5.1	8.6
		Celtis pallida	3.4	2.2	8.0	3.4	5.6
		Guaiacum angustifolium	3.2	2.1	8.0	3.4	5.5
		Ziziphus obtusifolia	1.5	1.0	4.0	1.7	2.7
		Koeberlinia spinosa	1.1	0.7	4.0	1.7	2.4
Corbett	13	*Pithecellobium ebano*	68.3	38.7	80.0	27.7	66.4
		Zanthoxylum fagara	22.4	12.7	36.0	12.5	25.2
		Prosopis glandulosa	23.6	13.4	28.0	9.7	23.1
		Celtis pallida	16.4	9.3	24.0	8.3	17.6
		Guaiacum angustifolium	12.2	6.9	24.0	8.3	15.2
		Bumelia celastrina	11.6	6.6	20.0	6.9	13.5
		Colubrina texensis	4.8	2.7	24.0	8.3	11.0
		Karwinskia humboldtiana	4.1	2.3	16.0	5.6	7.9
		Cordia boissieri	5.2	2.9	12.0	4.2	7.1
		Koeberlinia spinosa	3.7	2.1	8.0	2.8	4.9
		Eupatorium odoratum	3.4	1.9	8.0	2.8	4.7
		Aloysia gratissima	1.7	1.0	8.0	2.8	3.8

Table 7. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for all ocelot sites.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Phaulothamnus spinescens	36.9	25.7	48.0	24.2	49.9
Prosopis glandulosa	26.0	19.0	32.0	16.7	35.7
Celtis pallida	18.5	12.1	25.3	12.0	24.1
Zanthoxylum fagara	12.4	8.1	19.6	8.8	16.9
Acacia farnesiana	6.1	7.9	8.4	7.0	14.9
Pithecellobium ebano	13.9	7.5	16.4	5.7	13.2
Aloysia gratissima	8.0	5.6	15.1	6.9	12.5
Eupatorium odoratum	5.3	3.3	8.9	3.8	7.1
Castela texana	2.8	1.8	5.8	2.6	4.4
Karwinskia humboldtiana	2.7	1.7	6.2	2.5	4.2
Forestiera angustifolia	2.6	1.3	4.4	1.5	2.8
Citharexylum berlandieri	2.0	1.0	4.0	1.3	2.3
Guaiacum angustifolium	1.7	1.0	3.6	1.3	2.3
Bumelia celastrina	1.8	1.0	3.1	1.1	2.1
Ziziphus obtusifolia	1.6	0.8	2.7	0.9	1.7
Colubrina texensis	0.5	0.3	2.7	0.9	1.2
Opuntia engelmannii	1.1	0.5	1.3	0.4	0.9
Koeberlinia spinosa	0.5	0.3	1.3	0.5	0.8
Cordia boissieri	0.6	0.3	1.3	0.5	0.8
Condalia hookeri	0.6	0.3	1.3	0.4	0.7
Snag	0.3	0.2	0.9	0.4	0.6
Malpighia glabra	0.2	0.2	0.4	0.2	0.4
Abutilon fruticosum	0.2	0.1	0.4	0.1	0.2
Condalia spathulata	0.1	0.1	0.4	0.1	0.2

Table 8. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Coastal Brushland Potholes Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	31.1	24.3	37.2	22.2	46.5
Phaulothamnus spinescens	25.4	20.1	32.9	19.3	39.4
Acacia farnesiana	17.3	17.4	20.6	16.0	33.4
Celtis pallida	20.3	14.6	28.9	15.7	30.3
Zanthoxylum fagara	8.8	6.4	12.9	6.7	13.1
Parkinsonia aculeata	6.3	5.3	8.0	5.3	10.6
Eupatorium odoratum	4.6	3.2	7.4	3.6	6.8
Aloysia gratissima	4.1	2.9	7.7	3.7	6.6
Trixis inula	1.7	1.3	3.7	2.0	3.3
Ziziphus obtusifolia	2.2	1.2	3.4	1.4	2.6
Castela texana	1.5	1.1	2.8	1.4	2.5
Baccharis neglecta	1.7	1.2	2.2	1.2	2.4
Celtis laevigata	0.5	0.4	0.9	0.5	0.9
Forestiera angustifolia	0.3	0.2	0.9	0.4	0.6
Snag	0.2	0.1	0.6	0.3	0.4
Malpighia glabra	0.2	0.1	0.3	0.1	0.2
Borrichia frutescens	0.1	0.1	0.3	0.1	0.2

