FINAL REPORT

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Endangered and Threatened Species Conservation

Geographic Distribution and Habitat Suitability of the Sand Dune Lizard (*Sceloporus arenicolus*) in Texas

Prepared by:

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STATE: Texas **GRANT NUMBER:** E - 64

GRANT TITLE: Endangered and Threatened Species Conservation

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PROJECT TITLE: Geographic Distribution and Habitat Suitability of the Sand Dune Lizard (Sceloporus arenicolus) in Texas

OBJECTIVE(S):

Determine geographic distribution and habitat use of *S. arenicolus* in Texas, and incorporate these data into a range-wide habitat suitability model and an ongoing population genetics study over three years.

Significant Deviation:

None.

Summary Of Progress:

Please see Attachment A.

Location: Andrews, Winkler, Ward, Crane, Gaines, Yoakum, Cochran, Hockley, Terry, Ector, Dawson, Martin, Midland, Upton.

Prepared by: Craig Farquhar **Date:** 11 October 2007

Approved by: ______________________ **Date:** ______________
C. Craig Farquhar

GEOGRAPHIC DISTRIBUTION AND HABITAT SUITABILITY OF THE SAND DUNE LIZARD (*SCELOPORUS ARENICOLUS*) IN TEXAS

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ABSTRACT

The Dunes Sagebrush-lizard, *Sceloporus arenicolus*, is endemic to a small, but well-defined range in southeastern New Mexico, which extends into previously undefined portions of west Texas. The goal of this study was to define the distribution and habitat use of *S. arenicolus* in Texas and include these data in ongoing genetic and habitat modeling work. During April, May, and June of 2006 and 2007, we conducted 32 standardized surveys at 27 sites within appropriate habitat to define the geographic range and habitat preferences of *S. arenicolus* in Texas. Within suitable habitat, *S. arenicolus* were found at 3 sites, and more than one specimen at a site was documented at only 2 of those sites. We failed to find *S. arenicolus* at 3 historical sites in Texas where we surveyed, and documented the species at 2 new sites. Habitat type at the sites visited was primarily shinnery dune or shinnery flats.

INTRODUCTION

Sceloporus arenicolus (the Dunes Sagebrush-lizard) inhabits the second smallest range of any North American endemic lizard (Conant and Collins 1991). It is a habitat specialist, found solely in sand blowouts within shinnery oak (*Quercus havardi*) vegetation in Southeastern New Mexico and West Texas (Conant and Collins 1991, Stebbins 1985, Degenhardt et al. 1996). Efforts to document the geographic range of *S. arenicolus* in New Mexico provided a well defined range in that state, where it is classified as threatened; however, a systematic description of the presence of *S. arenicolus* in Texas had not been undertaken prior to this study.

S. arenicolus is of special interest to wildlife agencies in New Mexico and Texas owing to its small range and habitat specialization. Additionally, oil and gas development and herbicide spraying have fragmented and destroyed portions of the available habitat and persist in many regions of the *S. arenicolus* range. Therefore, in addition to providing the obvious biological distributional and habitat data needed for policy, these data better arm managers to address potential conflicting issues of shinnery habitat management.

OBJECTIVE (AS STATED IN PROJECT STATEMENT)

Determine geographic distribution and habitat use of *S. arenicolus* in Texas, and incorporate these data into a range-wide habitat suitability model and an ongoing population genetics study over three years.

LOCATION

Surveys were conducted in 6 counties in west Texas: Andrews, Crane, Cochran, Edwards, Ward and Winkler. These counties contain Shinnery Oak vegetation (Figure 1), and therefore include the best potential habitat for *S. arenicolus* in Texas.

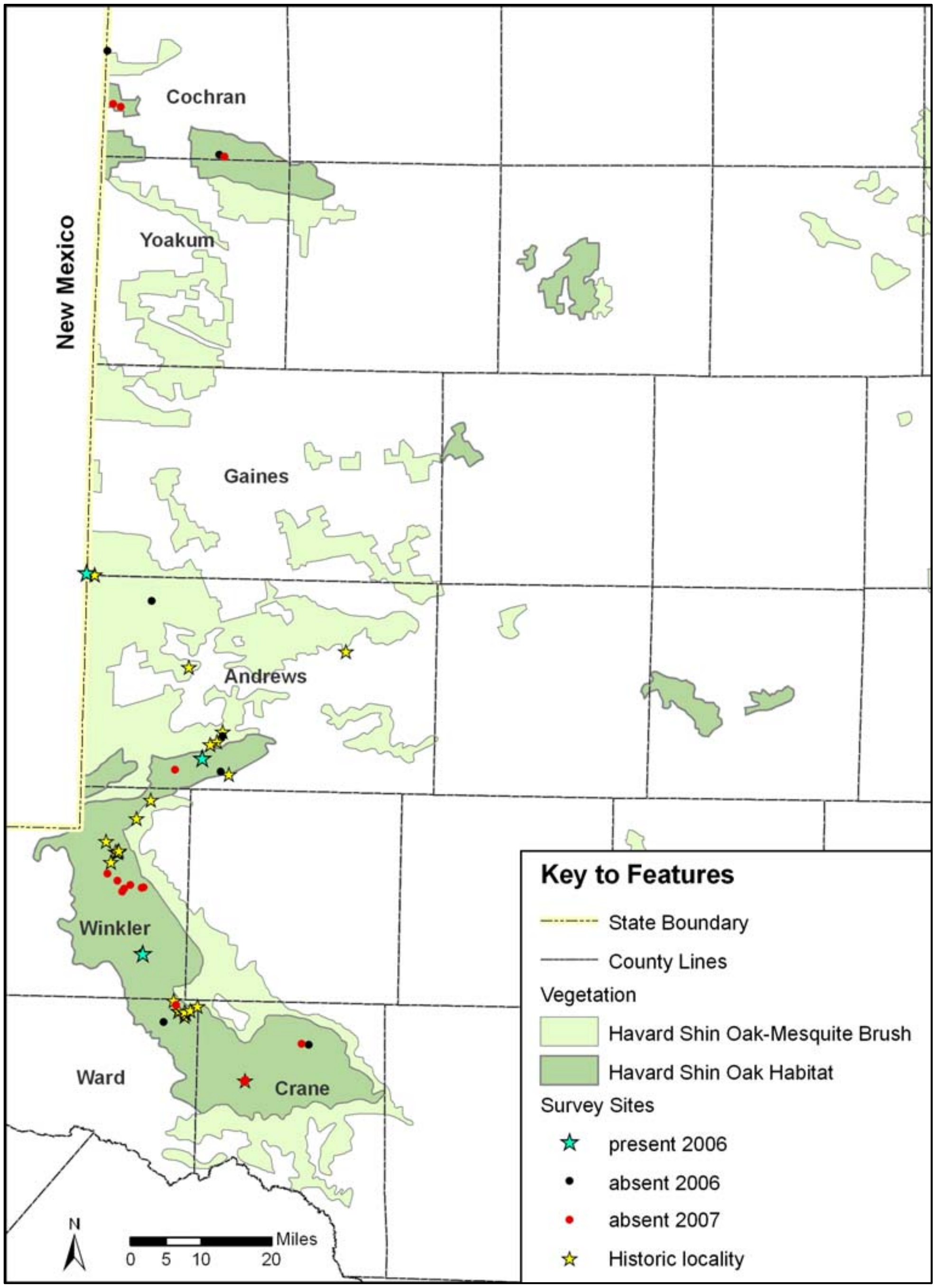
METHODS (AS STATED IN PROJECT STATEMENT)

Distribution surveys for presence and absence

Distribution surveys will follow the methodology described in Fitzgerald et al. (1997), designed for increased probability of finding *S. arenicolus* if they are present. Surveys will be conducted during May–June (months of peak lizard activity) 2005 and 2006.

To determine presence or absence of *S. arenicolus* at a survey site, 2 or more trained observers will walk slowly through potential habitat searching for lizards. At each site, the occurrence of habitat types will be noted (see 4.2 below). A **site** is a place where surveys will be conducted to determine the presence or absence of *S. arenicolus*. Surveys generally covered one-sixteenth of a section (400 x 400 m) or greater. Geographical coordinates of sites serve

Figure 1: Surveyed Sites



Note: Vegetation classifications on the map are general vegetation classes (McMahan et al. 1984), and are not micro-habitat descriptions.

practical purposes of mapping, while it is acknowledged that sites are the area surrounding the coordinates.

When *S. arenicolus* is verified in the field at a site the team will capture individuals for non-lethal tissue sampling (see 4.4.2 below), then move to a new site. The survey at a particular site will be discontinued if no *S. arenicolus* are found after a maximum of 6 person-hours of searching or the entire area has been searched. When *S. arenicolus* is present, it is usually very easy to find from mid-May through June. Fitzgerald et al. (1997) found *S. arenicolus* within 68 person-minutes at 96% of the sites where it was found; that is, 3 observers searching for only 23 minutes found *S. arenicolus* at almost all the sites where it had never been found. Sites where *S. arenicolus* is absent (not detected after 360 person-minutes) will be re-surveyed during the study, within logistical limits.

It is necessary to document presence with properly prepared voucher material. At each site, 2 *S. arenicolus* will be prepared as voucher specimens to allow scientific verification of the species' presence. Voucher specimens, with associated locality and ecological data, are the only permanent verifiable database of the presence of *S. arenicolus* at a specific place and time. Additionally, *S. arenicolus* can be difficult to identify from afar even for skilled herpetologists not working regularly with *S. arenicolus* in the field. *Sceloporus arenicolus* are not uncommon where they occur, and collecting 2 vouchers will not affect the continued presence of *S. arenicolus* at a survey site. All specimens will be deposited into the Texas Cooperative Wildlife Collection, Texas A&M University. (TAMU Animal Care and Use Committee must approve all protocols; Texas Parks and Wildlife Department will issue permits).

<u>Habitat surveys conducted concurrently</u>

Habitat surveys and vegetation classifications will follow the methodology described in Fitzgerald et al. (1997).

Potential habitat types where surveys will be conducted will be classified into 7 microhabitat types used by Fitzgerald et al. (1997). **Shinnery dunes** are active sand dune complexes dominated by shinnery oak (*Quercus havardi*) and characterized by the presence of open blowouts. (Blowouts are more or less bowl-shaped depressions among sand dunes). **Shinnery 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, and grasses. Landform 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 sites.

