Final Report

THE RANGE AND DISTRIBUTION OF *SCELOPORUS ARENICOLUS* IN TEXAS: RESULTS OF SURVEYS CONDUCTED 8-15 JUNE 2011

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1 July 2011

INTRODUCTION

The Dunes Sagebrush Lizard (DSL), *Sceloporus arenicolus*, has a very limited range in the American Southwest, among the smallest of any North American lizard (Conant and Collins 1991). It is endemic to Mescalero-Monahans shinnery dune ecosystem found only in southeastern New Mexico and adjacent Texas (Fitzgerald and Painter 2009). It is an extreme habitat specialist, using only shinnery dune blowouts within shinnery oak (*Quercus havardi*) vegetation in southeast New Mexico and west Texas (Stebbins 1985, Degenhardt et al. 1996; Fitzgerald et al. 1997; Laurencio et al. 2009; Smolensky and Fitzgerald 2010, 2011). This species is an ambush forager and consumes a variety of insects and other arthropod prey such as grasshoppers, crickets, beetles, ants, spiders and termites (Fitzgerald and Painter 2009). Not much is known about predation, but a variety of snake species, raptorial birds, and some mammals are potential or known predators of *S. arenicolus*. In a radio-tracking study, five out of twenty (20%) female *S. arenicolus* were preyed upon by snakes, four by Coachwhips (*Masticophus flagellum*) and the other by an unidentified snake (Hill and Fitzgerald 2007).

Loggerhead shrikes are known to prey on *S. arenicolus* (Toby Hibbitts, pers. comm. with specimen at Museum of Southwestern Biology, University of New Mexico and photograph).

Sceloporus arenicolus is of special interest to wildlife agencies in Texas and New Mexico because in addition to having a very restricted and naturally disjunct distribution, land use practices have contributed to fragmentation and loss of habitat (Smolensky and Fitzgerald 2011).

Efforts to document the geographic range of *S. arenicolus* in New Mexico provided a well-defined range in that state (Fitzgerald 1997; Laurencio and Fitzgerald 2010), where the species is classified as endangered by the New Mexico State Game Commission. Until recently, survey efforts in Texas have not been as extensive as in New Mexico where the bulk of the range exists. During 2006 and 2007, Laurencio et al. 2007 conducted 32 surveys at 27 sites in Andrews, Crane, Cochran, Edwards, Ward, and Winkler counties. All of these sites included historical localities as well as areas between historical localities within appropriate shinnery dune habitat. The distribution and habitat data provided in this report better defines the extent of the species' range in Texas, and adds to our current knowledge of its habitat characteristics in Texas.

The goal of this study was to better define the distribution and habitat of the Dunes sagebrush lizard in Texas in order to establish a baseline of the species' occurrence. This information is needed to inform the public, private interests, and state and federal resource agencies interested in formulating conservation plans for *S. arenicolus*.

TERMINOLOGY

Terms referring to the habitat, distribution, and occurrence of *S. arenicolus* should be clarified. To help standardize the terminology used during surveys for *S. arenicolus*, the terms presented below are modified only slightly from Fitzgerald et al. (1997) and Laurencio et al. (2007). The modifications to terms relate to the need to respect landowner confidentiality, and deletion of the ambiguous term, potential habitat. We suggest the terms below be understood and used by all individuals that conduct *S. arenicolus* surveys, conduct research on the species and discuss habitat conservation.

A **point** is the exact spot where an individual *S. arenicolus* was observed.

A **site** is a place where surveys were conducted to determine the presence or absence of *S. arenicolus*. Our surveys generally covered one-sixteenth of a section (400 x 400 m) or greater. Geographical coordinates taken at sites serve for the practical purposes of mapping, while it is acknowledged that sites are the area surrounding the coordinates. It is important to note that

geographic coordinates of sites are not shown because the surveys were largely conducted on private land with landowner permission. To comply with landowner confidentiality agreements, we report results by site and survey number in each county in Texas.

A **locality** is a place where *S. arenicolus* was verified to occur, as documented by museum voucher specimens. Historical localities are places where *S. arenicolus* were known to occur, as documented by voucher specimens not produced as part of this study. Individual *S. arenicolus* move around in their environment and belong to populations of the species spread throughout their habitat. Thus, a survey site or locality refers to an area much larger than a single point where an individual lizard was found.

Surveys, such as those conducted in this study, are systematic searches for the target species, in this case *S. arenicolus*, using an established protocol. When surveys determine the species is present at a site, common sense allows inference about the occurrence of *S. arenicolus* beyond the scale of a survey site. Areas of shinnery dunes where *S. arenicolus* occurs are usually larger than a site. It is reasonable to assume that *S. arenicolus* occurs throughout an area of connected habitat that contains a locality. Conversely, it is unreasonable to assume occurrence or absence of *S. arenicolus* in shinnery dunes that have not been surveyed, or that are several kilometers from localities.

The **geographical range** of *S. arenicolus* is the entire area encompassed by localities. **Distribution** refers to the spatial arrangement of localities within the range of *S. arenicolus*.

Suitable habitat refers to habitat of sufficient similarity to habitat at known localities that biologists consider it plausible that *S. arenicolus* could occur there. *Sceloporus arenicolus* may not occur in all areas of suitable habitat due to chance and the dynamic nature of extinction and colonization of suitable habitat through time.

Vegetation associations and landforms surveyed as plausible habitat for *S. arenicolus* include the following. **Shinnery dunes** are active sand dune complexes dominated by shinnery oak (*Quercus havardi*) and characterized by the presence of open sand blowouts. (Blowouts are more or less bowl-shaped depressions among sand dunes). **Shinnery oak flats** are sandy soils dominated by shinnery oak with relatively little topographic relief. **Open sand dunes** are large active dunes with steep slopes and open expanses of bare sand and sparse vegetation. **Dune grasslands** are sand dune formations with grasses predominating more than shinnery oak, including areas treated for shinnery oak removal. **Mesquite grasslands and mesquite scrub** are areas with varied topographic relief characterized by mesquite (*Prosopis* sp.), shinnery oak, and

grasses. Landforms at these sites may include mesquite hummocks separated by open sandy areas with sparse vegetation including shinnery oak, as well as short grasslands and Tabosa flats, lacking shinnery oak and dominated by grasses and scattered mesquite. **Anthropogenic shinnery dunes** are wind-eroded sands colonized by shinnery oak, often surrounding plowed fields or abandoned agricultural areas.

In discussions of range and distribution, and potential and suitable habitat for *S. arenicolus*, it is important to acknowledge that our perceptions reflect current and historical knowledge. It is unavoidable that as more data and different types of data become available, our perceptions of suitable habitat may change.

METHODS

Distribution surveys conducted during this study followed the methodology described in Fitzgerald et al. (1997) , designed to increase the probability of detecting *S. arenicolus* if they are present. This survey methodology has been used in most surveys of S. arenicolus, specifically by Laurencio et al. (2007), and surveys in New Mexico in 2008, 2010, 2011 (C. W. Painter personal communication). May and June are the months of peak lizard activity in the Mescalero-Monahans shinnery dune ecosystem when the lizards are establishing and defending territories, and engaged in mate-seeking and nesting (Fitzgerald and Painter 2009). The weather is also more favorable for activity of these small cold-blooded lizards. Daily activity declines as summer temperatures increase because during long periods of the day *S. arenicolus* and other lizards are incapable of thermoregulating when air and ground temperatures are too hot.

We conducted surveys during 8-15 June 2011 with 4 crews made up of experienced observers. The survey period was chosen when the 10-day weather forecast did not predict rain (which would have caused cancellation of surveys), was during the month of June (coinciding with the general season of high lizard activity), and allowed the crews sufficient time to carry out surveys at 50 sites. Each crew leader had extensive experience studying *S. arenicolus*. All surveys were carried out between 0800 and 1238 h during the morning activity period of the lizards. Two surveys were conducted with 2 observers, 33 with 3 observers, and 16 with 4 observers (Table 1). Lizard activity is dependent on temperature, and declines by mid-day and during peak summer activity. Lizards do exhibit late-afternoon activity as daily temperatures decrease, but afternoon activity is typically much less than morning activity in desert-dwelling lizards (Grant 1990). Thus, afternoon surveys are less effective than morning surveys and results from afternoon surveys are not directly comparable to morning surveys. Surveys are ineffective

during very hot weather because lizards that are present in the habitat can be easily missed. The crews all reported a significant drop in lizard activity by late morning and it was determined that surveys attempted in the afternoon during this survey period would not provide meaningful data on lizard presence.

Observers walked slowly through habitat searching for lizards. Observers did not walk a predetermined course, rather each observer carefully searched the area inspecting the habitat for all active lizards. At each site, the habitat was briefly described (Table 2) and observers searched for and tabulated all lizards seen. The time and duration of surveys were noted, and the number of person-minutes elapsed before finding the first *S. arenicolus* were tabulated. Surveys were designed to last up to 4.5 person hours (i.e., the total time spent by all observers combined; 270 total minutes), if no *S. arenicolus* were observed and up to 3 person-hours (180 total minutes) if *S. arenicolus* were found. In a few instances surveys lasted more than 270 person-minutes if the crew was searching a relatively large area or if that was the only site to be surveyed that day.