Table 9. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Woodland Potholes & Basins Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	39.9	33.7	45.3	30.2	63.9
Acacia farnesiana	8.9	9.3	11.3	10.2	19.5
Pithecellobium ebano	12.9	9.7	17.2	9.3	19.0
Phaulothamnus spinescens	13.6	9.6	18.7	9.3	18.9
Celtis pallida	9.8	6.3	14.4	7.0	13.3
Zanthoxylum fagara	7.3	4.8	12.2	5.5	10.3
Parkinsonia aculeata	4.0	3.9	4.6	4.2	8.1
Baccharis neglecta	3.5	3.0	4.1	3.1	6.1
Karwinskia humboldtiana	3.5	2.3	7.0	2.9	5.2
Condalia hookeri	2.7	1.6	4.3	1.8	3.4
Aloysia gratissima	1.9	1.3	3.2	1.5	2.8
Bumelia celastrina	2.2	1.4	3.3	1.4	2.8
Opuntia engelmannii	1.0	0.9	1.2	1.0	1.9
Cordia boissieri	1.4	0.9	1.8	0.8	1.7
Snag	1.0	0.9	1.2	0.8	1.7
Guaiacum angustifolium	1.1	0.7	2.0	0.8	1.5
Pithecellobium pallens	1.1	0.7	1.3	0.7	1.4
Eupatorium odoratum	0.8	0.6	1.3	0.7	1.3
Lantana horrida	0.8	0.6	1.4	0.7	1.3
Eupatorium azureum	0.9	0.5	1.7	0.7	1.2
Colubrina texensis	0.6	0.4	1.4	0.7	1.1
Opuntia leptocaulis	0.6	0.4	1.2	0.6	1.0
Trixis inula	0.8	0.4	1.2	0.4	0.8
Koeberlinia spinosa	0.3	0.2	0.8	0.4	0.6
Bastardia viscosa	0.3	0.3	0.4	0.3	0.6
Ephedra antisyphilitica	0.3	0.2	0.6	0.3	0.5
Leucophyllum frutescens	0.3	0.2	0.7	0.3	0.5

Table 9. Continued.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Ziziphus obtusifolia	0.3	0.2	0.4	0.2	0.4
Lycium berlandieri	0.2	0.2	0.4	0.2	0.4
Gutierrezia sarothrae	0.2	0.2	0.3	0.2	0.4
Bernardia myricifolia	0.3	0.1	0.3	0.1	0.2
Diospyros texana	0.1	0.1	0.2	0.1	0.2
Schaefferia cunefolia	0.1	0.1	0.2	0.1	0.2
Forestiera angustifolia	0.1	0.1	0.1	0.1	0.2
Croton dioicus	0.1	0.1	0.1	0.1	0.2

Table 10 shows the community composition and structure for the Loma/Tidal Flats Biotic Community. Honey mesquite is the dominant species. The species richness is higher here (26 species) than at the ocelot sites (23 species). Community similarity with the ocelot sites is 69.3%.

Table 11 shows the community composition and structure for the Sabal Palm Forest Biotic Community. Colima is the dominant species and snake-eyes is absent. The species richness is lower here (13 species) than the ocelot sites (23 species) and the community coefficient for comparison with the ocelot sites is 44.4%.

Table 12 shows the community composition and structure for the Mid-Delta Thorn Forest Biotic Community. Honey mesquite is the dominant species. The species richness is lower here (19 species) than the ocelot sites (23 species). The community similarity with the ocelot sites is 57.1%.

Table 13 shows the community composition and structure for the Mid-Valley Riparian Woodland Biotic Community. Granjeno is the dominant species. The species richness is higher here (30 species) than the ocelot sites (23 species). Community similarity with the ocelot sites is 60.3%.

Table14 shows the community composition and structure for the Upland Thorn Scrub Biotic Community. Sugar hackberry is the dominant species. The species richness is higher here (34 species) than the ocelot sites (23 species) and the community coefficient for comparison with the ocelot sites is 52.6%.

Table 15 shows the community composition and structure for the Upper Valley Flood Forest Biotic Community. Honey mesquite is the dominant species and snake-eyes

Table 10. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Loma/Tidal Flats Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	50.6	33.5	56.0	29.2	62.7
Citharexylum berlandieri	30.5	18.7	44.9	24.2	42.9
Pithecellobium ebano	20.1	13.5	23.7	11.4	24.9
Zanthoxylum fagara	11.8	7.1	20.0	8.8	15.9
Acacia farnesiana	9.7	7.1	12.3	6.7	13.8
Phaulothamnus spinescens	7.5	4.4	10.2	4.3	8.7
Celtis pallida	4.1	2.7	6.8	3.0	5.7
Ziziphus obtusifolia	1.4	2.4	5.5	2.5	4.9
Bumelia celastrina	5.0	2.4	6.5	2.1	4.5
Forestiera angustifolia	3.3	1.8	5.2	1.9	3.7
Celtis laevigata	1.4	1.1	1.5	0.9	2.0
Abutilon fruticosum	1.4	0.8	2.5	0.9	1.7
Condalia hookeri	1.7	0.7	2.8	0.9	1.6
Snag	0.7	0.5	1.5	0.8	1.3
Castela texana	0.7	0.4	1.8	0.8	1.2
Eupatorium odoratum	0.9	0.5	1.5	0.6	1.1
Karwinskia humboldtiana	0.6	0.4	1.5	0.7	1.1
Diospyros texana	0.8	0.5	1.2	0.5	1.0
Yucca treculeana	0.5	0.4	0.9	0.5	0.9
Acanthocereus pentagonus	0.6	0.4	0.9	0.5	0.9
Opuntia engelmannii	0.8	0.4	0.9	0.3	0.7
Atriplex acanothocarpa	0.3	0.2	0.9	0.5	0.7
Croton humilis	0.3	0.2	0.6	0.3	0.5
Capsicum annuum	0.2	0.1	0.6	0.4	0.5
Condalia spathulata	0.1	0.1	0.3	0.1	0.2
Lantana horrida	0.1	0.1	0.3	0.1	0.2
Schaefferia cunefolia	0.1	0.1	0.3	0.1	0.2