<u>Integration of the collected Texas data into a range-wide habitat suitability model being developed in Fitzgerald's lab</u>

Landscape features such as presence of shinnery oak dune complexes (bumpy dune topography and presence of sand dune blowouts) are clear habitat indicators for sand dune lizards (Painter et al. 1999). Additional abiotic factors such as sand grain size composition, and the size distribution of blowouts are associated with sand dune lizard presence and population density (Fitzgerald et al. 1997). Importantly, land uses such as oil field development, roads, and shinnery oak removal are also tied to sand dune lizard numbers (Snell et al. 1997, Sias and Snell 1998).

We will create habitat suitability models for sand dune lizards in a GIS framework. The GIS will allow measurement of extent of habitat according to habitat quality, and identification of dispersal corridors for sand dune lizards and other biodiversity that use shinnery oak sand dune habitat.

We will use existing data sets in the public domain, from Bureau of Land Management (BLM), NM State Land Office, USGS and from other sources as they become available to create a GIS of landscape features, habitat types, land use, and presence/absence of sand dune lizards throughout the geographical range of the sand dune lizards.

A habitat suitability model will be developed that is specific to the Mescalero Sands Ecosystem and the habitat requirements of sand dune lizards. There is an extensive and growing literature on habitat suitability models created for a wide variety of taxa that make use of a variety of statistical approaches including logistic regression (e.g., Andersen et al. 2000, Niemuth 2003, Rivieccio et al. 2003, Reutter et al. 2003, FWS Habitat Evaluation Process). We will make use of current approaches for developing GIS-based habitat suitability models. Examples of recent analytical approaches include regression-tree analyses and artificial neural networks (Dedecker et al. 2004). The extent, distribution, and connectedness of dune complexes within the range of sand dune lizards will be quantified. We will use classification algorithms in ARCinfo to classify habitat types, for example shinnery oak dune complexes, shinnery flats, and mesquite grasslands. Software programs such as FRAGSTAT will be used to quantify connectedness and other landscape metrics (McGarigal et al. 2002).

<u>Integration of the collected Texas data into ongoing population genetic studies of *S. arenicolus*</u>

Fitzgerald is collaborating with Lauren Chan, doctoral candidate, and Dr. Kelly Zamudio at Cornell University on population genetic studies of *S. arenicolus* throughout its range. Habitat loss, habitat specificity, and fine- and coarse-grained habitat heterogeneity are likely to have produced unique patterns of population structure in *S. arenicolus*. We will use a nested, hierarchical approach to determine the scale at which habitat changes influence gene flow and relatedness among fragmented populations.

RESULTS

Distribution surveys for presence and absence

To conform to the objective of documenting the geographical range of *S. arenicolus*, survey sites were selected to cover the entire geographical limits of the species distribution in Texas (Figure 1). Prior to conducting fieldwork, we created an atlas of potential *S. arenicolus* habitat using GIS data available in the public domain including vegetation, road networks, cities, counties, digital orthophotos, and historical *S. arenicolus* localities (Appendix 1). This provided the opportunity to identify survey sites with the appropriate habitat remotely, therefore, maximizing the time in the field to conduct surveys. Using the atlas, areas of shinnery dune habitat were identified in an 11 county area in West Texas. Reconnaissance in field vehicles determined that the areas in Lynn, Terry, Yoakum, Dawson, Howard, most of Gaines and extreme southwest Cochran counties were not suitable for *S. arenicolus*. Survey sites were then selected in 6 counties (Andrews, Crane, Cochran, Edwards, Ward and Winkler) containing potential habitat. These sites included historical localities as well as areas between historical localities within appropriate shinnery dune habitat.

During 2006 and 2007, we carried out 32 standardized surveys at 27 sites to determine the presence or absence of *S. arenicolus* (Table 1). The number of surveys is more than the number of sites due to repeated surveys at some sites. Site 13 was visited four times and sites 2 and 23 were visited twice.

Surveys included from one to 3 observers and ranged from 10 to 324 person-minutes. The average duration of surveys at sites where *S. arenicolus* was found was 185 person-minutes (n = 3; sd = 68). The average duration at sites where the species was not detected was 144 (n = 24; sd = 98).

Sceloporus arenicolus were present at three (0.11%) of 27 sites surveyed. Two of the sites were new localities for the species. One was in Andrews county, and the other in Winkler. These sites fell between historic localities and helped to fill in gaps in the distribution of the species The third was within 2 km of a

Table 1: Chronological listing of site surveys with locality data, outcome and habitat classifications.

Survey #	Site #	Date	Latitude	Longitude	Start Time	Stop Time	# Obs	Person Minutes	County	*S. arenicolus* found?	Habitat types
1	1	5-Jun-2006	31° 33' 52.8" N	102° 29' 53.6" W	0930	1150	3	310	Crane	No	Shinnery dune
2	2	6-Jun-2006	31° 29' 23.0" N	102° 38' 54.3" W	0950	1200	3	310	Crane	No	Shinnery dune
3	3	7-Jun-2006	31° 44' 49.1" N	102° 54' 19.6" W	0933	1109	3	288	Winkler	No	Shinnery dune
4	4	7-Jun-2006	32° 11' 54.7" N	102° 43' 24.7" W	1305	1325	3	60	Andrews	No	Mesquite scrub habitat with shinnery dunes also present
5	5	7-Jun-2006	32° 07' 29.4" N	102° 43' 36.3" W	1900	1932	3	96	Andrews	No	Shinnery dune
6	6	8-Jun-2006	32° 09' 06.2" N	102° 46' 21.3" W	1018	1155	3	259	Andrews	Yes	Shinnery dune
7	7	9-Jun-2006	32° 28' 25.6" N	102° 54' 14.0" W	1035	1250	3	299	Andrews	No	Shinnery flats with shinnery dunes present
8	8	10-Jun-2006	33° 36' 25.5" N	103° 02' 55.4" W	1116	1248	2	184	Cochran	No	Shinnery flats with shinnery dunes present
9	9	11-Jun-2006	33° 23' 57.2" N	102° 46' 00.6" W	0923	1109	2	212	Cochran	No	Shinnery flats with shinnery dunes present
10	10	12-Jun-2006	32° 31' 40.4" N	103° 03' 52.1" W	0858	1001	2	126	Gaines	Yes	Shinnery dune
11	11	13-Jun-2006	31° 44' 39.7" N	102° 54' 11.5" W	0903	1028	2	170	Winkler	Yes	Shinnery dune
12	12	13-Jun-2006	31° 36' 16.2" N	102° 50' 56.5" W	1141	1216	2	70	Winkler	No	Shinnery dune
13	13	12-Apr-2007	31° 29' 07.1" N	102° 39' 00.9" W	1310	1458	3	324	Crane	No	Shinnery dune with open dunes also present
14	14	13-Apr-2007	31° 34' 00.3" N	102° 30' 58.3" W	1135	1300	3	255	Crane	No	Shinnery dune
15	13	7-May-2007	31° 29' 07.1" N	102° 39' 00.9" W	1150	1311	1	81	Crane	No	Shinnery dune with open dunes also present
16	15	10-May-2007	33° 29' 51.8" N	103° 01' 50.1" W	1050	1105	3	45	Cochran	No	Shinnery flats with shinnery dunes present
17	16	10-May-2007	33° 29' 31.7" N	103° 00' 44.1" W	1125	1150	3	75	Cochran	No	Shinnery flats with shinnery dunes present
18	17	10-May-2007	33° 23' 43.1" N	102° 45' 16.7" W	1405	1455	3	125	Cochran	No	Shinnery flats with shinnery dunes present
19	18	10-May-2007	32° 07' 34.8" N	102° 50' 11.5" W	1845	1910	2	50	Andrews	No	Dune grassland and mesquite scrub
20	2	11-May-2007	31° 29' 23.0" N	102° 38' 54.3" W	1100	1200	3	140	Crane	No	Shinnery dune
21	19	12-May-2007	31° 52' 18.7" N	102° 57' 26.1" W	1230	1310	2	80	Winkler	No	Shinnery dune
22	20	12-May-2007	31° 52' 41.8" N	102° 57' 09.5" W	1325	1450	2	170	Winkler	No	Shinnery dune with shinnery flats also present
23	21	12-May-2007	31° 52' 51.3" N	102° 54' 36.1" W	1545	1550	2	10	Winkler	No	Shinnery dune
24	22	12-May-2007	31° 52' 54.6" N	102° 54' 20.1" W	1600	1612	2	24	Winkler	No	Shinnery dune
25	13	13-May-2007	31° 29' 07.1" N	102° 39' 00.9" W	1020	1210	2	220	Crane	No	Shinnery dune with open dunes also present
26	23	13-May-2007	31° 38' 25.7" N	102° 49' 11.0" W	1255	1335	2	80	Ward	No	Shinnery dune with dune grasslands also present
27	13	4-Jun-2007	31° 29' 07.1" N	102° 39' 00.9" W	1045	1100	1	15	Crane	No	Shinnery dune with open dunes also present
28	24	4-Jun-2007	31° 29' 15.2" N	102° 39' 07.2" W	1100	1405	1	185	Crane	No	Shinnery dune with dune grasslands and open dunes also present
29	23	4-Jun-2007	31° 38' 25.7" N	102° 49' 11.0" W	1815	1915	1	60	Ward	No	Shinnery dune with dune grasslands also present
30	25	6-Jun-2007	31° 53' 39.3" N	102° 58' 08.6" W	1030	1145	2	150	Winkler	No	Shinnery dune
31	26	6-Jun-2007	31° 53' 11.5" N	102° 56' 17.6" W	1240	1340	2	120	Winkler	No	Shinnery dune with shinnery flats also present
32	27	7-Jun-2007	31° 54' 31.3" N	102° 59' 37.4" W	1305	1410	2	130	Winkler	No	Shinnery dune with shinnery flats also present

historical locality south of Hobbs, Lea County, NM and is an extension of the New Mexican *S. arenicolus* distribution.

Habitat surveys conducted concurrently

Most of the sites surveyed contained primarily shinnery dune habitat, although sites containing a mix of shinnery dune and other habitats (shinnery flats, open dunes, grassland dunes) were also searched (Table 2). All *S. arenicolus* found in Texas were found in shinnery dune habitat. In fact, all *S. arenicolus* captured were in sand dune blowouts.