Individual species were identified in the field, and when *S. arenicolus* was documented at a site, the crew was free to move to a new site after the 3 person-hour minimum. However, there were surveys that were shorter or continued longer than the discovery of the first *S. arenicolus* as all team members were not in close proximity and could not be immediately alerted that the species had been documented on site. Furthermore, by the time a crew moved to a new survey site, temperatures would be too hot for additional surveys at new sites. Therefore on several occasions crews remained at a survey site and continued to tabulate lizard presences and evaluate habitat condition. Shorter surveys were due to either decreased lizard activity because of high temperatures or to the survey area being adequately searched. Generally the surveys were discontinued if no *S. arenicolus* were found after a maximum of 6 person-hours of searching, or if it became evident further searching was not productive because an entire area had been searched, or due to unfavorable conditions for lizard activity (i.e. extreme temperatures, inappropriate time of day, rain, overcast conditions). No surveys were discontinued due to weather. Variability in search effort (Table 1) was due to the size of the habitat patches being surveyed. In a few instances surveys were concluded in less than 180 minutes when the survey crew completely searched an entire small area. In several other instances, to increase our understanding of the density and relative abundance of *S. arenicolus*, some surveys exceeded 6 person-hours, especially if the habitat was judged to be suitable for *S. arenicolus*. Individuals of

other lizard species were collected or tabulated to document the assemblages of lizards present at each site.

When seen, lizards were tabulated and one or two *S. arenicolus* were collected by hand. One to several specimens of other species were also collected. Collecting was necessary to document the presence of the species at all sites with properly documented voucher specimens. Voucher specimens, with associated locality and ecological data, are the only permanent and verifiable data base of the presence of *S. arenicolus* at a specific place and time. The specimens were prepared with standard procedures for making herpetological specimens. The whole animal, including gut contents and reproductive tracts and all organs were preserved. Additionally, *S. arenicolus* can be difficult to identify from afar even for skilled herpetologists not working regularly with *S. arenicolus* in the field. All individuals collected were prepared as scientific specimens following standard herpetological techniques and all were deposited in the Texas Cooperative Wildlife Collection at Texas A&M University. Survey site locations and points where lizards were captured were determined in the field with a hand-held GPS unit (standard user precision only). Site locality data were recorded as decimal degrees using WGS84 as the GPS datum, but herein we report only site numbers to maintain compliance with landowner confidentiality agreements.

To visualize survey results in a meaningful manner, we classified areas of shinnery dunes that are potential habitat for *S. arenicolus* according to 4 categories of likelihood of occurrence: Very High; High, Low, and Very Low. These categories were created based on known presence in an area, its connectivity to other areas, and on-the-ground assessment of habitat condition. The categories are not classifications of habitat quality. Nor does low likelihood of occurrence mean that an area cannot support populations of *S. arenicolus*. The classifications do indicate according to these 4 broad categories, the likelihood that *S. arenicolus* will be detected using our survey protocol.

RESULTS

EFFECTIVENESS OF SURVEYS

The survey crews carried out 51 standardized surveys at 50 sites during 8-15 June 2011 to determine the presence of *S. arenicolus* (Table 1). Two surveys were conducted on subsequent days at a location in Winkler County to bolster search effort at that particular site. *Sceloporus arenicolus* were found at 28 (56%) of the 50 sites surveyed. Most of these sites were new localities for the species in Texas, though some were very close to historical localities (Laurencio

and Fitzgerald 2007). *Sceloporus arenicolus* was seen and confirmed to be *S. arenicolus*, but not collected at 3 sites, two in Andrews County and one in Winkler County. We have sufficient confidence in these sightings to include these localities in subsequent analyses.

We tabulated 1,643 lizards, 105 of which were *S. arenicolus*. We documented presence of seven other species of lizards during the surveys (Table 1). The observations of other lizard species is given to provide additional information that serves as a baseline for all the species encountered. This is useful for each of these species individually and to serve as a baseline for understanding the makeup of the lizard fauna at these sites. Accounts of all the lizard species' natural history are provided in Appendix 1.

Table 1. Summary of 51 lizard surveys sorted by county in Texas and presence of *Sceloporus arenicolus*. Survey number is chronological. Site 23 was surveyed twice on subsequent days. Lizard species codes: SCAR = *Sceloporus arenicolus* (dunes sagebrush lizard); ASGU= *Aspidoscelis gularis* (Texas spotted whiptail); ASMA = *Aspidoscelis marmoratus* (marbled whiptail); ASSE = *Aspidoscelis sexlineatus* (six-lined racerunner); GAWI = *Gambelia wislizenii* (leopard lizard); HOMA = Holbrookia maculata (lesser earless lizard); SCCO = *Sceloporus consobrinus* (prairie lizard); UTST = Uta stansburiana (side-blotched lizard); UNK = "unknown" (sightings of lizards that could not be identified during the survey).

				Time of day					Counts of each lizard species seen on survey								
Survey number	Site number	county	Date	crew start	crew stop	Observers	Person-minutes*	SCAR Presence	SCAR	ASGU	ASMA	ASSE	GAWI	HOMA	SCCO	UTST	UNK
31	31	Andrews	13-Jun-11	825	1045	4	545	yes	2	0	2	1	0	0	0	5	1
32	32	Andrews	13-Jun-11	1110	1210	4	240	yes	3	0	9	0	0	0	0	20	4
33	33	Andrews	13-Jun-11	826	1155	3	532	yes	5	0	4	1	0	0	0	25	2
34	34	Andrews	13-Jun-11	845	945	4	240	yes	4	0	3	0	0	0	0	17	2
35	35	Andrews	13-Jun-11	1010	1110	4	240	yes	3	0	1	1	0	0	0	10	3
36	36	Andrews	13-Jun-11	859	1022	4	290	yes	4	0	7	0	0	0	0	20	3
37	37	Andrews	13-Jun-11	1109	1124	4	52	yes	2	0	0	0	0	0	0	4	0
38	38	Andrews	14-Jun-11	851	1101	3	390	yes	4	0	2	0	0	0	0	4	3
39	39	Andrews	14-Jun-11	1132	1238	3	198	yes	2	0	2	2	0	0	0	1	1
41	41	Andrews	14-Jun-11	850	1034	3	312	yes	4	0	5	0	0	0	0	15	2
43	43	Andrews	14-Jun-11	842	1004	3	246	yes	2	0	1	0	0	0	0	9	3
44	44	Andrews	14-Jun-11	1018	1130	3	216	yes	1	0	3	1	0	1	1	9	2
45	45	Andrews	14-Jun-11	1150	1238	3	144	yes	3	0	3	0	0	0	0	1	2
47	47	Andrews	15-Jun-11	925	1205	3	480	yes	6	0	4	4	0	0	0	12	0
48	48	Andrews	15-Jun-11	900	1035	4	380	yes	13	1	3	0	0	0	0	17	1
49	49	Andrews	15-Jun-11	1105	1130	4	100	yes	4	2	9	0	0	0	0	0	0
50	50	Andrews	15-Jun-11	1145	1215	4	120	yes	1	0	0	2	0	1	1	2	1
40	40	Andrews	14-Jun-11	840	1142	3	514	visual	9	0	10	4	0	0	2	23	4
42	42	Andrews	14-Jun-11	1041	1130	2	110	visual	1	0	2	0	0	0	0	1	0
14	14	Crane	10-Jun-11	812	925	3	203	not detected	0	0	6	0	0	0	0	4	1
15	15	Crane	10-Jun-11	953	1008	3	45	not detected	0	0	4	0	0	0	0	1	0
16	16	Crane	10-Jun-11	1051	1135	3	132	not detected	0	0	4	0	0	0	0	0	0
19	19	Crane	10-Jun-11	830	1030	3	360	not detected	0	0	16	0	0	0	0	24	3
20	20	Crane	10-Jun-11	815	1103	3	486	not detected	0	0	27	0	0	0	0	68	10
10	10	Ector	9-Jun-11	1058	1214	4	304	not detected	0	0	32	2	0	0	0	32	1
17	17	Ector	10-Jun-11	810	1150	3	567	not detected	0	0	2	0	0	0	0	17	5
4	4	Ward	8-Jun-11	726	1103	3	548	yes	4	0	10	0	0	0	0	37	4
1	1	Ward	8-Jun-11	740	848	4	251	not detected	0	0	0	0	0	0	0	4	0
2	2	Ward	8-Jun-11	858	1020	4	315	not detected	0	0	10	0	0	0	0	14	5
3	3	Ward	8-Jun-11	1040	1155	4	287	not detected	0	0	44	0	0	0	0	19	0
18	18	Ward	10-Jun-11	830	1035	2	207	not detected	0	0	15	0	0	0	0	13	1
5	5	Winkler	8-Jun-11	828	954	4	333	yes	2	0	4	3	0	0	0	17	5
6	6	Winkler	8-Jun-11	802	1114	3	595	yes	5	0	7	0	0	0	0	73	3
7	7	Winkler	9-Jun-11	800	1010	3	390	yes	8	0	17	0	0	0	0	29	6
21	21	Winkler	11-Jun-11	855	1110	3	359	yes	1	0	19	0	0	0	0	16	0
22	22	Winkler	11-Jun-11	900	1136	3	418	yes	3	0	23	0	1	0	0	7	1
24	24	Winkler	11-Jun-11	850	1050	3	360	yes	7	0	6	0	0	0	0	21	2
25	25	Winkler	11-Jun-11	848	950	3	180	yes	1	0	5	0	0	0	0	12	1
23	23	Winkler	11-Jun-11	820	1112	3	434	visual	1	0	3	0	0	0	0	13	0
8	8	Winkler	9-Jun-11	800	1036	3	319	not detected	0	0	13	0	0	0	0	21	2
9	9	Winkler	9-Jun-11	820	950	4	324	not detected	0	0	5	1	0	0	0	22	0
11	11	Winkler	9-Jun-11	805	945	3	262	not detected	0	0	5	0	0	0	0	35	1
12	12	Winkler	9-Jun-11	1040	1119	3	99	not detected	0	0	13	0	0	0	0	19	0
13	13	Winkler	9-Jun-11	1127	1203	3	90	not detected	0	0	15	0	0	0	0	11	1
26	26	Winkler	11-Jun-11	1026	1129	3	137	not detected	0	0	13	0	0	0	0	3	0
27	23	Winkler	12-Jun-11	932	1113	3	303	not detected	0	0	1	0	0	0	0	17	1
28	28	Winkler	12-Jun-11	904	1140	3	375	not detected	0	0	5	2	0	0	0	37	0
29	29	Winkler	12-Jun-11	910	1042	4	312	not detected	0	0	10	0	0	0	0	30	4
30	30	Winkler	12-Jun-11	850	1042	3	291	not detected	0	0	7	0	0	0	0	14	0
46	46	Winkler	15-Jun-11	855	1040	3	305	not detected	0	0	58	0	1	0	0	49	4
51	51	Winkler	15-Jun-11	930	1101	3	273	not detected	0	0	37	0	0	0	0	28	0
								TOTALS	105	3	506	24	2	2	4	902	95

Our survey methodology was effective at finding *S. arenicolus*. *Sceloporus arenicolus* was detected within 60 minutes of searching during 26 of 27 surveys (Figure 1). The time to first observation was not noted on one survey, but in 26 of 27 surveys, *S. arenicolus* was detected within 60 minutes of searching. Site 23 was searched for 135 minutes on 11 June 2011 before an *S. arenicolus* was observed. The individual was not caught, thus this site was surveyed again the next day but no *S. arenicolus* were detected.