Table 11. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Sabal Palm Forest Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Zanthoxylum fagara	37.7	22.0	47.0	22.6	44.6
Ehretia anacua	25.0	13.7	35.0	16.5	30.2
Celtis pallida	22.2	13.6	30.0	14.3	27.9
Acacia farnesiana	19.9	11.9	21.0	10.1	22.0
Sabal texana	15.1	7.9	18.0	8.3	16.2
Snag	11.6	8.0	15.0	7.5	15.5
Prosopis glandulosa	13.8	7.8	14.0	6.4	14.2
Ziziphus obtusifolia	8.0	4.9	14.0	6.7	11.6
Celtis laevigata	12.1	5.6	1.5	0.7	6.3
Bumelia celastrina	4.0	2.4	7.0	3.4	5.8
Condalia hookeri	2.6	1.2	4.0	1.8	3.0
Leucaena pulverulenta	1.2	0.7	2.0	1.0	1.7
Pithecellobium ebano	0.5	0.3	1.0	0.5	0.8
Parkinsonia aculeata	0.3	0.2	1.0	0.5	0.7

Table 12. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Mid-Delta Thorn Forest Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	51.2	41.0	58.3	39.1	80.1
Acacia farnesiana	21.4	18.4	23.4	17.5	35.9
Celtis pallida	12.5	9.2	16.6	9.7	18.9
Celtis laevigata	10.1	7.7	11.1	7.5	15.2
Parkinsonia aculeata	6.2	5.3	6.9	5.4	10.7
Pithecellobium ebano	6.6	3.6	7.4	3.6	7.2
Zanthoxylum fagara	5.0	3.0	5.7	2.8	5.8
Ziziphus obtusifolia	4.0	2.5	6.6	3.1	5.6
Citharexylum berlandieri	3.5	2.4	5.4	3.1	5.5
Condalia hookeri	5.3	2.6	6.9	2.6	5.2
Leucaena pulverulenta	3.1	1.2	3.7	1.2	2.4
Forestiera angustifolia	0.9	0.7	1.7	1.0	1.7
Bumelia celastrina	1.8	0.7	2.6	0.8	1.5
Phaulothamnus spinescens	1.3	0.6	1.7	0.7	1.3
Ehretia anacua	0.8	0.4	1.7	0.7	1.1
Abutilon fruticosum	0.4	0.3	0.9	0.5	0.8
Opuntia leptocaulis	0.3	0.3	0.6	0.4	0.7
Sabal texana	0.5	0.2	0.9	0.3	0.5
Fraxinus berlandieriana	0.2	0.2	0.3	0.2	0.4

Table 13. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Mid-Valley Riparian Woodland Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Celtis pallida	21.1	11.5	32.0	12.6	24.1
Celtis laevigata	11.5	12.1	12.0	11.2	23.3
Bumelia celastrina	21.1	12.1	24.9	9.3	21.4
Acacia farnesiana	11.3	9.9	13.4	10.3	20.2
Prosopis glandulosa	17.2	8.9	20.0	7.9	16.8
Ulmus crassifolia	6.2	5.3	6.9	4.9	10.2
Melia azedarach	6.2	4.6	6.6	4.3	8.9
Baccharis neglecta	5.0	4.5	5.4	4.4	8.9
Diospyros texana	8.5	4.1	11.4	4.1	8.2
Parkinsonia aculeata	4.6	4.1	5.4	4.0	8.1
Acacia greggii	6.6	3.5	10.3	3.8	7.3
Guaiacum angustifolium	3.3	2.4	6.9	2.8	5.2
Snag	2.7	2.1	4.6	2.8	4.9
Condalia hookeri	4.6	2.4	6.3	2.3	4.7
Phaulothamnus spinescens	2.4	1.7	6.0	2.3	4.0
Ehretia anacua	2.3	1.5	4.3	1.8	3.3
Acacia wrightii	3.3	1.5	4.0	1.4	2.9
Leucaena pulverulenta	1.8	1.3	2.3	1.4	2.7
Amyris texana	1.9	1.1	3.4	1.3	2.4
Zanthoxylum fagara	1.7	1.1	2.3	1.0	2.1
Salix nigra	1.5	1.1	2.0	0.9	2.0
Abutilon fruticosum	1.1	0.6	2.6	1.0	1.6
Pithecellobium ebano	0.9	0.7	1.7	0.7	1.4
Ziziphus obtusifolia	1.2	0.8	1.4	0.5	1.3
Condalia spathulata	1.0	0.7	1.1	0.4	1.1
Malpighia glabra	0.5	0.3	1.4	0.5	0.8
Forestiera angustifolia	0.7	0.3	1.1	0.4	0.7
Karwinskia humboldtiana	0.5	0.2	0.9	0.3	0.5
Koeberlinia spinosa	0.3	0.1	0.6	0.2	0.3
Adelia vaseyi	0.1	0.1	0.3	0.1	0.2
Acacia berlandieri	0.2	0.1	0.3	0.1	0.2