Table 2: Micro-habitat classifications for the 27 Texas *Sceloporus arenicolus* survey sites

Site No.	County	Status	Micro-Habitat Classification
1	Crane	absent	shinnery dune with mixed grasses and shrubs present
2	Crane	absent	shinnery dune
3	Winkler	absent	shinnery dune
4	Andrews	absent	mesquite scrub with small patch of shinnery dunes
5	Andrews	absent	shinnery dune
6	Andrews	present	shinnery dune
7	Andrews	absent	shinnery flats
8	Cochran	absent	shinnery flats with patch of Shinnery dune
9	Cochran	absent	shinnery flats
10	Gaines	present	shinnery dune
11	Winkler	present	shinnery dune
12	Winkler	absent	shinnery dune
13	Crane	absent	shinnery dune classification.
14	Crane	absent	shinnery dune
15	Cochran	absent	shinnery flats with few dunes and blowouts
16	Cochran	absent	shinnery flats with two groups of dunes and blowouts
17	Cochran	absent	shinnery flats with some small dunes and blowouts present
18	Andrews	absent	dune grassland and mesquite scrub with some shin oak present
19	Winkler	absent	shinnery dune
20	Winkler	absent	shinnery dune with shinnery flats
21	Winkler	absent	shinnery dune
22	Winkler	absent	shinnery dune
23	Ward	absent	shinnery dune with dune grasslands
24	Crane	absent	shinnery dune with dune grasslands and open dunes also present
25	Winkler	absent	shinnery dune
26	Winkler	absent	shinnery dune with shinnery flats
27	Winkler	absent	shinnery dune with shinnery flats

Integration of the collected Texas data into a range-wide habitat suitability model being developed in Fitzgerald's lab

A habitat suitability model for *S. arenicolus*, based on analysis of landscape characteristics, is currently being developed using detailed vegetation data available from the State of New Mexico and the Bureau of Land Management (BLM). The program FRAGSTATS (McGarigal and Marks, 1995) was used to calculate a variety of landscape metrics related to area, density, shape, isolation/proximity, and connectivity of vegetation patches. To date, presence/absence models have been developed, using both logistic regression and discriminate function analysis based on the FRAGSTATS metrics, at three different scales: 1) the site scale (~20 ha), 2) an intermediate scale (~100 ha) and 3) a large scale (~1000 ha). Preliminary results of the model, confirm that the number of blowouts, and distance between them, the amount of Honey Mesquite Patches, the amount of grassland present, and the total area of Shinnery Oak Duneland present within a given area are important in predicting presence and absence of *S. arenicolus*. Furthermore, preliminary results indicate that analysis of the landscape at the intermediate scale (~100 ha) provides the best predictability. Current efforts are underway to validate the presence/absence models and determine which scale and model provides the best predictability.

Integration of the collected Texas data into ongoing population genetic studies of *S. arenicolus*

Voucher specimens were taken at all three sites where *S. arenicolus* were present (Table 3). For each voucher, tissues were taken and sent to Lauren Chan at Cornell University to be used in population genetic analyses of *S. arenicolus*. Two papers have been published since the start of this project using tissues collected from Texas *S. arenicolus* (Chan et al. 2006, Chan et. al. in review, *Conservation Genetics*).

Table 3: *Sceloporus arenicolus* voucher specimens collected in Texas during the 2006 and 2007 field seasons. All voucher specimens were deposited at the Texas Cooperative Wildlife Collection (TCWC), Texas A&M University, College Station, Texas.

TCWC ID	County	Latitude	Longitude	Sex
91402	Andrews	32° 08' 50.4" N	102° 46' 29.7" W	Female
91415	Winkler	31° 44' 39.7" N	102° 54' 11.5" W	Male
91416	Winkler	31° 44' 38.9" N	102° 54' 11.2" W	Female
91469	Gaines	32° 31' 35" N	103° 03' 49.4" W	Female
91470	Gaines	32° 31' 31.3" N	103° 03' 46" W	Male
91471	Gaines	32° 31' 30.4" N	103° 03' 52.1" W	Male
91472	Gaines	32° 31' 36.2" N	103° 03' 51.8" W	Male
91473	Gaines	32° 31' 33.7" N	103° 03' 52.4" W	Female

DISCUSSION

Distribution surveys for presence and absence

Cochran County is near the edge of the New Mexican distribution of *S. arenicolus* and contained habitat for *S. arenicolus*. However, most of the habitat was shinnery oak flats with a few dunes and blowouts interspersed patchily throughout the matrix. Our searches in this area produced no *S. arenicolus*. The potential habitat in southwestern Cochran and northwest Yoakum County has been modified by agricultural practices and no longer contains good shinnery dune habitat.

Crane County, to the south of the known distribution contained good habitat in the north and western sectors of the county. Repeated surveys at these localities also did not turn up any *S. arenicolus*. While most of the searched areas were in shinnery dune habitat, much of the area has been fragmented by oil and gas development and a site containing a historic locality in this area has been further disrupted by all terrain vehicle pathways and tracks.

The stronghold for *S. arenicolus* in Texas seems to be the large band of sand dunes located in Ward, Winkler and Andrews counties. Two of the three *S. arenicolus* collected in this study came from this area (Table 3). Additionally, a majority of the historic localities for *S. arenicolus* occur here as well (Figure 1; Appendix 1). It is possible this band of sand dunes contains the remaining populations of *S. arenicolus* in Texas. The third site where *S. arenicolus* were collected was located at the border with New Mexico in Gaines Co. This site lies within the easternmost edge of the southern distribution of the species in New Mexico, which ends just east of the Texas border.

Given the number of person-hours spent searching in potential habitat favored by *S. arenicolus*, the number of lizards observed was very low. In similar searches in New Mexico, Fitzgerald et al. (1997) found a *S. arenicolus* within 68 person-minutes at 96% of sites and within 31 person-minutes at 74% of sites where the lizards were found. The longest search time to encounter a S. arenicolus in that study was 115 person-minutes. In this study, the majority of surveys (n = 25) lasted longer than 68 person-minutes. Only 7 of our searches lasted < 68 person-minutes. The amount of potential habitat at 5 of these sites (Sites 13, 15, 18, 21, 22) was so limited that the entire area was completely covered during the survey. The remaining 2 sites (Sites 4, 23) were searched for 60 person-minutes.

We suggest three possibilities for why *S. arenicolus* were not detected at sites with potential habitat: 1) the lizards are not present; 2) the lizards are present in such low densities they are difficult to detect; and 3) the lizards are present in reasonable densities and not being detected. Each of these explanations has implications for the well being of *S. arenicolus* populations in Texas.

We can rule out the possibility that we did not detect lizards under normal circumstances based on the experience of the same observers finding *S. arenicolus* at multiple sites in New Mexico during the last 10 years. We also found other lizard species at all sites very quickly during the surveys.

It is possible that at some sites *S. arenicolus* exists in low densities and difficult to detect, but we have no indication our protocol was compromised when lizard densities were low (Fitzgerald et al. 1997). However, it is possible that for Texas populations relatively long search times may be necessary to detect the species when abundance is low. For example at site 6 the specimen was found after 259 person-minutes. In contrast, at site 10 in Gaines County, where *S. arenicolus* were abundant, they were observed in <10 person-minutes. High temperatures are known to limit lizard activity, and at several sites substrate temperatures exceeded 50˚C at some point during the surveys. However, we continued to observe *Uta stansburiana* and *Aspidoscelis tigris* at these sites, and we still observe *S. arenicolus* during similar conditions in New Mexico. Furthermore, *S. arenicolus* is usually the first or second most easily observed species when it is present in New Mexico (Fitzgerald et al. 1997).

Summarizing, although low population densities may confound our ability to detect *S. arenicolus* when they were present, we have no reason to suspect the survey protocol was ineffective. Therefore, we can conclude that *S. arenicolus* is probably absent from most sites surveyed, and if it does exist at those sites, they are not common.

It was notable that we failed to see *S. arenicolus* at Monahans Sandhills State Park. This area is a well-known historical locality for the species. We (Fitzgerald, pers. obs.) found *S. arenicolus* there in 1996 very quickly around the campground, but we did not find *S. arenicolus* in the park during 2 surveys lasting 140 person-minutes. Dr. Gary Ferguson, Professor Emeritus, Texas Christian University, has also failed to find *S. arenicolus* in the park recently (pers. comm. July 2007). We will conduct more surveys for the species during 2008 and inform TPWD of our findings.

<u>Habitat surveys conducted concurrently</u>

All lizards were caught in shinnery dune habitat and caught in blowouts. This is consistent with work in New Mexico, which showed that 100% of the time, *S. arenicolus* was found in active shinnery oak dunes with blowouts (Fitzgerald et al. 1997). *S. arenicolus* was never found in shinnery flats in New Mexico or Texas.

Atlas of Sceloporus arenicolus localities and habitat, and Integration of the collected Texas data into a range-wide habitat suitability model being developed in Fitzgerald's lab

We produced an atlas of potential *S. arenicolus* habitat in Andrews, Crane, Ector, Ward, and Winkler counties. The atlas serves as a tool for visualizing the landscape configuration of potential and suitable habitat for *S. arenicolus* in Texas. A complete atlas is provided in Appendix 1.

Preliminary results of a spatially explicit presence/absence model indicate that analysis at the small site scale may not encompass the entire landscape that effects *S. arenicolus* distribution. Analysis at a larger scale of 100ha, provides better differentiation of presence and absence sites. Using both logistic regression and discriminate function analysis to create a predictive model yields similar results. Number and connectedness of blowouts, number of honey mesquite patches, amount of grasslands, and total area of shinnery dunelands are important factors affecting presence and absence of *S. arenicolus*. The model is currently being validated using new survey sites from New Mexico, and as detailed vegetation data become available for Texas, these survey sites can be used to further validate the model.

Integration of the collected Texas data into ongoing population genetic studies of *S. arenicolus*

Results from the ongoing genetic studies should help answer some of these questions. Additionally, repeated surveys over several years will help to answer the question of whether extreme heat, a bad reproductive year or other stochastic events were the cause for the low number of *S .arenicolus* observed, or if the populations have very low densities or have been extirpated locally at historic localities.