The average duration of surveys where *S. arenicolus* was found was 320.2 person-minutes (N = 28; sd = 153.0; range = 52 - 595 person-minutes). The average survey where *S. arenicolus* was not detected lasted 271.6 person-minutes (N = 23; sd = 121.6; range = 45 – 567 person-minutes).

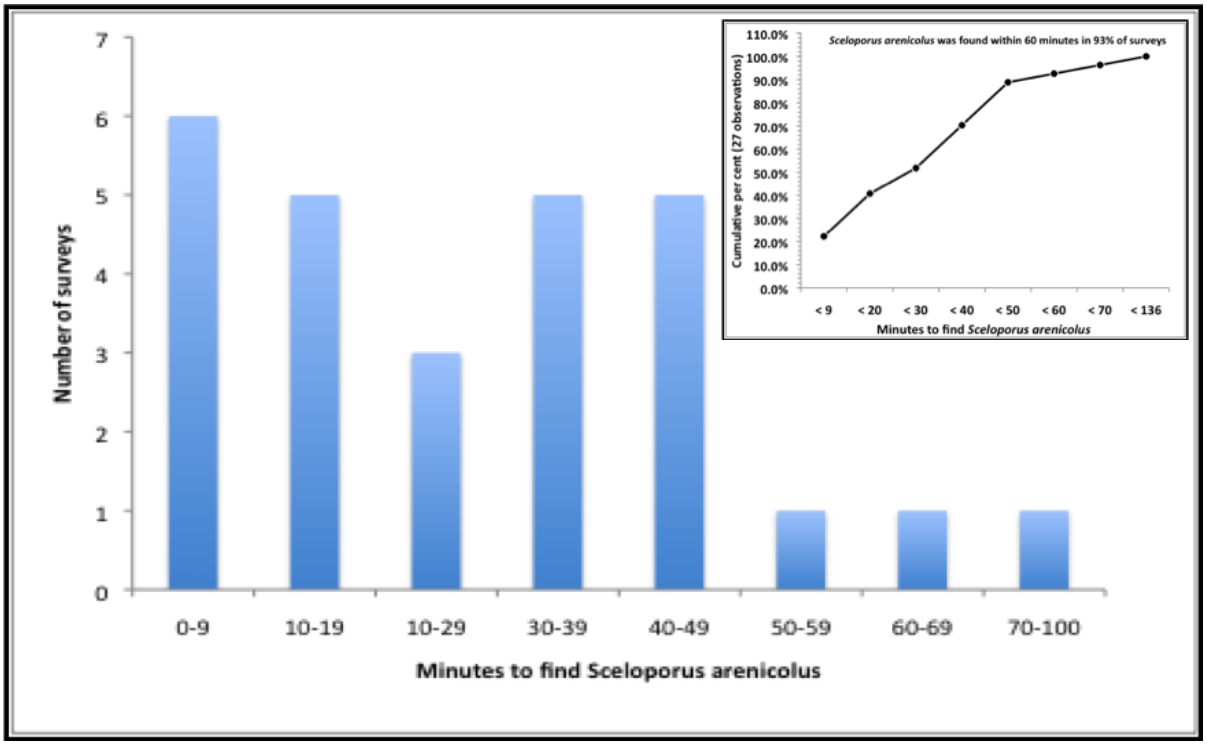


Figure 1. The number of minutes to find *Sceloporus arenicolus* during 27 surveys where the species was found in Texas during 8-15 June 2011. The upper right panel shows the cumulative percentage of surveys where *S. arenicolus* was found by minutes of searching. *Sceloporus arenicolus* was found within 60 person-minutes in 93% of the surveys where it was detected, and the longest time to find it was 135 minutes.

GEOGRAPHIC COVERAGE OF SURVEYS

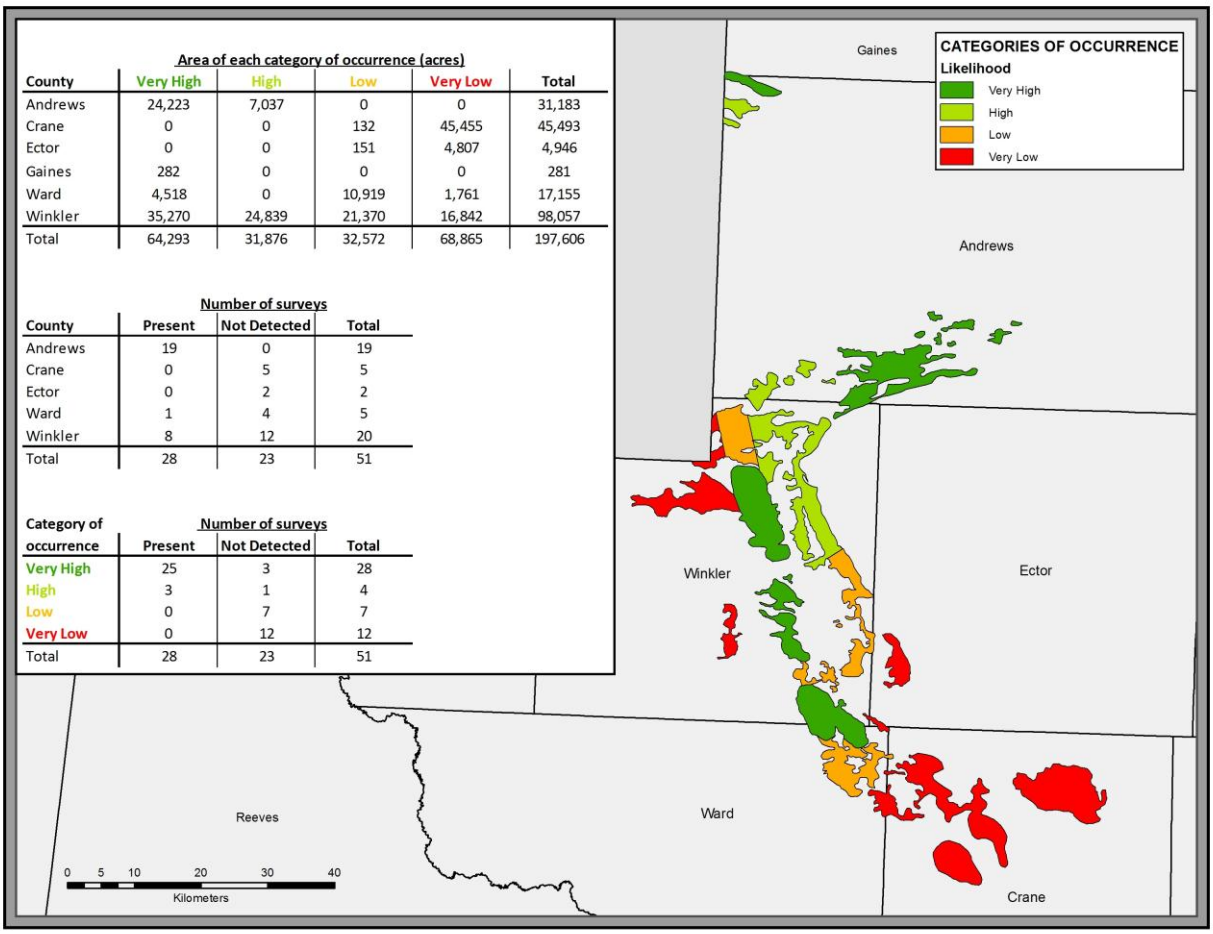
To conform to the objective of documenting the geographical range of *S. arenicolus*, survey sites covered the entire geographical limits of the species' distribution in Texas. Areas of suitable habitat were delineated prior to this study (Hibbitts in litt. 2011, Available from: http://www.texasahead.org/economic_developer/endangered_species/priority/dsl.html). Sites with potential habitat were surveyed beyond the limits of the species' known distribution without finding *S. arenicolus*. For example, we carried out the first surveys in Ector County and other areas where *S. arenicolus* has never been known to exist. We elected not to visit historical localities where the species has been recently documented because our focus was adding to the baseline of known distribution. However, we did use historical localities from museum specimens and published information (Laurencio and Fitzgerald 2007, Fitzgerald in litt to TPWD 2010, Painter and Sias 1998) to develop our current understanding of the species' distribution.

THE RANGE OF *SCELOPORUS ARENICOLUS* IN TEXAS

To facilitate discussion of the species' distribution in Texas, we report results by county and then discuss the areas of habitat shown in Map 1.