Table 14. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Upland Thorn Scrub Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Celtis laevigata	24.5	20.6	25.8	19.3	39.9
Prosopis glandulosa	18.6	15.2	18.2	11.7	26.9
Acacia farnesiana	7.6	7.0	8.9	7.4	14.4
Bumelia celastrina	8.1	6.0	12.9	6.2	12.2
Phaulothamnus spinescens	10.1	6.2	13.8	5.5	11.7
Celtis pallida	8.6	5.1	14.2	5.3	10.4
Cordia boissieri	8.8	5.2	13.3	4.9	10.1
Guaiacum angustifolium	4.7	3.0	9.3	4.1	7.1
Parkinsonia texana	5.9	3.7	7.1	3.2	6.9
Zanthoxylum fagara	6.5	3.7	9.3	3.1	6.8
Pithecellobium ebano	3.3	2.4	4.9	2.9	5.3
Salvia ballotaeflora	5.0	2.6	8.0	2.6	5.2
Lantana horrida	2.9	1.6	6.2	2.0	3.6
Leucaena pulverulenta	2.1	1.8	2.2	1.7	3.5
Croton humilis	2.6	1.5	5.3	1.8	3.3
Karwinskia humboldtiana	2.4	1.4	5.3	1.8	3.2
Acacia rigidula	3	1.6	4.4	1.4	3.0
Pithecellobium pallens	3.1	0.7	4.0	1.3	3.0
Koeberlinia spinosa	2.3	1.4	3.6	1.5	2.9
Salix nigra	2.1	1.4	2.2	1.3	2.7
Acacia shaffneri	1.7	1.2	2.7	1.4	2.6
Lantana macropoda	0.9	0.6	4.0	1.6	2.2
Snag	1.3	0.8	2.2	1.3	2.1
Eysenhardtia texana	0.9	0.5	2.7	0.9	1.4
Forestiera angustifolia	0.7	0.5	1.8	0.8	1.3
Viguiera stenoloba	1.0	0.5	2.2	0.8	1.3
Bernardia myricifolia	1.1	0.6	2.2	0.7	1.3

Table 14. Continued.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Zexmenia brevifolia	0.9	0.5	1.8	0.7	1.2
Ziziphus obtusifolia	0.3	0.2	1.8	1.0	1.2
Diospyros texana	1.0	0.5	1.3	0.4	0.9
Aloysia gratissima	0.5	0.3	0.9	0.5	0.8
Schaefferia cunefolia	0.4	0.3	0.4	0.3	0.6
Citharexylum brachyanthum	0.4	0.2	0.4	0.2	0.4
Malpighia glabra	0.1	0.1	0.4	0.1	0.2
Amyris texana	0.1	0.1	0.4	0.1	0.2

Table 15. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Upper Valley Flood Forest Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	70.8	47.8	72.8	41.2	89.0
Celtis pallida	30.7	20.3	47.2	25.3	45.6
Tamarix aphylla	17.2	11.1	18.4	9.6	20.7
Zanthoxylum fagara	9.6	5.4	15.2	6.1	11.5
Acacia wrightii	9.6	5.4	13.6	5.5	10.9
Opuntia engelmannii	5.0	2.9	8.0	3.4	6.3
Ziziphus obtusifolia	4.1	2.4	7.2	3.1	5.5
Condalia hookeri	3.5	2.0	6.4	2.6	4.6
Phaulothamnus spinescens	2.2	1.2	3.2	1.3	2.5
Parkinsonia aculeata	1.6	1.0	2.4	1.3	2.3
Diospyros texana	1.0	0.5	1.6	0.7	1.2

is of low importance. The species richness is lower here (11 species) than the ocelot sites (23 species). The community similarity with the ocelot sites is 41.1%.

Table 16 shows the community composition and structure for the Barretal Biotic Community. Honey mesquite is the dominant species. The species richness is lower here (18 species) than the ocelot sites (23 species). Community similarity with the ocelot sites is 53.6%.

Table 17 shows the community composition and structure for the Ramaderos Biotic Community. Honey mesquite is the dominant species. The species richness is lower here (21 species) than the ocelot sites (23 species) and the community coefficient for comparison with the ocelot sites is 54.5%.

Table 18 shows the community composition and structure for the Chihuahuan Thorn Forest Biotic Community. Honey mesquite, huisache, and granjeno have similar importance values and there is no clear dominant. The species richness is lower here (18 species) than the ocelot sites (23 species). The community similarity with the ocelot sites is 58.5%.

The plant species at the ocelot sites that made up more than 50% of the total cover and importance values include snake-eyes, granjeno, honey mesquite, Texas ebony, and colima. The mean total cover for each site is comprised of the sum of the individual cover values of each species, which at these sites provided overlap of different layers of vegetation. Consequently, the mean total cover for all the sites is 142% and the mean total cover for all the ocelot sites is 146% (Table 19). A t-test comparing the total cover

Table 16. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Barretal Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	38.4	25.7	43.3	19.4	45.1
Acacia rigidula	15.6	11.2	25.3	11.8	23.0
Cordia boissieri	12.9	8.6	20.0	8.9	17.5
Parkinsonia texana	9.4	8.6	16.0	8.3	16.9
Pithecellobium pallens	12.5	8.9	14.0	6.5	15.4
Celtis pallida	9.4	6.0	27.3	6.0	12.0
Karwinskia humboldtiana	7.2	5.1	14.0	6.5	11.6
Lantana macropoda	6.4	4.8	12.8	6.7	11.5
Aloysia gratissima	7.0	4.5	16.0	6.9	11.4
Guaiacum angustifolium	4.6	3.3	11.3	5.3	8.6
Leucophyllum frutescens	3.9	3.3	5.0	3.1	6.4
Condalia spathulata	3.6	2.7	6.0	2.9	5.6
Eysenhardtia texana	3.1	2.5	6.0	3.0	5.5
Condalia hookeri	3.6	2.1	4.0	1.8	3.9
Bumelia celastrina	2.5	1.5	4.7	2.1	3.6
Diospyros texana	1.5	1.2	2.7	1.3	2.5
Snag	1.5	0.9	2.7	1.1	2.0
Phaulothamnus spinescens	1.2	0.8	2.0	0.8	1.6
Zanthoxylum fagara	0.5	0.3	0.7	0.3	0.6