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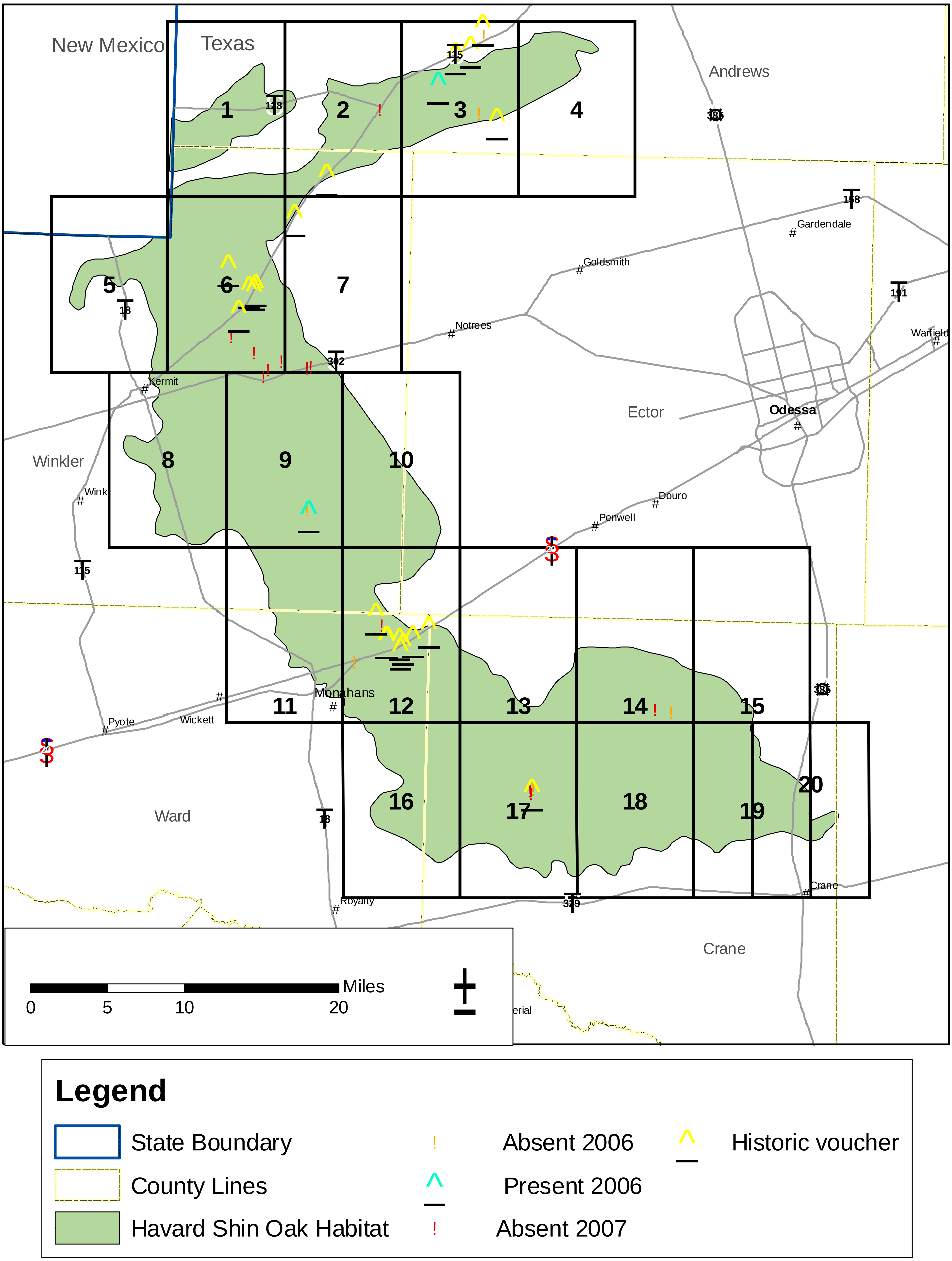
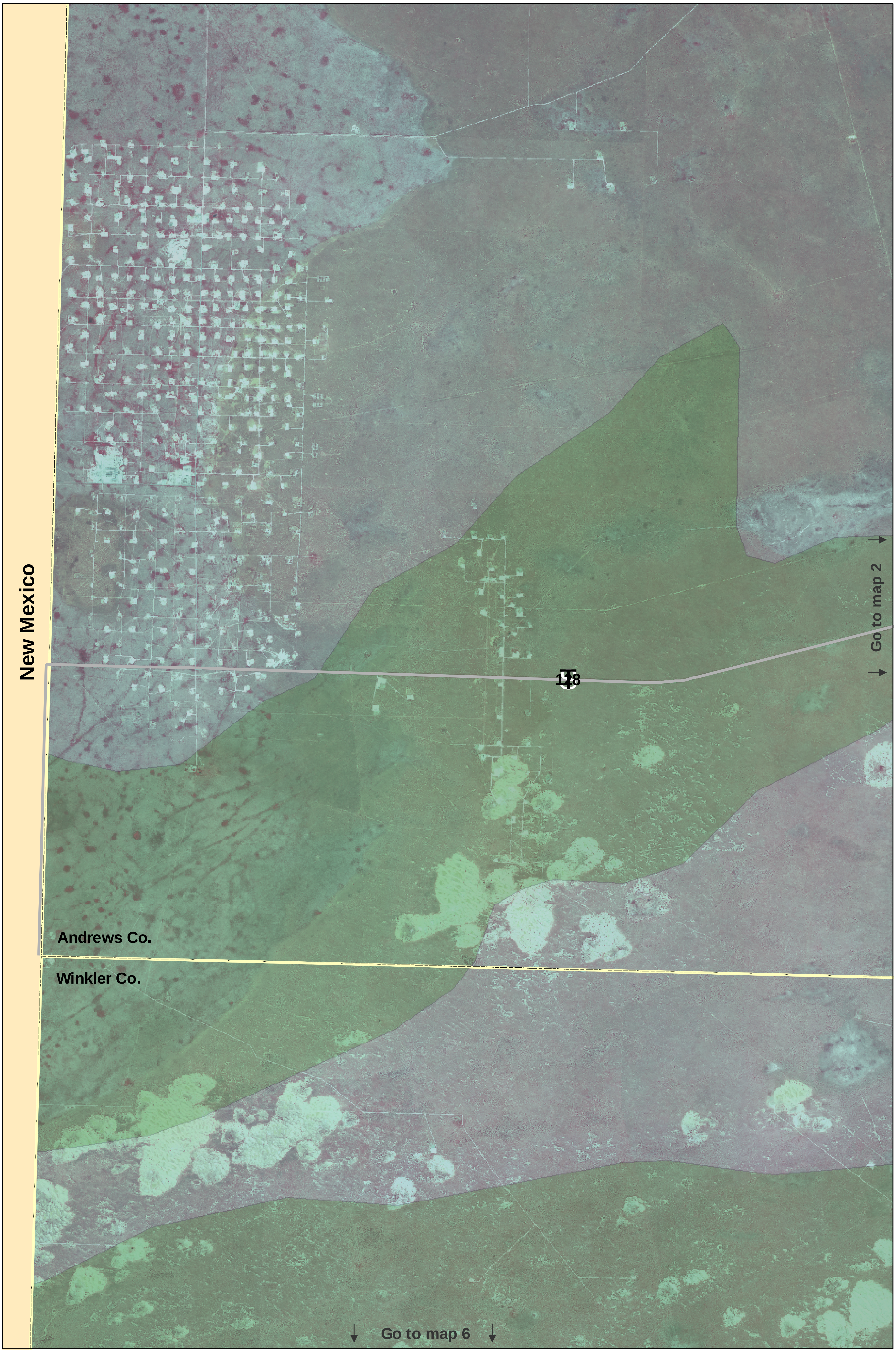
Appendix 1: Atlas of potential habitat for *Sceloporus arenicolus* in Texas

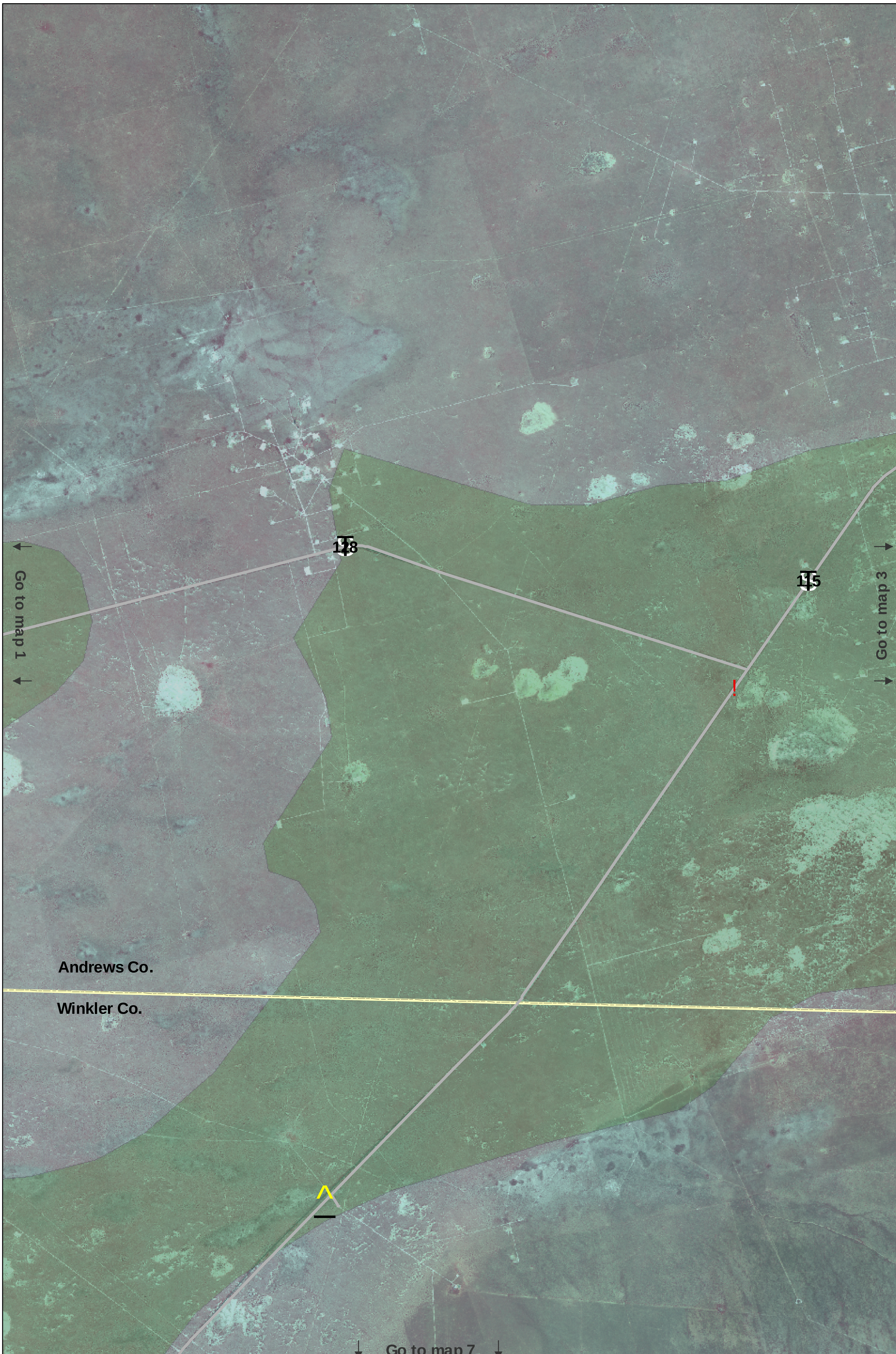
Grid numbers refer to detailed map pages