DISTRIBUTION AND HABITAT IN GAINES COUNTY

Sceloporus arenicolus is known only from an area of 281 acres in the southwestern corner of Gaines County (Figure 1). We did not survey this area because the species was documented there in 1998 (Painter and Sias 1998) and again in 2006 (Laurencio et al. 2007). In Gaines County *S. arenicolus* occurs in shinnery dunes habitat that is contiguous with known occupied habitat, southeast of Hobbs, New Mexico (Fitzgerald et al. 1997) that also extends into northwestern Andrews County. The shinnery dunes in Gaines County were classified as the highest category for probability of occurrence. The occupied shinnery dunes in Gaines County are the northern limit of the range of *S. arenicolus* in Texas.



Map 1. Areas of shinnery dunes in Texas where *Sceloporus arenicolus* is known to occur or is likely to occur. The map depicts 4 categories of occurrence, ranging from very high likelihood to occur to very low likelihood to occur. These categories were created based on known presence in an area, its connectivity to other areas, and on-the-ground assessment of habitat condition. The inset tables show the acreage of each category by county, and summarizes survey results by county and by category of occurrence.

DISTRIBUTION AND HABITAT IN ANDREWS COUNTY

We found *S. arenicolus* at all 19 sites surveyed in Andrews County (Map 1). Based on the extent of shinnery dunes we now know are occupied by *S. arenicolus* in Andrews County, as well as the condition and connectivity of the habitat, we expect the species occurs throughout the 31,260 acres of shinnery dunes habitat extending from south-central Andrews County to the southwestern corner of the county near the New Mexico border, although the habitat becomes more patchy closer to New Mexico. Small areas of habitat occur in the northwestern part of the county that extend from occupied sites in New Mexico and Gaines County.

DISTRIBUTION AND HABITAT IN WINKLER COUNTY

We found *S. arenicolus* at 8 of 12 sites searched in Winkler County. Winkler County contains a total of 98,320 acres of potential habitat. The westernmost areas of potential habitat for *S. arenicolus* occur in Winkler County, in the vicinity of the southeastern corner of the New Mexico border. These areas were generally characterized as shinnery hummocks and blowouts interspersed with mesquite grasslands. We did not find *S. arenicolus* at any of our survey sites in this region of Winkler County (Table 2). Nor have *S. arenicolus* been reported from adjacent areas near Jal, New Mexico. Thus, because of zero documented occurrences of the species, our assessment of relatively low quality and patchy habitat and the lack of nearby known localities for *S. arenicolus*, these habitat areas comprising 16,842 acres were assigned the lowest likelihood of occurrence (Map 1). However, we note that much of this acreage has not been thoroughly surveyed and though the habitat for *S. arenicolus* does not appear as good as elsewhere we cannot conclude the species does not occur in this area.

Areas in central-northern Winkler County, extending southeasterly across the county into Ward County were classified as having a Very High and High likelihood of *S. arenicolus* occurrence and we did document presence of *S. arenicolus* in several localities in these areas (Map 1). These areas in Winkler County comprise 60,109 acres. Areas classified as low likelihood of occurrence in Winkler County comprise 21,370 acres. These areas are near, sometimes surrounded by, areas where *S. arenicolus* is known to occur. As such, if access is granted to some of these areas where Very High and High likelihood of occurrence are adjacent, we would not be surprised to find *S. arenicolus* in the areas of shinnery dunes in north-central Winkler County.

DISTRIBUTION AND HABITAT IN ECTOR COUNTY

Sceloporus arenicolus is not known from Ector County and we did not find it there during two surveys. Our crews characterized the habitat at these two sites as patchy shinnery dunes with mixed grasses and presence of mesquite. There is a total of 4957 acres of shinnery dunes in Ector County that we classified as low (151 acres) and Very Low (4806 acres) likelihood of occurrence (Map 1).

DISTRIBUTION AND HABITAT IN WARD COUNTY

Sceloporus arenicolus is known only from the northeastern corner of Ward County from in and near Monahans Sandhills State Park. We completed 5 surveys in Ward County and only found *S. arenicolus* at one site. Ward County contains 17,198 acres of potential *S. arenicolus* habitat (Map 1). The Monahans Sandhills area was classified as Very High likelihood of occurrence (4518 acres). To the south of the Monahans Sandhills are patches of shinnery dunes that were classified as Low likelihood (10,919 acres). In northeastern Ward County near the Crane County border, patches of shinnery dunes were not contiguous with the dunes to the north and were classified as Very Low likelihood of Occurrence (1,761 acres). Sites surveyed in the areas classified as Low likelihood were characterized by sparse shinnery oak, small blowouts, presence of mesquite and dense grasses, and no known localities for *S. arenicolus*.

Table 2. Abbreviated habitat descriptions for each survey site. Site 23 was surveyed twice on subsequent days.

Survey number	Site number	county	Date	*Sceloporus arenicolus* found?	Brief description of surveyed area
1	1	Ward	8-Jun-11	not detected	shinnery oak sparse; mesquite among dunes; few blowouts
2	2	Ward	8-Jun-11	not detected	large dunes with big blowouts; mesquite on flats; grass in blowouts
3	3	Ward	8-Jun-11	not detected	shinnery oak sparse; mesquite present; shinnery oak hummocks abundant; blowouts large, w/ steep sand slopes; apprears to be good SCAR habitat
4	4	Ward	8-Jun-11	yes	shinnery oak; mixed grasses; mesquite
5	5	Winkler	8-Jun-11	yes	Shinnery dunes with large blowouts, some open sand areas.
6	6	Winkler	8-Jun-11	yes	shinnery oak; blowouts lacking; open sand between dunes flat and w/ mesquite, grasses, and tamarisk
7	7	Winkler	9-Jun-11	yes	shinnery oak hummocks extensive, large, and mature; large blowouts w/ little vegetation
8	8	Winkler	9-Jun-11	not detected	shinnery oak; occasional dunes w/ mixed grasses
9	9	Winkler	9-Jun-11	not detected	Shinnery dunes and shinnery flats some decent blowouts, some mesquite in flats on edges of dunes, some areas of open sands. Sands here were much redder than other areas
10	10	Ector	9-Jun-11	not detected	Shinnery dunes with a lot of mesquite associated with the flats around the dunes.
11	11	Winkler	9-Jun-11	not detected	shinnery oak dunes and blowouts w/ abundant grasses and mesquite; widely seperated dunes and blowouts
12	12	Winkler	9-Jun-11	not detected	shinnery oak dunes isolated; habitat between dunes of thick mesquite, grasses, and shrubs; heavy livestock use
13	13	Winkler	9-Jun-11	not detected	shinnery oak dunes isolated; habitat between dunes of thick mesquite, grasses, and shrubs; heavy livestock use
14	14	Crane	10-Jun-11	not detected	shinnery oak sparse; mesquite hummocks numerous w/ mixed shinnery oak; windblown sand and mesquite grassland; not good SCAR habitat
15	15	Crane	10-Jun-11	not detected	shinnery oak sparse; area small and surrounded by mesquite grassland; grass abundant; not good SCAR habitat
16	16	Crane	10-Jun-11	not detected	shinnery oak hummocks throughout but mixed with large amount of mesquite; grass abundant in flat areas; not good SCAR habitat
17	17	Ector	10-Jun-11	not detected	shinnery oak; mixed grasses and sunflowers; mesquite encroachment
18	18	Ward	10-Jun-11	not detected	shinnery oak in small rolling hills; mesquite and grasses abundant
19	19	Crane	10-Jun-11	not detected	Large shinnery dunes and blowouts.
20	20	Crane	10-Jun-11	not detected	shinnery oak dunes large; good habitat; sand appreas to be very fine
21	21	Winkler	11-Jun-11	yes	shinnery oak habitat near Hwy best habitat but dry and sparse south; open areas dominated by mesquite, grasses, and soapberry
22	22	Winkler	11-Jun-11	yes	shinnery oak extensive; large, open blowouts w/ numerous grasses; mesquite sparse
23	23	Winkler	11-Jun-11	visual	shinnery oak habitat near Hwy best habitat but dry and sparse south; open areas dominated by mesquite, grasses, and soapberry
27	23	Winkler	12-Jun-11	not detected	shinnery oak dunes good habitat, but small area; mesquite and grasses abundant in interdune depressions; same site was surveyed on 11 June
24	24	Winkler	11-Jun-11	yes	Shinnery dunes, lots of large mounds and big blowouts
25	25	Winkler	11-Jun-11	yes	shinnery oak dunes isolated; open sand habitat abundant
26	26	Winkler	11-Jun-11	not detected	shinnery oak dunes isolated; open sand habitat abundant
28	28	Winkler	12-Jun-11	not detected	shinnery oak
29	29	Winkler	12-Jun-11	not detected	Shinnery dunes and flats, shallow blowouts, lots of mesquite.
30	30	Winkler	12-Jun-11	not detected	shinnery oak dunes lacking blowouts; mesquite and grassy flats w/ open sand; mesquite hummocks abundant
31	31	Andrews	13-Jun-11	yes	shinnery oak dense; large dunes w/ sparse grasses in blowouts
32	32	Andrews	13-Jun-11	yes	shinnery oak dense; medium-large dunes; grasses sparse
33	33	Andrews	13-Jun-11	yes	shinnery oak; extensive dunes and blowouts; mostly open but some with extensive grasses and mesquite
34	34	Andrews	13-Jun-11	yes	Large open sandy area with small band of shinnery dunes around the edge.
35	35	Andrews	13-Jun-11	yes	Narrow strip of nice shinnery dunes area with large blowouts
36	36	Andrews	13-Jun-11	yes	shinnery oak dunes w/ blowouts; moderate oil/gas development in area
37	37	Andrews	13-Jun-11	yes	shinnery oak dunes good habitat, but isolated and very small
38	38	Andrews	14-Jun-11	yes	shinnery oak dense; well connected large, extensive blowouts blowouts; very little mesquite present
39	39	Andrews	14-Jun-11	yes	shinnery oak large and mature; medium to large blowouts w/ grasses sparse
40	40	Andrews	14-Jun-11	visual	shinnery oak; large dunes with grasses in bottom of blowouts
41	41	Andrews	14-Jun-11	yes	Shinnery dunes large shinnery bumps surrounded by sand, some mesquite at bottom of largest blowouts.
42	42	Andrews	14-Jun-11	visual	Large open sandy area with small band of shinnery dunes around the edge.
43	43	Andrews	14-Jun-11	yes	shinnery oak dunes good habitat; grasses abundant in blowouts; mesquite hummocks
44	44	Andrews	14-Jun-11	yes	shinnery oak dunes isolated; mixed with shinnery oak flats; oil and gas development dense in area
45	45	Andrews	14-Jun-11	yes	shinnery oak dunes w/ deep blowouts; open sand habitat abundant
46	46	Winkler	15-Jun-11	not detected	shinnery oak scattered and small, shallow blowouts in mesquite grasslands
47	47	Andrews	15-Jun-11	yes	shinnery oak extensive; large, open dunes with large blowouts surrounded by numerous grasses
48	48	Andrews	15-Jun-11	yes	Really nice shinnery dunes and big blowouts, extensive area of good habitat
49	49	Andrews	15-Jun-11	yes	Shinnery dunes with big blowouts, some of the largest blowouts with mesquite at bottom
50	50	Andrews	15-Jun-11	yes	Shinnery dunes and shinnery flats, some good blowouts
51	51	Winkler	15-Jun-11	not detected	shinnery oak dunes w/ open sand habitat abundant; mesquite and grasses abundant; isolated habitat