Table 17. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Ramaderos Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	43.8	25.5	48.0	25.6	51.1
Celtis pallida	24.8	16.0	35.4	16.7	32.7
Acacia farnesiana	19.2	12.7	20.6	11.0	23.7
Acacia rigidula	15.5	12.4	21.7	10.9	23.3
Pithecellobium ebano	11.2	6.1	12.6	5.5	11.6
Aloysia gratissima	8.0	4.8	13.1	5.8	10.6
Ziziphus obtusifolia	5.3	3.6	8.0	3.8	7.4
Karwinskia humboldtiana	4.2	2.2	7.4	3.9	6.1
Phaulothamnus spinescens	3.7	2.6	5.7	3.1	5.7
Celtis laevigata	4.8	2.6	5.1	2.2	4.8
Capsicum annuum	2.7	2.3	4.0	2.4	4.7
Acacia berlandieri	2.6	2.3	2.9	1.7	4.0
Eysenhardtia texana	2.3	1.4	4.0	1.9	3.3
Condalia spathulata	1.7	0.9	4.6	1.9	2.8
Leucophyllum frutescens	1.6	0.9	4.0	1.7	2.6
Helietta parvifolia	1.2	1.0	2.3	1.4	2.4
Koeberlinia spinosa	0.9	0.5	1.7	0.7	1.2
Bumelia celastrina	0.6	0.3	1.7	0.7	1.0
Opuntia leptocaulis	0.6	0.3	1.1	0.5	0.8
Lantana macropoda	0.4	0.3	0.6	0.3	0.6
Snag	0.6	0.3	0.6	0.2	0.5
Condalia hookeri	0.2	0.2	0.6	0.3	0.5

Table 18. Woody species composition, cover (%), relative cover (%), frequency (%), relative frequency (%), and importance value summarized for Chihuahuan Thorn Forest Biotic Community.

Species	Cover	RelCov	Freq	RelFreq	ImpVal
Prosopis glandulosa	33.5	19.5	39.3	19.3	38.8
Acacia farnesiana	27.2	19.2	33.3	17.7	36.9
Celtis pallida	38.2	19.1	44.0	17.2	36.3
Celtis laevigata	14.3	7.8	16.0	6.2	14.0
Parkinsonia aculeata	8.8	5.4	12.0	5.3	10.7
Ziziphus obtusifolia	8.5	4.8	12.7	5.3	10.1
Fraxinus berlandieriana	9.5	4.2	11.3	4.0	8.2
Zanthoxylum fagara	5.3	2.6	12.0	4.5	7.1
Pithecellobium ebano	6.4	3.5	7.3	3.1	6.6
Tamarix aphylla	3.3	2.9	3.3	2.5	5.4
Opuntia engelmannii	3.0	1.9	5.3	2.5	4.4
Snag	3.1	2.2	4.0	2.1	4.3
Bumelia celastrina	1.9	1.4	4.0	2.5	3.9
Phaulothamnus spinescens	2.5	1.4	4.7	2.0	3.4
Condalia hookeri	3.1	1.6	4.7	1.8	3.4
Forestiera angustifolia	1.8	0.9	4.7	1.8	2.7
Karwinskia humboldtiana	1.7	0.9	3.3	1.3	2.2
Leucophyllum frutescens	0.8	0.6	1.3	0.7	1.3
Capsicum annuum	0.4	0.2	1.3	0.5	0.7

of ocelot sites with that of all other sites indicated that there was no significant difference. I also compared the total cover of ocelot "hit" sites with that of other "hit" sites, the total cover at visit sites with non-visit sites, and the total cover of ocelot sites with those of bobcat sites (Table 19). The ocelot sites averaged 146% total cover and all other sites averaged 142%. The tests indicated that there was no significant difference between the total cover at the sites where ocelots were found and the other sites.

By conducting species association tests for all sites, I found that snake-eyes, granjeno, honey mesquite, Texas ebony, and colima all have co-occurrence values similar to that expected by chance. However, contingency chi-square tests for each species indicated that there is a significant interaction between the presence of snake-eyes and colima with the presence of ocelot (Table 20).

The degree of similarity in woody species composition (Sorensen community coefficient) of dense thornscrub brush among all nine ocelot sites was 58.7% (Table 21). The ocelot sites were located in three Tamaulipan Biotic Province Communities: Coastal Brushland Potholes (San Perlita had 3 sites and El Jardin Tracts had 3 sites), Woodland Potholes & Basins (Corbett Ranch had 2 sites), and Loma/Tidal Flats (Vista Del Mar Tract had 1 site) (Fig. 9). Comparisons of similarity between ocelot sites and tracts from other biotic communities resulted in values indicating that six additional communities have tracts with similar woody species composition (50% or greater similarity) to those where ocelot were found (Table 22). Only two biotic communities (Sabal Palm Forest and Upper Valley Flood Forest) did not have any tracts with values similar to those of the ocelot sites (less than 50% similarity).