Map 1

0 0.5 1 2 Miles



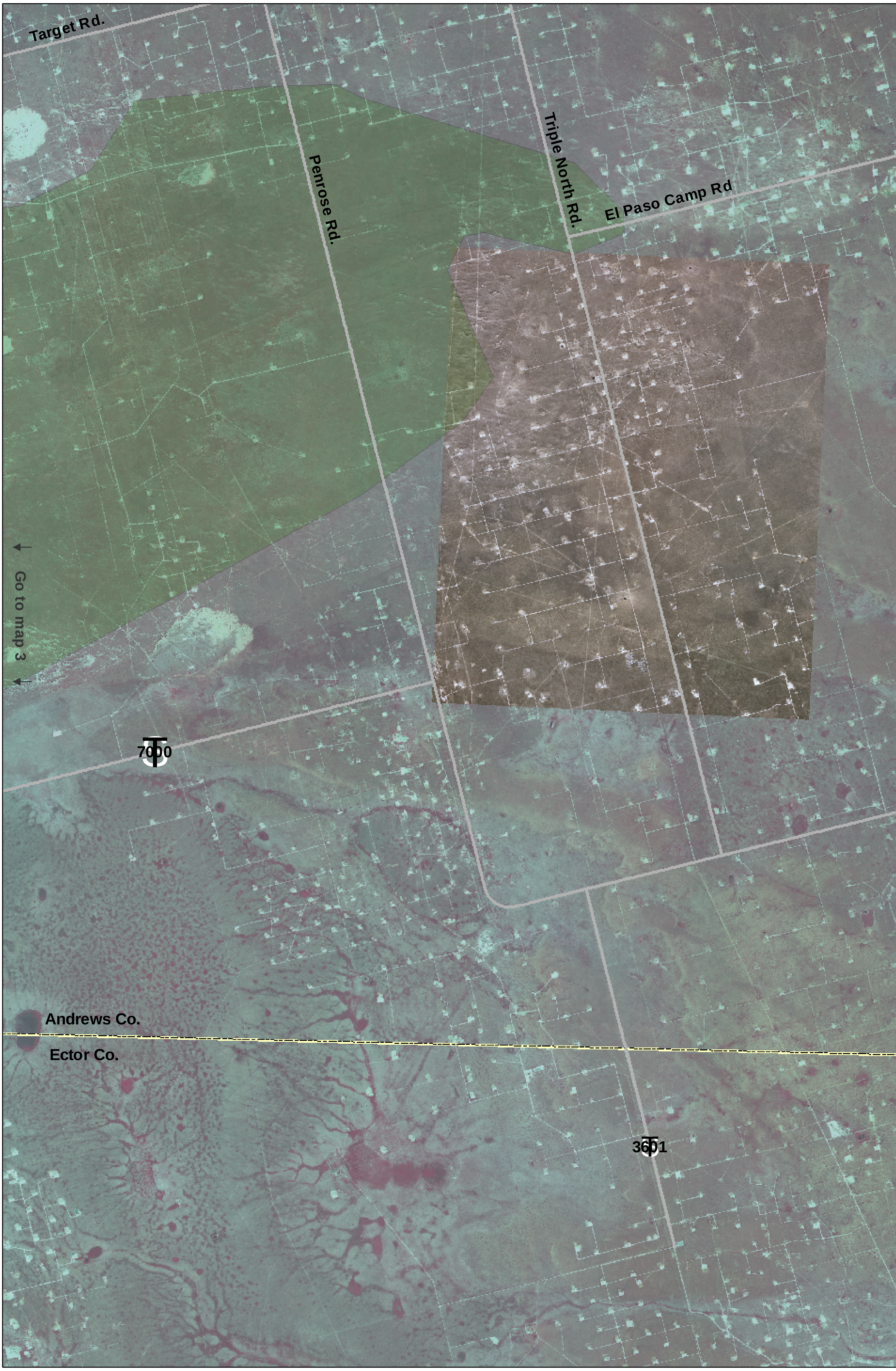
Map 2

0 0.5 1 2 Miles

Map 3

0 0.5 1 2 Miles

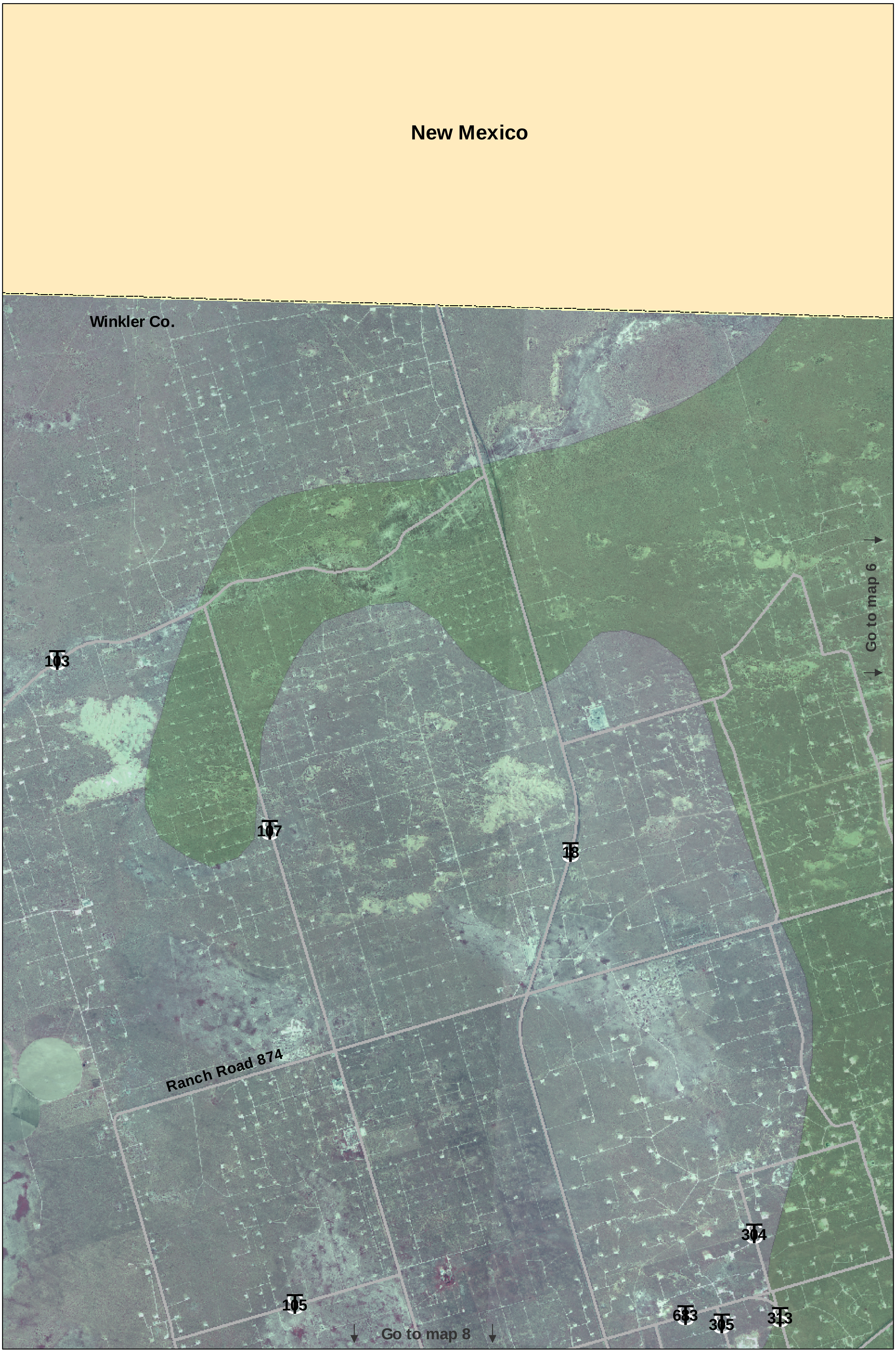
Note: The different colored photo in the southwest is from a DOQQ taken from 1994-1997.