DISTRIBUTION AND HABITAT IN CRANE COUNTY

Sceloporus arenicolus is known from one historical record in Crane County at the intersection of FM 1053 and FM 1233. Five surveys were conducted in Crane County by Laurencio et al. (2007) and they did not detect the presence of *S. arenicolus*. We surveyed 5 sites in Crane County as part of this study, and again did not detect *S. arenicolus* at any of these sites. A large amount of potential habitat exists in the county (45,587 acres; Map 1), but we classified the entire area of potential habitat as Very Low likelihood of Occurrence. Some of the survey sites appear to have very good habitat, but long surveys by the most experienced observers have been carried out there over a number of years without success. Other sites in the county were characterized by low dunes, sparse shinnery oak, and the presence of mesquite.

CONCLUSIONS AND RECOMMENDATIONS

This distribution study of *S. arenicolus* in Texas significantly enhances our knowledge of the species' distribution. We added 28 localities to the known distribution in Texas (albeit several were near known historical records in contiguous habitat (Laurencio and Fitzgerald 2007)). Because habitat was delineated at the landscape-scale by Dr. Hibbitts (http://www.texasahead.org/economic_developer/endangered_species/priority/dsl.html), the delineation in combination with the survey data from this study enhances our ability to predict where *S. arenicolus* may be expected to occur, as well as where it will be less likely to be found.

Based on these surveys we can draw helpful inferences about landscape-level correlates to species' occupancy. An overarching conclusion from the site surveys was that within the range of S. *arenicolus*, the probability was high that *S. arenicolus* would be found in suitable habitat consisting of relatively extensive areas of shinnery dunes with large blowouts containing sparse vegetation. As previously known, the species lives only in shinnery dunes with open sand blowouts or areas that are relatively open with shinnery oak on the slopes and tops of loose sandy hummocks. Although our characterizations of habitat at sites were subjective, *S. arenicolus* was clearly much more likely to occur when the dune blowouts were open and did not contain mixed grasses or sand sage. Conversely, sites where mesquite was relatively common, often occurring between dunes and among blowouts, were consistently associated with lack-of-detection of *S. arenicolus*. These observations are consistent with studies of habitat selection and range occupancy in New Mexico (Fitzgerald et. al. 1997, Laurencio and Fitzgerald 2010, Leavitt and Fitzgerald 2010).

Recommendation: Information on the distribution of *S. arenicolus* in Texas should be integrated with information on the species' distribution in New Mexico. Doing so would provide a better understanding of the extent of occupied habitat, the full range of habitat conditions where the species exists, a larger perspective on habitat condition across the range of the entire species.

Improved knowledge of distribution of *S. arenicolus* in Texas allows for better understanding of connectivity among populations in the southern part of the species' range. The species' range is relatively disjunct in Texas, with areas of shinnery dunes relatively isolated from each other. We could not survey all areas of potential habitat on private lands. If access to private land becomes available in northern Winkler or Western Andrews counties, we would achieve even better understanding of the geographic distribution of *S. arenicolus*.

Recommendation: If and when access becomes available, areas in northern Winkler and Western Andrews counties should be surveyed to determine if *S. arenicolus* is present there.

The surveys in this study provided critical information necessary to develop the categories of likelihood of occurrence and points to areas where habitat conservation should be a priority. Contiguous areas of shinnery dunes in Texas, which occur as long ridge-like formations extending southeasterly across Winkler County into Ward County, and the shinnery dunes in Andrews County almost all have demonstrated occupancy. Conservation of this occupied habitat should be a priority to ensure persistence of large interconnected populations of *S. arenicolus* in Texas.

Recommendation: The map showing 4 categories of likelihood of occurrence was based on coarse criteria of known occupancy, historical occupancy, and obvious connectivity of shinnery dune areas. We recommend refinement of habitat occupancy maps as more information becomes available.

Distribution information helps define future research questions and priorities. For example, with a better understanding of where lizard populations exist, we can identify areas that are the best suited for specific research questions. Depending on the research topic, ranging from lizard behavior to habitat restoration, sites can be selected that vary in amount of habitat, connectedness of habitat, and land-use. For example, we can select sites appropriate for studying the effects of different size caliche roads on movements of lizards, or the effects of proximity of structures on shinnery dune habitat.

Recommendation: Distribution data should be used to select study sites that are appropriate for an array of ecological studies in varying landscape conditions.

An important outcome of the present study is that we documented the presence of *S. arenicolus* at or near many sites where they were not found or were difficult to find in the past (e.g., Laurencio et al. 2007). In the Laurencio et al. (2007) study, for example, *S. arenicolus* was not found in Monahans Sandhills State Park even though the species was known there since the 1960s. *Sceloporus arenicolus* was not detected there again until summer 2010, despite multiple searches over several years (Fitzgerald 2010. Letter and photographs to Texas Parks and Wildlife). Since 2010, *Sceloporus arenicolus* has been found in the park with regularity. We suspect the species was always present in the park in low numbers, making it difficult to find during 2006-2009. However we can not reject the alternative explanation that the species could have been temporarily absent, and individuals had dispersed and recolonized areas of Monahans Sandhills State Park.

Lizard populations, like all wildlife populations, fluctuate over time and space. Classic research on the ecology and population biology of lizards demonstrated that varying environmental conditions, such as periods of drought, reduce the abundance of food resources. This in turn translates into less reproduction in the lizard population and fluctuations in populations over time (Dunham 1980). However, because populations of insects and the quality and quantity of habitat vary across the landscape, lizard populations do not fluctuate in synchrony across broad landscapes; there is variation in population size from one place to another for myriad reasons. Furthermore, the extent to which immigration and emigration are necessary for long-term persistence of populations of *S. arenicolus* is not known.

Recommendation: This distribution study serves as a baseline to document known occupancy of large areas of shinnery dune habitat in the southern portion of the species' range. Periodic surveys at the same areas will provide information on how populations may wax and wane at multiple sites. It is a long-term endeavor, but surveys over many years are needed to understand if populations of *S. arenicolus* undergo temporary, local, extinctions and are rescued by recolonization.

Distribution information such as that gathered in this study represents the first step needed to build models that can test effects of land use on persistence of populations and connectivity among populations.

Recommendation: Research designed to model and map the extent of *S. arenicolus* distribution, the degree of isolation among populations that are not directly connected by shinnery dune habitat, and to evaluate potential habitat corridors should make use of recent and historical information on localities where *S. arenicolus* has been known to occur. These habitat suitability and landscape occupancy models (in the broad sense) will become an important tool for informing conservation strategies for *S. arenicolus* in Texas and throughout its entire range.

ACKNOWLEDGMENTS

This work depended on an experienced team of observers with experience finding and capturing lizards in harsh conditions. We are extremely grateful to the crew members who made this work successful and enjoyable: Brandon Bowers, Lauren Chan, Drew Dittmer, Mary Gorton, Michael Hill, Larry Kamees, Dan Leavitt, Ryan Nelson, Heather Prestridge, and Scott Wahlberg. We also had the help of Agrilife Extension agents when identifying landowners: Joshua Blanek of Andrews County, Arlan Gentry of Ward County, Terry Millican of Gaines County and Chase Settle of Winkler County. Ben Love also helped with identifying and contacting landowners with potential habitat. We sincerely thank the many landowners for their cooperation with the project. Landowner cooperation enabled us to survey extensive areas of shinnery dunes that had never been surveyed before and they were instrumental in the success of this survey effort. This study was conducted under the authority of permits from the Texas Parks and Wildlife Department.

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Appendix 1. Lizards Observed During 8-15 June 2011 Surveys in the Monahans Sandhills

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The biodiversity of the American Southwest includes a rich and diverse assemblage of amphibians and reptiles, and Texas is no exception with 220 known species occurring statewide. There are at least 33 species of lizards in southwest Texas alone. The following section is a review of the natural history of the 8 species of lizards observed in the Monahan Sandhills. This information is presented as a baseline summary of the species and number of individuals observed during June 2011.