Table 19. Comparisons of total cover at ocelot sites with all other sites, ocelot "hit" sites with all other "hit" sites, visit sites with non visit sites, and ocelot sites with bobcat sites.

Total Cover Category	Type	N	Mean	t	df	P
All Sites	Ocelot	9	146.22	0.314	125	0.754
	All other	118	142.09			
Hit Sites	Ocelot	9	146.22	0.135	93	0.893
	Non-Ocelot	86	144.38			
Visitation Sites	Visits	91	144.03	0.777	135	0.439
	No visits	33	138.22			
Cat Sites	Ocelot	9	146.22	0.668	45	0.508
	Bobcat	38	156.37			

Table 20. Plant species association values for all ocelot sites.

	Coefficient Of Association	Calculated Chi-Square	Critical Chi-Square
Snake-eyes	0.072	4.23	3.84
Granjeno	0.031	1.68	3.84
Mesquite	0.017	0.55	3.84
Colima	0.090	7.32	3.84

Table 21. Community similarity values between all ocelot sites.

	Sorensen Coefficients (Average)
San Perlita vs. El Jardin	70.6
San Perlita vs. Corbett	57.1
El Jardin vs. Corbett	52.2
Corbett vs. Vista Del Mar	50.0
San Perlita vs. Vista Del Mar	47.6
El Jardin vs. Vista Del Mar	43.5
Mean For All Ocelot Sites	58.7

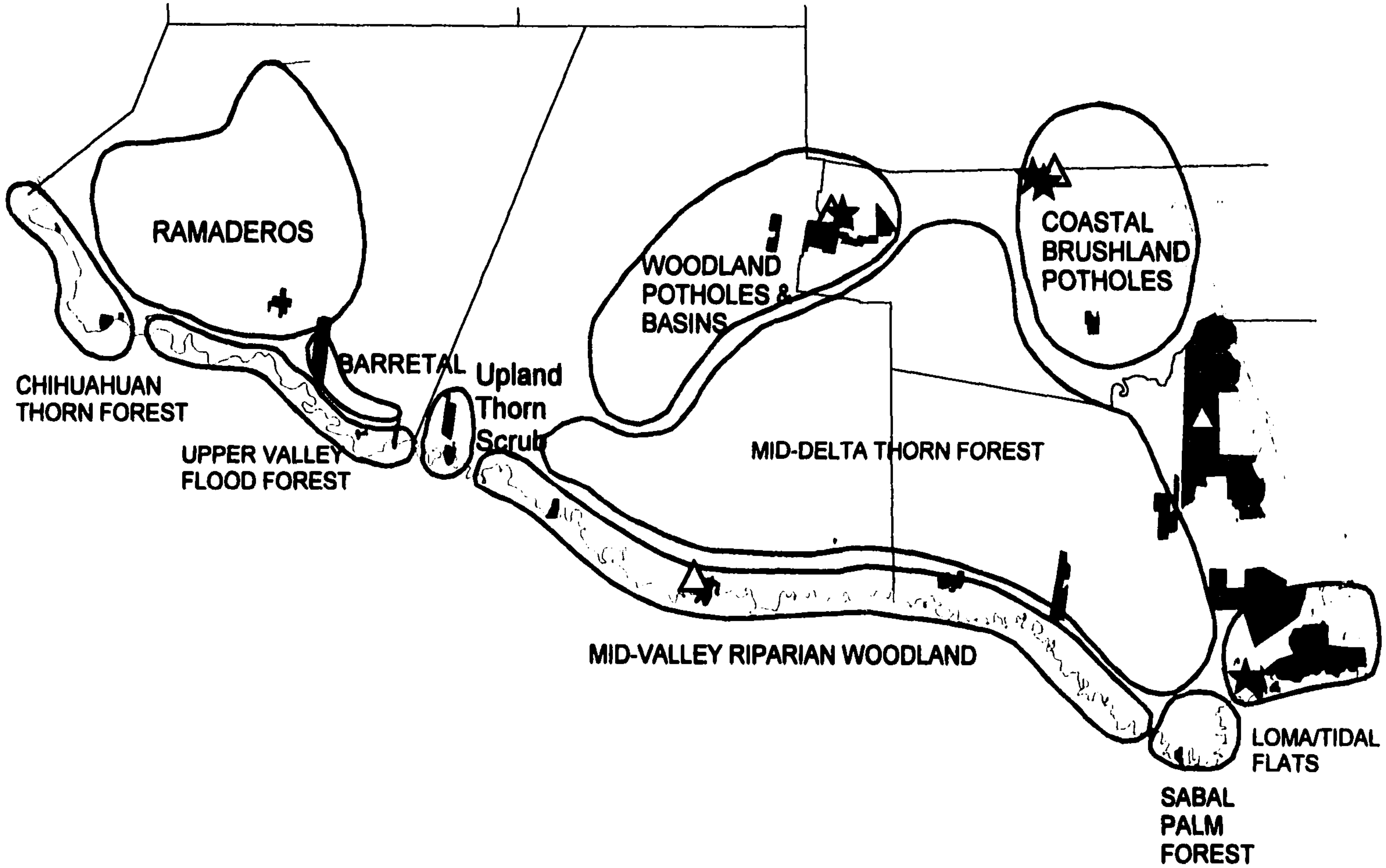

Figure 9. Ocelot locations within the biotic communities. Red stars represent ocelot sites in this study and yellow triangles represent ocelot sites in other studies.