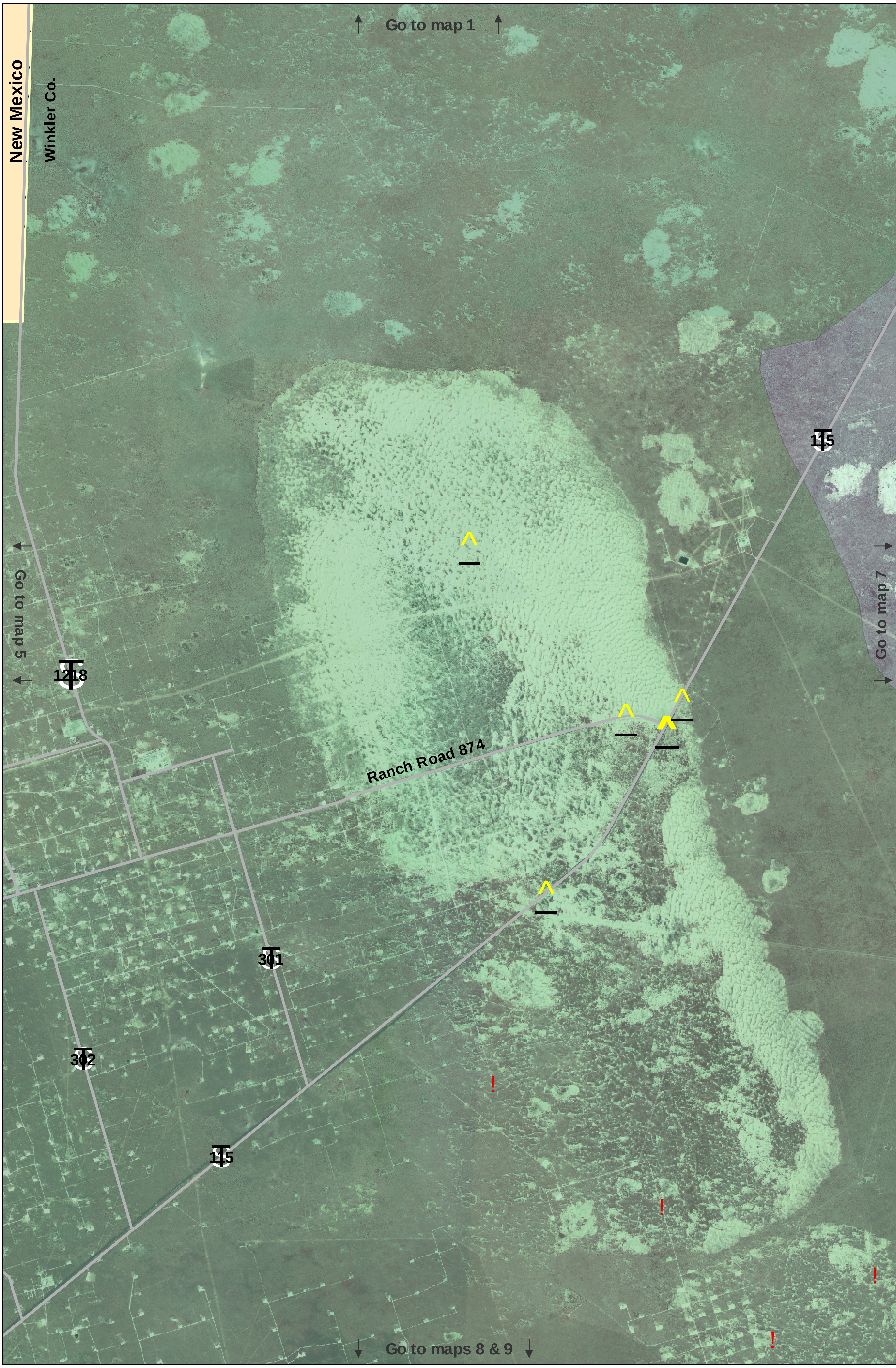
Map 4

0 0.5 1 2 Miles

Note: The different colored photo in the center of the map is from a DOQQ taken from 1994-1997.

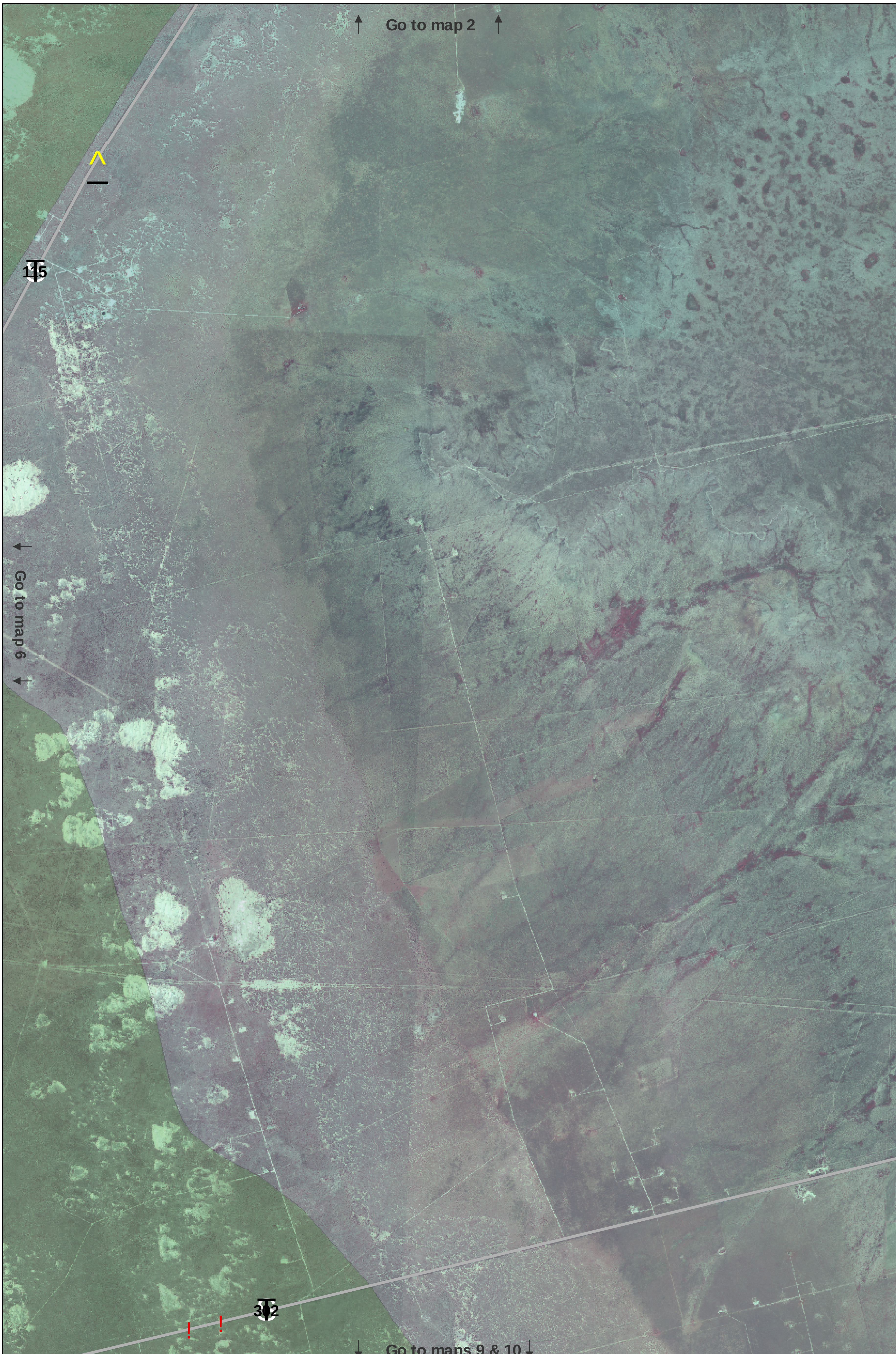

New Mexico
Winkler Co.
Go to map 6
103
107
18
Ranch Road 874
304
105
683
305
313
Go to map 8
0
0.5
1
2
Miles