To help conserve and manage species we must first understand the basic life history traits of the species. Understanding species' life histories is a necessary first step to developing conservation strategies for species and for identifying factors that potentially impact their populations and habitats. Careful documentation of species observed during the surveys is useful information that establishes a benchmark at a specific time that can be compared to future studies to help establish trends in distribution and status of lizard species in the Monahans Sandhills.

Family Crotaphytidae – Collared and Leopard Lizards

Long-nosed Leopard Lizard -- *Gambelia wislizenii* (Baird and Girard 1852)

The Long-nosed Leopard Lizard occurs in west Texas, New Mexico, Arizona, Nevada, Utah, extreme western Colorado, southern Idaho, Oregon, extreme northeastern California, and southern California in the United States. In Mexico they occur in northeastern Baja California, northern Sonora, Chihuahua, western Coahuila, eastern Durango, and extreme northern Zacatecas (Hollingsworth 2009). This is a moderate sized lizard. The tail is long, often reaching more than twice the length of the body. The head is relatively large with a long snout and distinct neck. Prominent dark spots and pale transverse lines overlay the dorsal color of white, cream, or gray. Hatchlings resemble the adults. The normal ground color of ovulating and gravid females is replaced by a suffusion of red-orange coloration on the side of the face, body, and ventral surface of the tail.

The species was relatively uncommon in the area surveyed at Monahans Sandhills; during the period 8 - 15 June 2011, only 2 individuals were observed on 2 (<1%) of 50 surveys. The species

is also uncommon in the shinnery oak ecosystem of adjacent New Mexico; Degenhardt et al. (1996) reported only a single specimen from Lea County, and during a recent pitfall study (2005 – 2009) at Mather Wildlife Area in the shinnery oak ecosystem of Chaves County not a single individual was reported in the 1729 individual lizards captured (NMDGF unpubl. data). The species is largely confined to flat areas of arid to semiarid lands. In Texas and New Mexico, the species is usually found in sandy flatlands, loose sandy basins, or low, gently rolling sand dunes, all with sparse vegetative cover including mesquite, creosotebush, acacia, shinnery oak, snakeweed, and yucca.

This is a large lizard in the Monahans Sandhills with females averaging somewhat larger than males; females reach 144 mm snout-vent length (SVL), while males reach 119 mm SVL (Hollingsworth 2009).

The primary prey of the Long-nosed Leopard Lizard are grasshoppers, except during the spring when lepidopterans, beetles, ants, wasps, spiders, and caterpillars and are also consumed. Vertebrate prey includes lizards (*Aspidoscelis*, *Phrynosoma*, *Sceloporus*, and *Uta* spp.), including members of its own species, snakes, and small rodents. Occasional herbivory has been reported in this species, which is uncommon for lizards in this family.

Female Long-nosed Leopard Lizards sexually mature at around 90 - 95 mm SVL; a single clutch is laid between late May and early July; average clutch size is 7.3 eggs with larger females laying larger clutches. Hatchlings appear in August and are 38 - 46 mm SVL. Individual females may live 8 years but most reproduction is accomplished by females 3 - 4 years old. Communal nesting may occur. Males are reproductively mature at approximately 85 mm SVL. Spermatogenesis is well underway by mid-May in warmer parts of their range and the testes are completely regressed by the end of June (Degenhardt et al. 1996, and references therein)

No subspecies of *Gambelia wislizenii* are currently recognized.

Family Phrynosomatidae – Zebra-tailed, Earless, Fringe-toed, Spiny, Brush, Side-blotched, California Rock, and Horned Lizards

Common Lesser Earless Lizard -- *Holbrookia maculata* Girard 1851

The Common Lesser Earless Lizard occurs across the central and southwestern United States from western Nebraska and south to northern Durango, Mexico and southeastern Kansas to northwestern Arizona (Rosenblum et al. 2009). This is a handsome and extremely variable lizard. The background color of individuals varies from almost pure white at White Sands National Monument in south central New Mexico to dark brown elsewhere. Paired, dark dorsal blotches are found down the back and the dorsum is often very heavily speckled with cream to white small spots. All lizards of this species have a lateral pair of vertical black bars, sometimes edged with blue, on either side of the mid body. There are no markings on the underside of the tail. Gravid females develop an orange to bright crimson coloration that permeates the ground color.

The species was uncommon in the area surveyed; during the period 8 - 15 June 2011, only 2 individuals were observed on 2 (<1%) of 50 surveys. This was somewhat unexpected as the species is often encountered in the shinnery oak ecosystem of adjacent New Mexico. During a recent pitfall study (2005 – 2009) at Mather Wildlife Area in the shinnery oak ecosystem of Chaves County 120 individuals were reported in the 1729 individual lizards captured (NMDGF unpubl. data).

This is a species adapted to relatively level terrain with sparse, low-lying vegetation and loose, friable soils. They are found in a variety of vegetative communities from homogeneous alkali sacaton grass flats to mixed grass-shrub communities.

The Common Lesser Earless Lizard reaches a maximum of 75 mm SVL in males and 70 mm SVL in females. During 1992 - 95, 1061 Common Lesser Earless Lizards collected on Mescalero Sands in Chaves County, New Mexico averaged 52 (21.3 – 69.5) mm SVL; 542 adult males averaged 55.3 (44.1 - 63.8) mm SVL and 4.7 (2.2 - 6.9) grams; 409 adult females averaged 55.3 (45.2 - 69.6) m SVL and 5 (2.3 - 9.1) grams (Degenhardt et al. 1996).

These lizards are a diurnal, widely foraging species that consumes a generalized insect diet, with grasshoppers and true bugs being especially important in their diet. They are known to prey upon hatchling whiptails and spiny lizards. They generally forage in open spaces between vegetation.

In eastern New Mexico females reach sexual maturity at 45 mm SVL, males at 44 mm SVL, although males as small as 34 mm SVL have been found with enlarged testes (Parker 1973). Females are gravid from mid-June through mid-July with oviposition usually during mid-July. Average clutch size varies with female size and has been reported to vary between 2.9 - 6.1 eggs. Clutch weight may represent as much as 23% of the female body weight. Males have enlarged testes at spring emergence; they remain enlarged through the end of June. Individuals are generally short-lived with a maximum of 4-5 years although most individuals live three years or less.

The subspecies *H. m. approximans Baird 1859 "1858"* – Speckled Earless Lizard occurs in the Monahans Sand Region. However, the systematics and nomenclature of this species is confusing and some authors (e.g. Rosenblum et al. 2009) choose not the designate subspecies until further investigations into their relationships are completed.

Dunes Sagebrush Lizard -- *Sceloporus arenicolus* Degenhardt and Jones 1972

The Dunes Sagebrush Lizard is restricted to a very limited range in the Mescalero Sands of southeast New Mexico and the Monahans Sandhills in adjacent Texas. In New Mexico and Texas the range is highly fragmented by unsuitable habitat and includes only parts of Chaves, Eddy, Lea, and Roosevelt counties (New Mexico) and Andrews, Crane, Gaines, Ward, and Winkler counties (Texas). The New Mexico range was presented in great detail by Fitzgerald et al. (1997), Painter et al. (1999), and Laurencio and Fitzgerald (2010); the Texas range was presented by Fitzgerald et al. (2007) and Fitzgerald et al. (2011, this report).

The species is light brown dorsally and generally lacks a pattern except for a poorly defined grayish-brown band extending from the upper margin of each ear opening posteriorly onto the tail. The blue coloration of the chin and throat in mature males is reduced to scattered flecking or is absent altogether. The blue on the venter is reduced and widely separated. Females develop a lateral yellow-orange suffusion from the throat posteriorly onto the tail when they are reproductively active. The venter is white or cream colored in females and juveniles, and hatchlings and juveniles resemble the adults. The species has 8 or more scales separating the

medial ends of the femoral pore series. This character alone will easily separate the Dunes Sagebrush Lizard from the similar Prairie Lizard, *Sceloporus consobrinus*, which has 7 or fewer scales separating the medial ends of the femoral pore series. The Side-blotched Lizard, *Uta stansburiana*, is easily separated from the Dunes Sagebrush Lizard by the dark blotch on the flank just behind the front limbs.

The species was commonly observed in the area of Monahans Sandhills surveyed; during the period 8 - 15 June 2011, 104 individuals were observed on 27 (54%) of 50 surveys.

Dunes Sagebrush Lizards are habitat specialists and occur only in the sand-dune complexes dominated by Shinnery Oak and scattered Sand Sage. Significant declines in Dunes Sagebrush Lizards are associated with the removal of this vegetation through defoliation or other habitat alteration. Within the limits of their geographical range, the species has a strong affinity for bowl-shaped depressions in active dune complexes referred to as sand dune blowouts. They prefer relatively large blowouts, and select microhabitats within a given blowout that are not to hot. Within their geographic range, the presence of this species is associated with composition of the sand; they occur only at sites with relatively coarse sand. Attempts to recreate this specific habitat after anthropogenic disturbance have not been successful and further research into attempts at conservation of this species through habitat restoration should be investigated.

This is a medium sized, terrestrial lizard reaching a maximum of 75 mm SVL in males and 63 mm SVL in females. During 1992 – 95, 1094 Dunes Sagebrush Lizards collected on the Mescalero Sands in Chaves County, New Mexico averaged 51.1 (22.4 - 64.9) mm SVL; 507 adult males averaged 54.5 (49 – 64.9) mm SVL and 5.1 (2.6 – 8.6) grams; 339 adult females averaged 53.8 (49 – 62.2) mm SVL and 4.8 (2.8 – 8.3) grams (Degenhardt et al. 1996).