Table 22. Community similarity values between ocelot sites and representative tracts from other biotic communities.

	Sorensen Coefficients (Average)
Woodland Potholes & Basins: Payne	77.2
Loma/Tidal Flats: Boca Chica	71.4
Mid-Valley Riparian Woodland: Santa Ana	70.8
Woodland Potholes & Basins: Teniente	68.2
Woodland Potholes & Basins: Schalaben	65.3
Barretal: La Puerta	57.1
Chihuahan Thorn Forest: Arroyo Ramirez	57.1
Ramaderos: Los Olmos	56.5
Upland Thorn Scrub: Yturria Brush	53.8
Mid-Delta Thorn Forest: Ranchito	52.6
Sabal Palm Forest: Boscaje Del La Palma	48.6
Upper Valley Flood Forest: Guerra	43.8

DISCUSSION

The Weaver hair-snaring data collected in this study provides evidence that ocelots are using the Lower Rio Grande Valley National Wildlife Refuge corridor in at least three Tamaulipan Biotic Province communities. The three communities where ocelots were detected were Coastal Brushland Potholes, Loma/Tidal Flats, and Woodland Potholes and Basins.

Data in this study show that ocelot are using at least six Refuge tracts, San Perlita, El Jardin, Vista Del Mar, Tulosa Ranch, Boca Chica, and the salt lakes area tracts. All of these tracts historically supported ocelot, but only San Perlita and El Jardin are known to have supported ocelot in recent years. Both of these tracts are small and have space available for a limited number of cats and many are likely forced off to search for other suitable locations. Nine ocelot pad "hits" or photographs were documented at these tracts. The salt lakes area (Payne, Teniente, Schalaben, La Sal del Rey, and East Lake tracts) held both male and female ocelot as late as the early 1980's, but until the test run of this study in 1999, the cats seemed to have vanished. Two photographs were taken that identified an ocelot using the area. Playa Del Rio also has had a history of ocelot use, but researchers have identified none in recent years. A male ocelot was captured on the Vista Del Mar tract in 1998, and with the use of radio telemetry it was documented using Vista Del Mar, Tulosa Ranch, and Boca Chica tracts as it traveled through the area.

Eleven ocelot were detected using the Weaver hair-snaring survey (2 during the trial run and 9 during the seasonal surveys) and one was detected in a live capture. From the snared hairs, 5 males and 3 females were identified using genetic analysis. Photographs at sites where no hairs were deposited located three ocelot. Confident sexual determinations were not possible, but physical appearance indicates two were the same young male. The live captured ocelot also was identified as a young male. Individual determinations were not made through genetic analysis by the conclusion of the study due to the inability to find a reliable marker to separate individual hair samples. However, photographic analysis of forehead markings was able to distinguish at least three different cats on the San Perlita and El Jardin tracts and one cat on the Corbett Ranch.

Due to the repetitiveness of the detections, it appears that the cats found at San Perlita and El Jardin are permanent residents, especially since one photograph identified an old radio collar on a cat from earlier studies. The cats located on the Corbett Ranch and Vista Del Mar, however, were not relocated in either the 2000 or 2001 survey and appear to be transient young males. The collared male at Vista Del Mar was tracked across several Refuge tracts, the Brownsville ship channel, and several State highways, to Laguna Atascosa National Wildlife Refuge. The Corbett cat also was not identified in any further surveys including several live trapping surveys and 2 hair-snaring surveys. Both the salt lakes area and the Playa Del Rio area, lie geographically close to existing ocelot populations and contain large areas of thornscrub brush. However, both areas have extensive man-made obstacles such as highways, agricultural fields, and human development between them and the existing ocelot populations.

Common vegetative features at ocelot sites include mean total cover values greater than 100% and dense, low growing thornscrub brush, which includes snake-eyes, granjeno, honey mesquite, Texas ebony, and colima. Snake-eyes and colima are significantly linked to the presence of ocelot. Similar in growth habits, both snake-eyes and colima are low growing, densely branched, shrubs with small, tightly packed leaves. Both provide great horizontal and verticle cover. These areas all have microhabitat characteristics similar to those reported by Shindle (1995). He examined microhabitat features of three different locations where ocelots resided and found that vertical cover greater than 85%, a canopy height greater than 2 meters, and horizontal coverage greater than 97% were necessary for ocelot use. He also indicated that the predominant shrub species were granjeno, snake-eyes, colima, crucita, elbow bush, whitebrush, brasil, and lotebush, but he did not quantify their abundance. He suggested that these micro-habitat features should not be used as a sole criteria by which potential ocelot distribution and abundance is predicted, but that these features should increase the likelihood that an ocelot would use that area if it was available. Findings from this survey suggest the same structural and vegetative components are important and clearly show that snake-eyes and colima are good indicators of appropriate habitat for ocelots in southern Texas.