Map 5



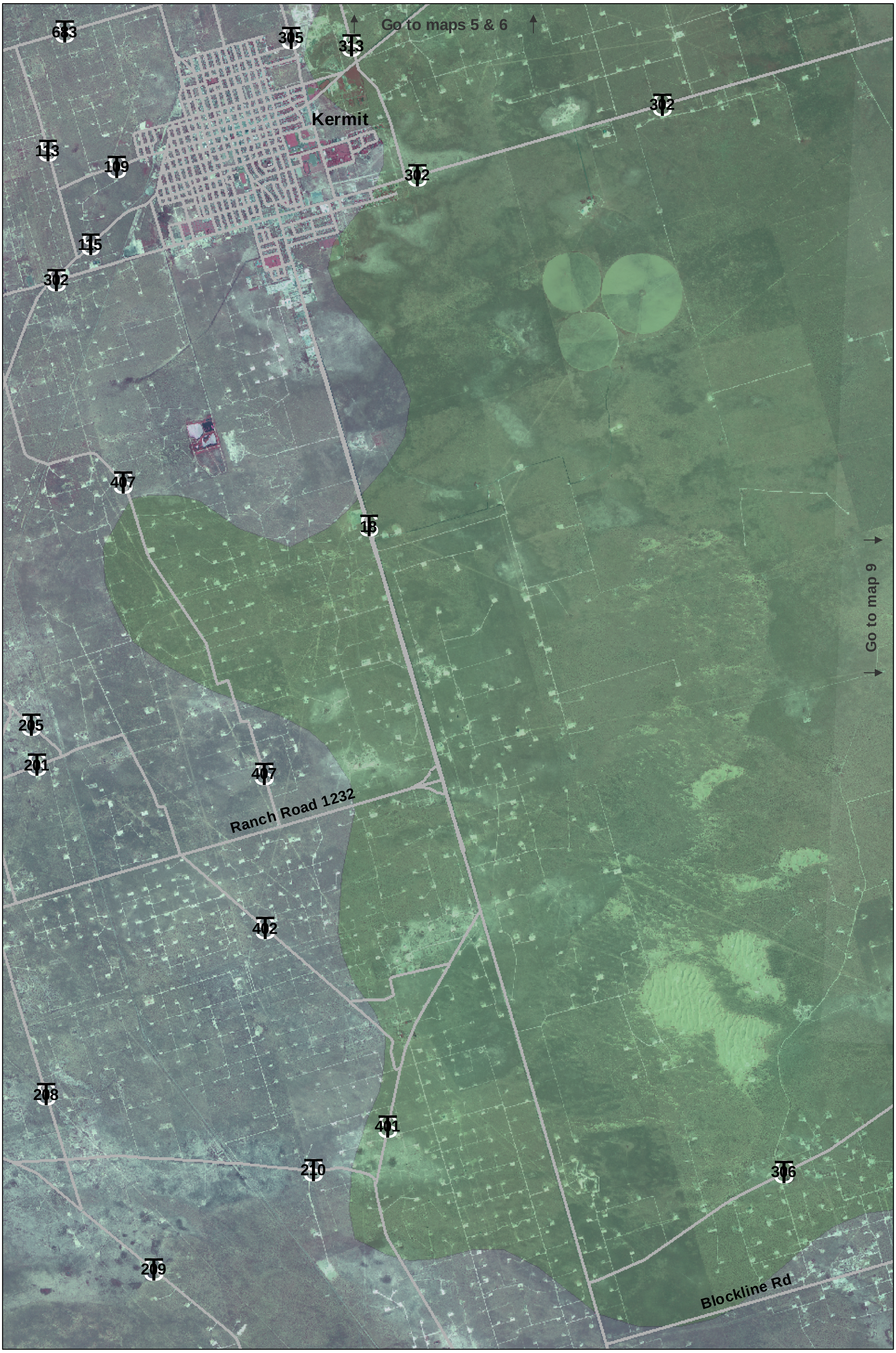
Map 6

0 0.5 1 2 Miles



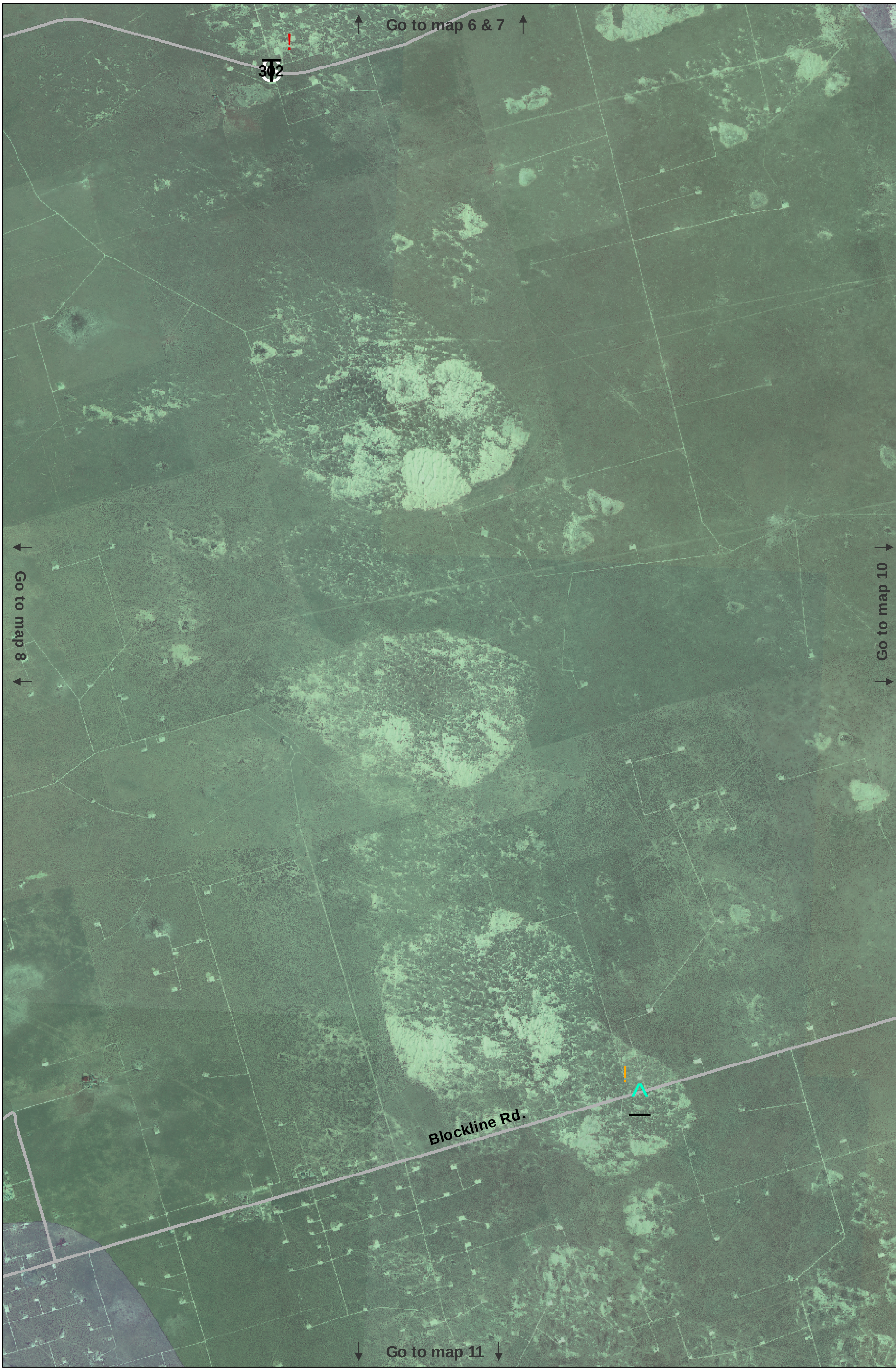
Map 7

0 0.5 1 2 Miles



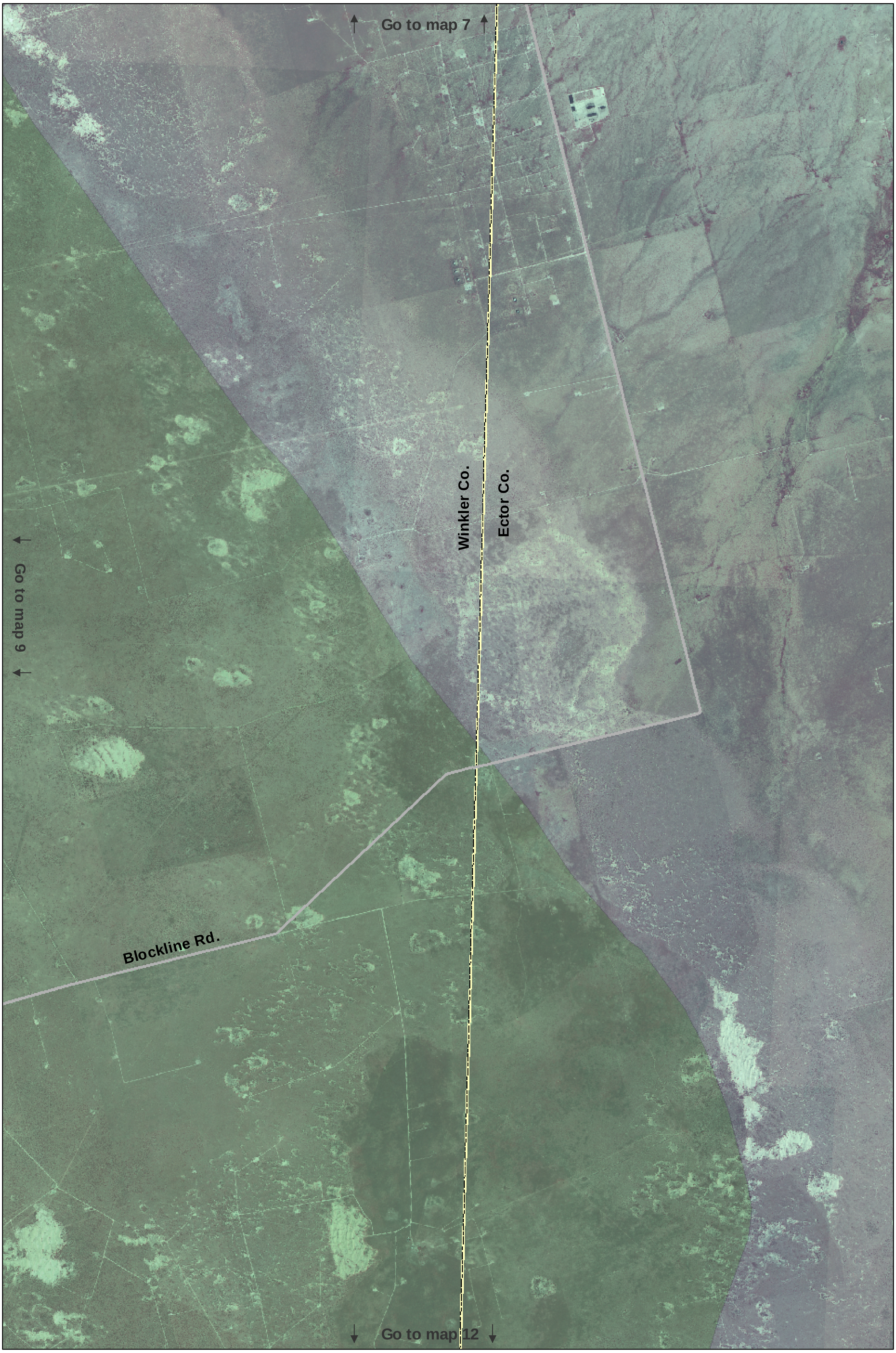
Map 8

0 0.5 1 2 Miles



Map 9

0 0.5 1 2 Miles



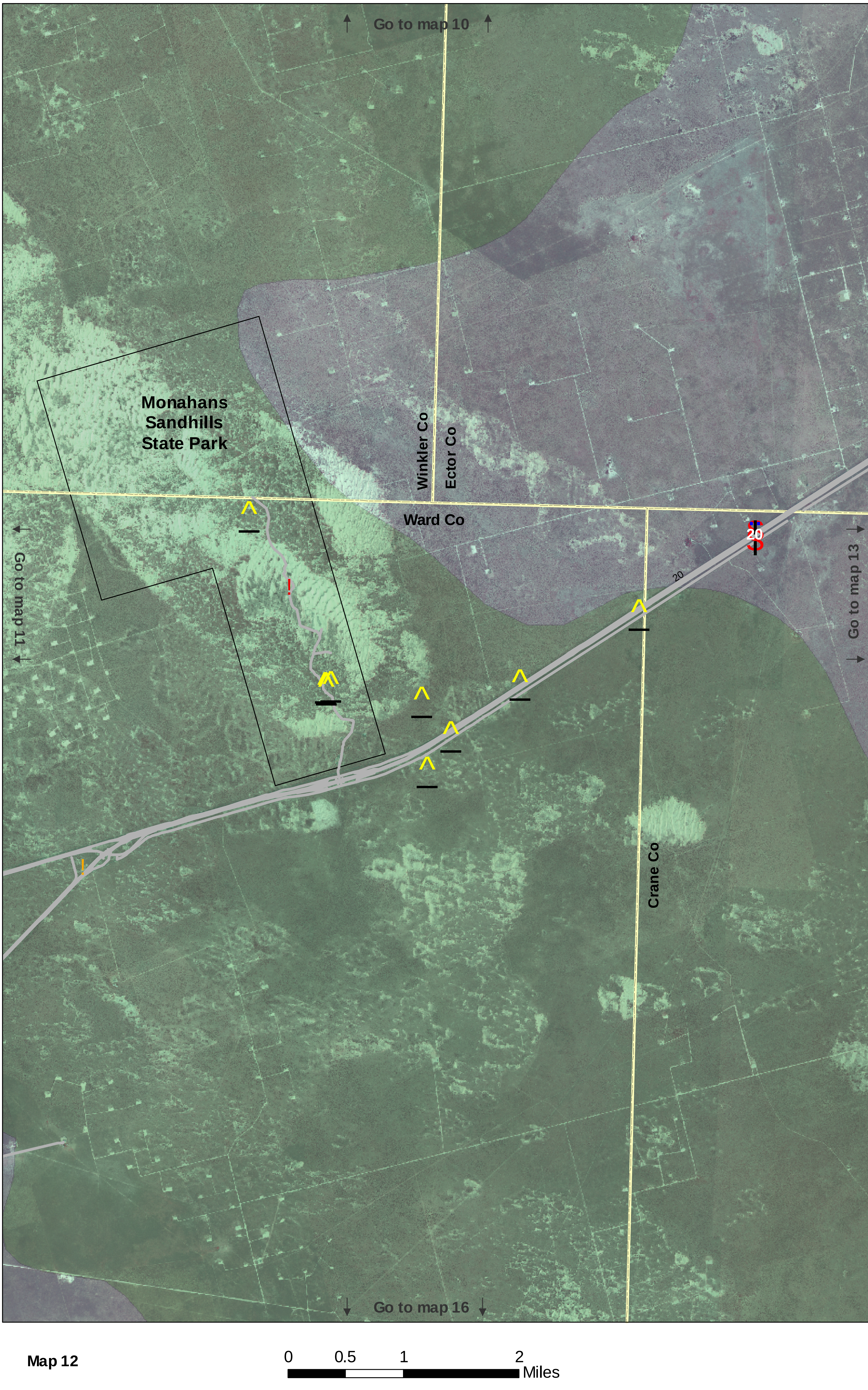
Go to map 7
Winkler Co.
Ector Co.
Go to map 9
Blockline Rd.
Go to map 12