This is an active, diurnal species which consumes a large variety of arthropod prey, including spiders, scorpions, beetles, grasshoppers, mantids, flies, true bugs, planthoppers, ants, bees, butterflies, dragonflies, and mole crickets (NMDGF unpubl. data). Activity peaks during May and June, then declines as summer temperatures increase.

Female Dunes Sagebrush Lizards can reach sexual maturity in their first spring following hatching. The smallest female reported to contain oviductal eggs was 49 mm SVL (Sena 1985). Individual females produce 1 – 2 clutches of eggs per year averaging about 5 (3 – 6) eggs each. The first clutch is laid in late June and the second in late July to early August. Clutch size is positively correlated with female body size. Hatchlings first appear between the end of July and the end of September (Degenhardt et al. 1996). Sexually mature males (at least 49 mm SVL) emerge in April with testes at maximum size; testes reach maximum size in July (Sena 1985).

No subspecies of *Sceloporus arenicolus* are currently recognized. Much of the literature for this species is found under the name Sand Dune Lizard, *Sceloporus gracious arenicolus*. Degenhardt and Jones (1972) originally described *Sceloporus arenicolus* as a subspecies of *S. graciosus* (see also Censky 1986), but the species has been treated as a separate species by several recent authors because of allopatry and a distinctive color pattern relative to other *S. graciosus* (Collins 1991; Smith et al. 1992; Degenhardt et al., 1996; Wiens and Reeder 1997). The original spelling *arenicolous* was corrected to *arenicolus* by Smith et al. (1992).

Prairie Lizard -- *Sceloporus consobrinus* Baird and Girard 1853

The Prairie Lizard occurs throughout the central United States from the grasslands in eastern New Mexico and eastern Colorado to the Mississippi River. They range as far north as South Dakota and south into San Luis Potosí and Zacatecas, Mexico (Lahti and Leaché 2009). The species has spiny, keeled dorsal scales and an incomplete gular fold. There are generally distinctive light longitudinal stripes on a dorsal background color of brown or grey. The blue belly and throat patches are generally faint or absent all together in some populations. The species has 7 or fewer scales separating the medial ends of the femoral pore series. This character alone will easily separate the Prairie Lizard from the similar Dunes Sagebrush Lizard, *Sceloporus arenicolus*, which has 8 or more scales separating the medial ends of the femoral pore series.

The Prairie Lizard was uncommon in the area of the Monahans Sandhills surveyed; during the period 8 - 15 June 2011only 4 individuals were observed in 3 (<1%) of 50 surveys. This was somewhat unexpected as the species is often encountered in the shinnery oak ecosystem of

adjacent New Mexico. During a pitfall study at Mather Wildlife Area in the shinnery oak ecosystem of Chaves County 73 individuals were reported in the 974 individual lizards captured during 2005 - 07 (NMDGF unpubl. data). This species is mostly terrestrial and occupies a wide variety of habitats, including prairies, stabilized sand dunes, rocky outcrops, and grasslands. They are often seen basking on low lying debris although they may retreat to the upper branches of low shrubs during the extreme heat of the day.

The Prairie Lizard is a relatively small species. Females are larger than males; females reaching about 68 mm SVL, males approximately 59 mm SVL. During 1992 - 95, 320 Prairie Lizards collected on Mescalero Sands in Chaves County, New Mexico averaged 46.5 (21.7 – 66.3) mm SVL and 3.2 (0.3 - 9.0) grams; 136 males averaged 44.4 (2.7 - 56.4) mm SVL and 2.7 (0.3 - 5.8) grams; 184 females averaged 48.0 (22.8 - 66.3) mm SVL and 3.5 (0.3-9.0) grams (NMDGF, unpubl. data).

As with numerous *Sceloporus* sp. the Prairie Lizard is a generalized insectivore, although various other arthropods are included in its diet as well. Common prey includes ants, beetles, grasshoppers, flies, spiders, termites, and centipedes (Lahti and Leaché 2009).

The Prairie Lizard breeds during early spring with reproduction occurring during early April at lower altitudes to early May elsewhere. Female clutch size is 5.5 eggs per clutch and females may lay 1 - 3 clutches per year, especially during periods of extended warm temperatures. Hatchlings appear in mid summer and may continue to emerge into early October.

No subspecies of *Sceloporus consobrinus* are currently recognized. Much of the literature for this species is found under the name Southern Prairie Lizard, *Sceloporus undulatus consobrinus*. Leaché and Reeder (2002) applied the name *S. consobrinus* to the populations formerly referred to as *S. undulatus* from the central United States, most of which occur in the plains between the Mississippi River and the Rocky Mountains. This includes the form described as *Sceloporus undulatus tedbrowni*, which was thought to be restricted to the Mescalero Sands region of southeast New Mexico.

Common Side-blotched Lizard -- *Uta stansburiana* Baird and Girard 1852

The Common Side-blotched Lizard is widely distributed throughout the western United States and northern Mexico. It also occurs on many of the islands in the Sea of Cortez. The dorsal scales are small and only weakly keeled. In the form occurring in the Monahans Sandhills these scales grade smoothly from the largest along the midline to the smallest laterally. There is a distinct gular fold. The dorsal ground color is usually brown or grey and there is a large black patch on the lateral flanks behind the axillary region on each side of the body. Adult males have a salt-and-pepper pattern of light and dark spots and a distinctive turquoise blue tail. Adult females and juveniles have a pale dorsolateral stripe on each side of the body which extends from the snout onto the tail (Brennan 2009). Some individuals from the sand dune areas of southeastern New Mexico are patternless. The lateral black patch just behind the fore limbs will distinguish this species from all other lizards in the Monahans Sandhills.

The Common Side-blotched Lizard was the most commonly observed lizard in the Monahans Sandhills; a total of 887 individuals were observed in 48 (96%) of 50 surveys. Tinkle (1967), in a study near Kermit, Texas reported densities of 5-62 individuals per hectare. The species is one of the most intensively studied of any lizard species. It is definitely a habitat generalist, found on most all substrates and soil types; from boulder fields to sand dunes.

This is a small lizard; males are larger than females with a maximum of 64 mm SVL for males and 58 mm for females. During 1992 - 95, 2440 Common Side-blotched Lizards collected on Mescalero Sands in Chaves County, New Mexico averaged 42.5 (19.2 - 58.7) mm SVL and 2.7 (0.1 - 5.7) grams; 1137 adult males averaged 48.6 (42.1 - 58.7) mm SVL and 3.7 (1.6 - 5.7) grams; 656 adult females averaged 45.9 (42 - 53.4) mm SVL and 3.0 (1.3 - 4.7) grams (Degenhardt et al. 1996).

The Common Side-blotched Lizard is an opportunistic, generalized insectivore eating a wide variety of insects and other arthropods which are caught using a “sit-and-wait” foraging strategy. Ants, beetles, true bugs, grasshoppers, and spiders are all important components of the diet.

Minimum reproductive size is 42 mm SVL for males and females, and early season hatchlings can obtain this size at an age of 3 - 4 months, although these precious individuals do not

reproduce until the following spring. Mature females may lay as many as 3 clutches annually of 2 - 5 eggs each but females breeding for the first time produce only 1 - 2 clutches. Incubation takes 60 - 80 days and hatchlings (18 - 23 mm SVL) appear in mid-June and may continue to emerge throughout the remainder of the season. Population turnover is annual in west Texas, although the rare adult lives to be 3 years old. Only about 20% of the hatchlings live to reproduce (Tinkle 1967).

The subspecies *Uta stansburiana stejnegeri* Schmidt 1921 – Eastern Side-blotched Lizard occurs in the Monahans Sandhills.

Family Teiidae – Whiptails and their Allies

Common Spotted Whiptail -- *Aspidoscelis gularis* (Baird and Girard 1852)

The Common Spotted Whiptail ranges from the Red River Valley of the Texas/Oklahoma border southward throughout most of Texas, into the southeast corner of New Mexico, and into Mexico in the states of Aguascalientes, Querétaro, and Veracruz (Degenhardt et al. 1996). This is a striped and spotted whiptail with distinct spots in the dark brown to black dark fields. There are usually 7 longitudinal cream colored stripes although the vertebral stripe may be divided to form an 8th stripe. The tail is pinkish to reddish brown in color. The unmarked venter of the female is cream colored although the venter of the male may be vividly marked with a pink, red, or orange throat and a blue-black chest and abdomen. There is often a dark black blotch just posterior of the gular fold and the sides may be suffused with a pale turquoise blue. The dorsal spots on the juveniles may be either absent or indistinct (Leavitt and Leavitt 2009).

The Common Spotted Whiptail was infrequently observed during these surveys of the Monahans Sandhills; only 3 individuals were observed during 2 (<1%) of 50 surveys. This was not surprising as the species generally prefers shortgrass prairies, shrublands, riparian areas, and rocky hillsides. It is frequently observed in disturbed areas, including city parks, sparsely occupied residential areas, or grassy road sides. It has not been observed in the shinnery oak sandhill habitats in New Mexico.

This is a moderate size whiptail with a maximum of 105 mm SVL. The tail is long and slender and may be twice the body length.

Studies from Trans-Pecos Texas (Schall 1978) suggest the Common Spotted Whiptail is an arthropod generalist, as most whiptails. Grasshoppers, beetles, ants, lepidopteran larvae, termites, and spiders are important components of this generalized diet. No apparent differences in food preferences between the sexes or age classes have been demonstrated.

In Trans-Pecos Texas minimum size at sexual maturity is 59 mm SVL. Females produce an average of 3.2 – 4.9 eggs per clutch, depending upon age and body size. Clutch size is positively correlated to female body size, with larger females producing larger clutches. Clutch weight is approximately 18% of female body weight. Females dig nesting chambers as much as 30 cm below the surface and cover the eggs with dirt. Hatchlings first appear during August at 24 - 40 mm SVL. Tail coloration in hatchlings is pinkish or reddish. Males emerge from brumation in late May in Trans-Pecos Texas with testes at maximum size (Schall 1978).