Comparison of ocelot sites with other Tamaulipan Biotic Province community sites, suggest that there are additional locations on the Refuge with suitable habitat for ocelots. The average community coefficient among ocelot sites was 58.7% and at least six additional communities contain tracts with similar habitat to those where ocelot were located, as well as several other tracts within the occupied communities. These tracts include Payne (77.2%), Boca Chica (71.4%), Santa Ana NWR (70.8%), Teniente (68.2%), Schalaben (65.3%), La Puerta (57.1%), Los Olmos (56.5%), Yturria Brush (53.8%), and Ranchito (52.6%). Five of these sites in fact had higher similarity with the ocelot sites than the ocelot site average. All of these sites possess dense, low growing thornscrub brush, high total cover values, most of the woody species present at ocelot sites, and a geographic area large enough to contain a pair of ocelot. Several smaller Refuge tracts also contain suitable habitat (Arroyo Ramirez and Arroyo Morteros), but they are not large enough to support ocelot. They might serve as travel corridors to connect larger tracts, however.

The Weaver hair-snaring survey technique appears to be a useful tool for surveying large areas at a reasonable cost. The use of remote cameras at each site is highly recommended to obtain additional cats that inspect the pads out of curiosity, but do not leave hairs on the pad. There were three ocelot sites where this occurred. The hair-snaring data may be especially useful for the identification of individuals. Photographs assist in immediate identification of the species of cat, but unless at just the right view, will not provide information on the sex or individual identity. Genetic analysis is much more reliable for this information. When reliable markers have been found to identify individual ocelot, this method will be extremely useful in collecting population information about ocelot on the Refuge. However, I think the key to the success of this survey is the Weaver scent. Regardless of the presence of a camera, it is the scent that draws the attention of the cat.

The Weaver hair-snaring technique appears to be useful in surveying for bobcat as well as ocelot. Although the scent was designed to attract ocelots, it worked well in attracting bobcats. A total of 44 visits by bobcat were detected, either through genetic analysis of hair samples or identification by photograph. Bobcats were found in all of the 11 Tamaulipan Biotic Province Communities. This is in keeping with their generalist tendencies, ability to adapt to a wide variety of habitat types, and large population (Fischer 1998).

The primary ocelot population in Texas occurs in the two eastern counties of the LRGV, Cameron and Willacy. The ocelots found in this study were only in areas on the periphery of this eastern coastal region where travel corridors and pockets of natural vegetation still exist. Because habitat loss is the primary threat to ocelot persistence in Texas, the continued progression of vegetation removal and infrastructure development, makes it ever more difficult for ocelot to find suitable habitat. Formidable obstacles exist such as large urban areas, numerous highways, and large expanses of open agricultural lands. I think this is the reason that few cats were found in the surveys. Through restoration efforts by the Refuge and mere fortune that some lands were not cleared, there are areas in the LRGV suitable for ocelots. For an increase in ocelot to occur, it will take man's efforts to overcome the obstacles he has made for the ocelot. It is clear that ocelot are attempting to reach some of these suitable LRGV areas by evidence of transient males reaching distant tracts, only to return without finding a mate or being killed along one of the State's highways. Currently, highway mortality is one of the leading causes of death for ocelots in southern Texas. Active translocations of both male and female cats to these distant locations will help to insure that populations become established. And, hopefully, after translocation, transients that do make it on their own will find cohorts to join. From this point, it might then be possible for the cats to migrate even farther to other locations in the vicinity.

Further study needs to be done to monitor for ocelot population expansion on Refuge lands and to acquire specific data needed for recovery efforts. This study provides valuable information on Refuge sites that may be suitable for ocelots. Specifics as to how much land must be available, prey abundance, and possible hazards to avoid or correct also are needed. Additional surveying in likely sites should be done to detect incoming cats or cats missed in this survey. Individual ocelot identified in this study may be followed in subsequent population studies.

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VITA

Kevin James Shinn was born on August 10, 1970 in Fenton, Michigan. His parents are Kevin E. Shinn, Jeanette M. Butts and Ronald C. Butts. His current mailing address is Rt. 2, Box 202-A, Alamo, Texas 78516.

He attended Michigan State University, East Lansing, Michigan, from September 1988 until December 1992, when he received his Bachelor of Science degree in Fisheries & Wildlife. He later attended University of Texas-Pan American, Edinburg, Texas, from January 2000 until May 2002, when he received his Master of Science degree in Biology.

He is currently working as an Assistant Manager and a Refuge Officer at the Lower Rio Grande Valley National Wildlife Refuge, Alamo, Texas, since April of 1998. From July 1997 until December of 1997 he worked as a Black-footed Ferret/Black-tailed Prairie Dog Technician at Badlands National Park, Interior, South Dakota. From April 1996 until June 1997 he worked as a Red-cockaded Woodpecker Technician at the Savannah River National Forest, New Ellenton, South Carolina. From May 1995 until October 1995 he worked as a Biological Science Technician at the Bitterroot National Forest, Stevensville, Montana. From May 1994 until September 1994 he studied black bears as a Graduate Student at the University of Tennessee, Knoxville, Tennessee. From December 1993 until April 1994 he worked as a Florida Panther Research Assistant for the Florida Game & Freshwater Fish Commission, Naples, Florida. He also worked other seasonal research positions while attending Michigan State University.

Mr. Shinn is certified as an Associate Wildlife Biologist with the Wildlife Society and has been a member since 1989.