Map 10

0 0.5 1 2
Miles

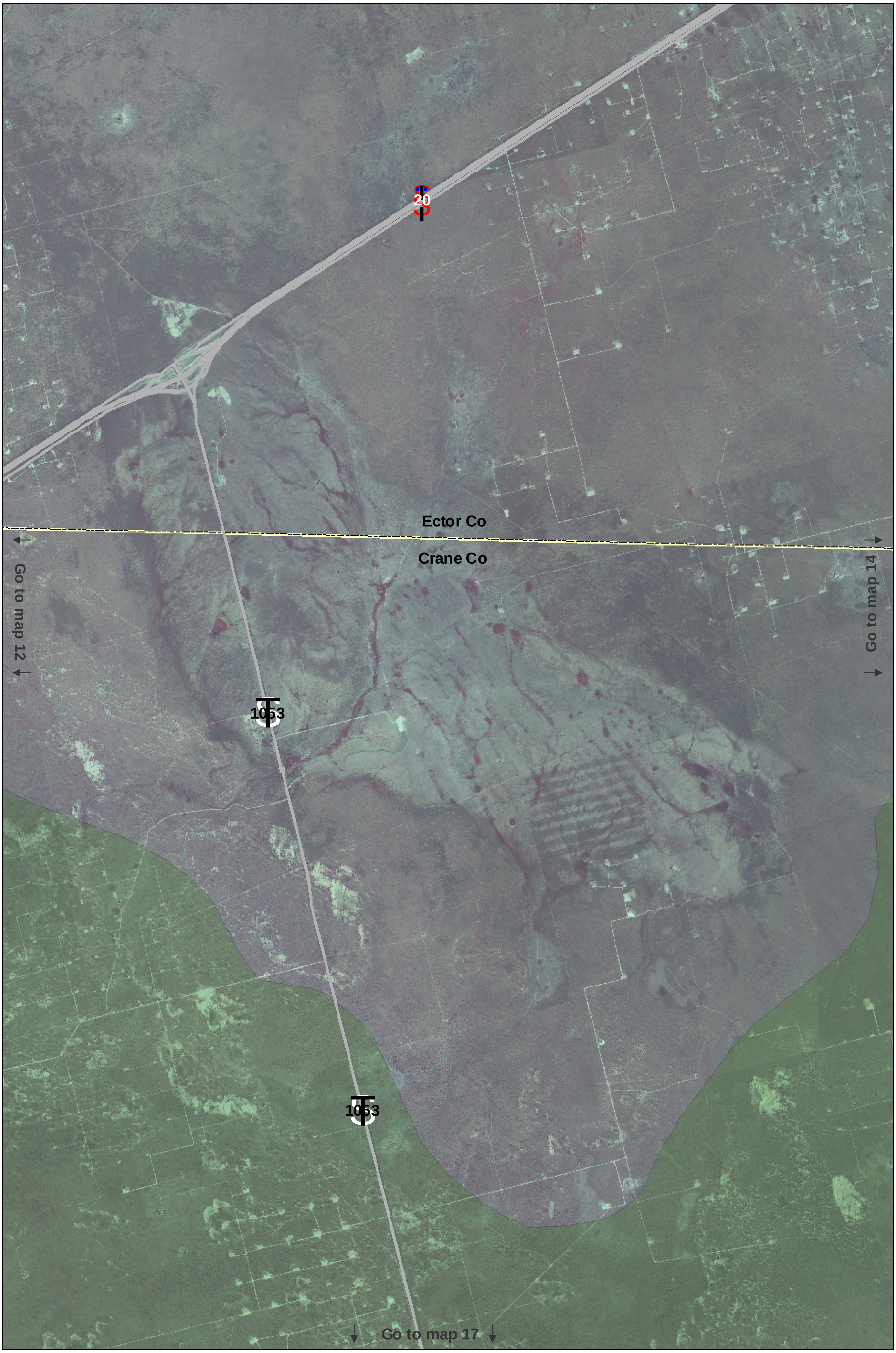
Map 11

0 0.5 1 2 Miles



Go to map 10
Monahans
Sandhills
State Park
Winkler Co
Ector Co
Ward Co
Go to map 11
Go to map 13
20
Crane Co
Go to map 16
0
0.5
1
2
Miles

Map 12



Map 13

0 0.45 0.9 1.8
Miles

Map 14

0 0.5 1 2
Miles

Map 15

0 0.45 0.9 1.8 Miles

Map 16

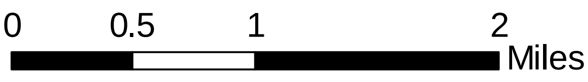
0 0.5 1 2 Miles


Go to map 13
1053
1233
Go to map 16
Go to map 18
Exxon Loop
Pennzoil Loop
Jim Tubbs Rd.
Barnsley Loop
0
0.5
1
2
Miles

Map 17

Go to map 14
1601
1233
Go to map 17
Go to map 19
329
Barnsley Loop

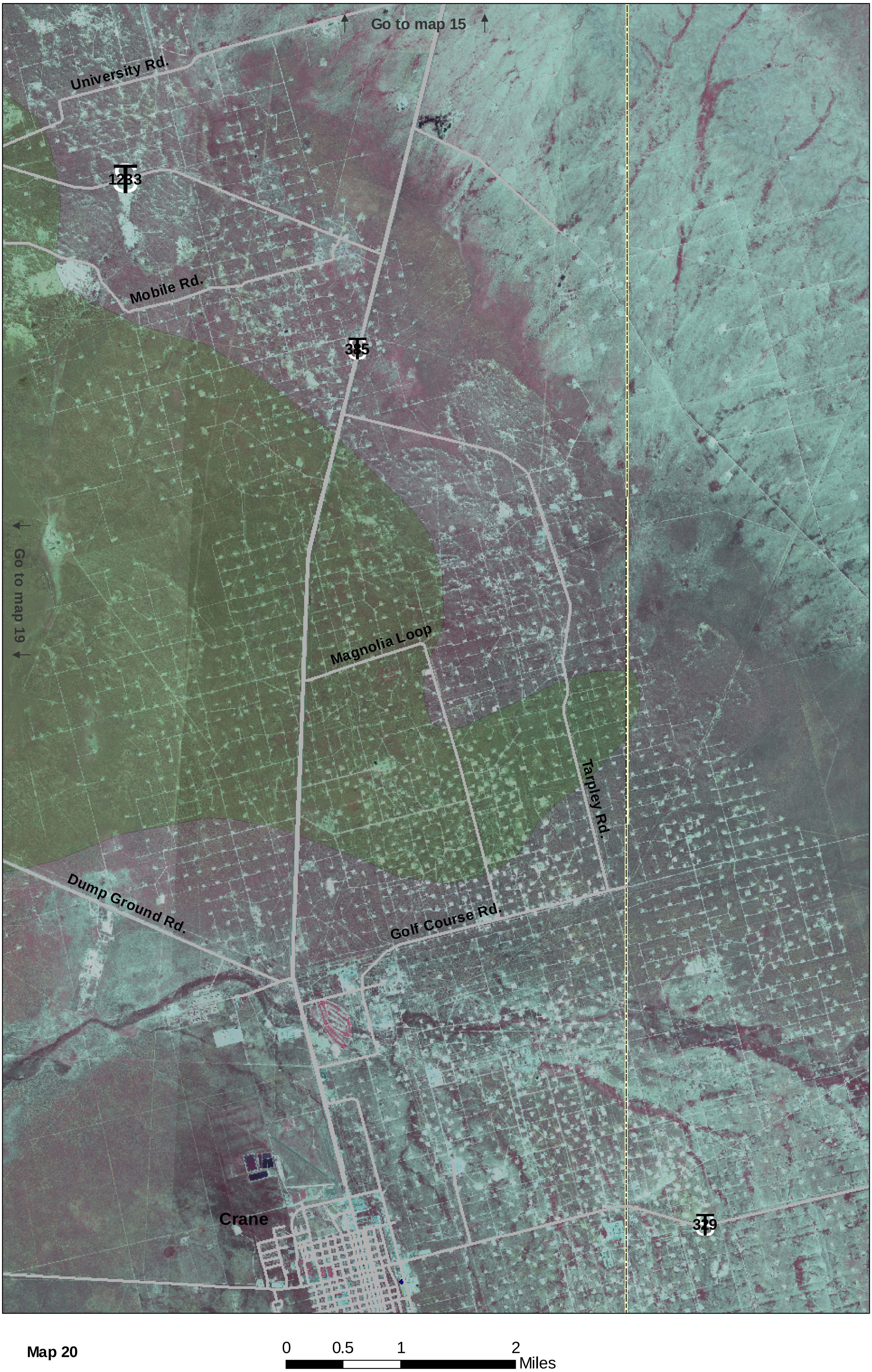
Map 18



0
0.5
1
2
Miles


Go to map 15
University Rd.
1233
Mobile Rd.
385
Tarpley Rd.
Go to map 18
Go to map 20
Arco Rd.
Dump Ground Rd.
Navajo Rd.
1601
329
Crane
0
0.5
1
2
Miles

Map 19


Go to map 15
University Rd.
1233
Mobile Rd.
385
Go to map 19
Magnolia Loop
Tarpley Rd.
Dump Ground Rd.
Golf Course Rd.
Crane
329
0
0.5
1
2
Miles

Map 20