The subspecies *Aspidoscelis gularis gularis* (Baird Girard, 1852), Texas Spotted Whiptail occurs in the Monahans Sandhills.

Marbled Whiptail -- *Aspidoscelis marmorata* Baird and Girard 1852

The Marbled Whiptail has a rather limited range. It is confined to the Chihuahuan Desert, generally below 1520 m in elevation in the southern half of New Mexico, west Texas, and most of the states of Chihuahua and Coahuila and extreme western Nuevo León in Mexico. There is an isolated population found just north of Laredo, Texas along the Rio Grande (Dixon 2009). This is a uniquely patterned whiptail with a ground color of gray brown to brown. There are bold pale spaces surrounded by dark brown to black markings that tend to form reticulations on the dorsal and lateral parts of the body. Hatchlings are striped and spotted. Adults may retain these stripes or develop a marbled pattern with no indication of stripes. The dorsal scales are granular and the belly plates are rectangular. Patternless morphs of this species have been reported from Crane County, Texas (Ballinger and McKinney 1968) and Lea County, New Mexico (Acre et al. *in press*).

The Marbled Whiptail is a very common and often observed lizard in the Monahans Sandhills; a total of 488 individuals were observed in 47 (94%) of 50 surveys .Population densities can be very high; Milstead (1965) estimated a population of 44 lizards per hectare during an extended drought in West Texas; ten years after the drought the population was estimated to be 183 per hectare. This species is found in a variety of habitats within its range in the Chihuahuan Desert, including open desert shrublands on a variety of soils from sandy to rocky alluvium. It is abundant in the open, rolling Sandhills of west Texas and southeast New Mexico. An important component of the habitat is open spaces clear of all vegetation which are used for foraging.

During 1992-95, 114 male Marbled Whiptails collected on Mescalero Sands in Chaves County, New Mexico averaged 83 (43 - 104) mm SVL and 16.5 (1.9 – 39.7) grams; 96 females averaged 76.8 (41.8 – 97.4) mm SVL and 12.5 (1.6 – 24.5) grams (NMDGF unpubl. data).

This is an active and widely foraging species that consumes a wide variety of insects and arthropods. Prey includes grasshoppers, beetles, ants, lepidopterans and their larvae, and termites. Termites are a particularly important component of the diet and are consumed in large numbers, especially after the summer rains bring them close to the surface. Best and Gennaro (1985) reported grasshoppers to consist of 84% of the diet in a study near Carlsbad, New Mexico.

The Marbled Whiptail is a large whiptail, the largest reported from Mescalero Sands reaching 104 mm SVL. Males mature at 70 mm SVL, females at 60 mm SVL. Breeding has been observed during July with the first appearance of young during July. There is generally only one clutch of eggs each summer which varies from 1 – 5 with an average of 2.6 (Dixon 2009). However, clutch size varies based on the body size and age of the female. Schall (1978) reported an average of 2.02 (1 - 4) eggs per clutch in Trans-Pecos Texas and Medica (1967) reported 1 - 2 clutches of 2 eggs per female in south-central New Mexico. Clutch weight prior to oviposition is approximately 10% of an individual female's body weight. These lizards generally live 3 - 4 years although occasional individuals may reach 7 – 8 years of age.

The seasonal activity of the Marbled Whiptail is well studied and perhaps represents the generalized pattern of the whiptail lizards occurring in the Monahans Sandhills region. Juveniles are the first to appear in the spring, as early as mid-March. Adults appear in abundance in early May and generally disappear by mid to late August. Hatchlings first appear in late July and are present until early October. Adult males are active earlier in the season than females, although females often remain active later than males. Gravid females retire underground for up to three weeks prior to oviposition and then reappear to mate again to forage to supply energy stores for brumation (Degenhardt et al. 1996).

The subspecies *Aspidoscelis marmorata reticuloriens* (Vance 1978) occurs in the Monahans Sandhills. Most of the literature for this species occurs under the name *Cnemidophorus tigris marmoratus*.

Six-lined Racerunner -- *Aspidoscelis sexlineata* (Linnaeus 1766).

The Six-lined Racerunner has an extensive distribution in eastern and central United States, occurring from the eastern seaboard westward into eastern New Mexico, generally east of the Pecos River. It occurs throughout most of Texas except the Trans Pecos area, south to Brownsville. The species is easily recognized; it is a striped whiptail without spots in the dark fields; the bright green anterior dorsal body color of the adults will distinguish it from all other lizards at Monahans Sandhills. The species was relatively uncommon in the area surveyed; during the period 8 - 15 June 2011, only 18 individuals were observed on 13 (26%) of 50 surveys. The species generally occupies open, relatively xeric habitats with patchy vegetative cover and well-drained, usually sandy soils. It is more often observed on the shinnery oak flats and less often in the open, sandy blowouts. Juveniles seem to prefer more open habitats than adults.

The species is a relatively small whiptail with adults typically 55 - 75 mm SVL, but reaching a maximum size of 85 mm SVL. Females are slightly larger than males. During 1992-95, 390 Six-lined Racerunners collected on Mescalero Sands in Chaves County, New Mexico averaged 59.6 (28.8 - 70.9) mm SVL; 182 adult males averaged 61.7 (55.3 - 70.0) mm SVL and 5.3 (2.4 - 12.9)

grams; 146 adult females averaged 62.5 (55.2 - 70.9) mm SVL and 5.3 (2.9 - 8.9) grams (Degenhardt et al. 1996).

The Six-lined Racerunner is an active, terrestrial forager, finding prey opportunistically by sight and olfaction. They forage mostly on the ground although may occasionally climb into low bushes in search of prey. As most racerunners, the species is an arthropod generalist, feeding on grasshoppers, spiders, butterflies, caterpillars, ants, beetles, and various other terrestrial arthropods (Degenhardt et al. 1996; Paulissen 1987b).

Females reach reproductive maturity during their second year at approximately 68 mm SVL. Less than 10% of a population studied in Kansas (Fitch 1958) lived to be 4 years old. Females are gravid from May through August with a peak in July. The average clutch size is 2.5 (1 - 6) and incubation lasts 46 - 63 days with hatching occurring in June – September (Kwiatkowski 2009). Hatchlings are generally 31 - 35 mm SVL (Carpenter 1960; Paulissen 1987a).

The subspecies *A. s. viridis* (Lowe 1966) – Prairie Racerunner occurs in the Monahans Sand Region. Most of the literature for this species occurs under the name *Cnemidophorus sexlineatus*.

Reptiles observed during 8-15 June 2011 in the Monahans Sandhills

Amphibia

(no amphibians were observed during surveys in the Monahans Sandhills area)

Reptilia

Family Crotaphytidae

Gambelia wislizenii (Baird and Girard 1852) -- Leopard Lizard

Family Phrynosomatidae

Holbrookia maculata Girard 1851 -- Lesser Earless Lizard

Sceloporus arenicolus Degenhardt and Jones 1972 -- Sand Dune Lizard

Sceloporus consobrinus Baird and Girard 1853 -- Prairie Lizard

Uta stansburiana Baird and Girard 1852 -- Side-blotched Lizard

Family Teiidae

Aspidoscelis gularis (Baird and Girard 1852) -- Common Spotted Whiptail

Aspidoscelis marmorata (Baird and Girard 1852) -- Marbled Whiptail

Aspidoscelis sexlineata (Linnaeus 1766) -- Six-lined Racerunner

Family Colubridae

Coluber flagellum (Shaw 1802) -- Coachwhip

Family Viperidae

Crotalus viridis (Rafinesque 1818) -- Prairie Rattlesnake

Family Emyidae

Terrapene ornata (Agassiz 1857) -- Ornate Box Turtle

Lizards likely to occur at Monahans Sandhills but not observed during surveys conducted 8-15 June 2011

The following list of species was developed from an examination of the range maps presented by Jones and Lovich (2009). While the natural range of all of these species is known to include the survey area many are habitat specialists (e.g., *Coleonyx brevis*; *Sceloporus bimaculosus*) and are not expected to occur within the shinnery oak ecosystem; others are secretive or nocturnal (e.g. *Plestiodon multivirgatus* and *P. obsoletus*) and are not often encountered with the techniques employed during these surveys. Other species, including the horned lizards, *Phrynosoma cornutum* and *P. modestum,* are sometimes observed during terrestrial walking surveys, although they are often reluctant to flee upon approach so it is not surprising they were not observed during these surveys.

Family Scincidae -- Skinks

Plestiodon multivirgatus (Hallowell 1857) – Many-lined Skink

Plestiodon obsoletus (Baird and Girard 1852) – Great Plains Skink

Family Phrynosomatidae – Zebra-tailed, Earless, Fringe-toed, Spiny, Brush, Side-blotched, California Rock, and Horned Lizards

Cophosaurus texanus Troschel 1852 – Greater Earless Lizard

Phrynosoma cornutum (Harlan 1825) – Texas Horned Lizard

Phrynosoma modestum Girard 1852 – Round-tailed Horned Lizard

Sceloporus bimaculosus Phelan and Brattstrom 1955 – Twin-spotted Spiny Lizard

Urosaurus ornatus (Baird and Girard 1852) – Ornate Tree Lizard

Family Crotaphytidae – Collared and Leopard Lizards

Crotaphytus collaris (Say *in* James 1823) – Eastern Collared Lizard

Family Teiidae – Whiptails and their Allies

Aspidoscelis tesselata (Say 1823) – Common Checkered Whiptail

Family Eublepharidae – Eyelidded Geckos

Colenoyx brevis Stejneger 1893 – Texas Banded Gecko

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