Section 6 (Texas Traditional) Report Review

Form emailed to FWS S6 coordinator (mm/dd/yyyy): 3/26/2013

TPWD signature date on report: 3/25/2013

Project Title: Survey for the Texas kangaroo rat (Dipodomys elator)

Final or Interim Report? Final

Grant #: TX-E-131-R

Reviewer Station: Arlington ESFO

Lead station concurs with the following comments: NA (reviewer from lead station)

Interim Report (check one):

- ☐ Acceptable (no comments)
- ☐ Needs revision prior to final report (see comments below)
- ☐ Incomplete (see comments below)

Final Report (check one):

- ☒ Acceptable (no comments)
- ☐ Needs revision (see comments below)
- ☐ Incomplete (see comments below)

Comments:

FINAL PERFORMANCE REPORT

As Required by

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. TX E-131-R

Endangered and Threatened Species Conservation

Survey for the Texas Kangaroo rat (*Dipodomys elator*)

Prepared by:

Allen Nelson

Carter Smith
Executive Director

Clayton Wolf
Director, Wildlife

25 March 2013

FINAL PERFORMANCE REPORT

STATE: Texas **GRANT NUMBER:** TX E-131-R

GRANT TITLE: Survey for the Texas Kangaroo rat (*Dipodomys elator*)

REPORTING PERIOD: 1 Oct 10 to 28 Feb 13

OBJECTIVE(S):

To assess demographic data from known populations of the Texas kangaroo rat (*Dipodomys elator*) to determine their conservation status and burrow ecology over two years.

Segment Objectives:

Task 1. Travel to Wichita and Hardeman counties to establish base camps for trapping throughout the range of the Texas kangaroo rat. At a minimum, trap two weeks in December, one week in March, and three weeks in May.

Task 2. Analyze inventory data and ecological data gathered in May from active populations

Task 3. Repeat task one and two for a second year.

Task 4. Prepare reports and publications and presentations at professional meetings.

Significant Deviations:

None.

Summary Of Progress:

Please see Attachment A; GIS data files for burrow localities also attached (Excel).

Location: Hardeman, Montague, Wilbarger, and Wichita Counties, Texas.

Cost: Costs were not available at time of this report, they will be available upon completion of the Final Report and conclusion of the project.

Prepared by: Craig Farquhar **Date:** 25 March 2013

Approved by:  Date: 25 March 2013

C. Craig Farquhar

ATTACHMENT A

Status Survey for the Texas Kangaroo Rat (*Dipodomys elator*)

Prepared for

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TPWD Contract No. 403892

1 October 2011-30 February 2013
Final Report

Introduction.

The Texas Kangaroo Rat, *Dipodomys elator*, was first described as a separate species of kangaroo rat over 100 years ago (Merriam 1894). *Dipodomys elator* is unusual in that the habitat in which it is found is not typical among kangaroo rats. *Dipodomys elator* seems to prefer soils with high clay content which support overgrazed or short grasses (Dalquest & Collier 1964; Roberts & Packard 1973; Dalquest & Horner 1984; Stangl et al. 1992; Schmidly 2004; Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010) and has rarely been recorded in locations with dense vegetation. In addition, *D. elator* has a distinctive dental morphology that has led previous researchers to suggest that *D. elator* may represent a separate lineage deserving recognition at the genus level (Dalquest et al. 1992). Alternatively, based on molecular data, it and *D. philipsii* are putative sister species that comprise a unique lineage within the genus (Johnson & Selander 1971; Mantooth et al. 2000).

Historically *D. elator* was known sporadically from an approximate area of 2.7 million ha within Comanche and Cotton counties, Oklahoma and Cottle, Clay, Childress, Hardeman, Wilbarger, Archer, Baylor, Foard, Montague, Motley, Wichita, and Coryell counties, Texas. However, the single specimen collected in 1953 from Coryell County, Texas was likely misidentified (Carter et al. 1985; Jones et al. 1988; Martin 2002). The historic range of *D. elator* spanned across the convergence of two physiographic regions, the Rolling Plains to the west, and the West Cross Timbers to the east. As a result of overgrazing and control of wildfires, mesquite (*Prosopis glandulosa*), and other disturbance-related shrubs, grasses and forbs have increased in abundance across the Rolling Plains and habitat modification such as conversion of pastureland to monoculture has resulted in extensive fragmentation of Texas kangaroo rat habitat (Diamond & Shaw 1990). From 1996-2000, Martin (2002) surveyed the historic range of *D. elator* and found this species in only five counties in Texas: Archer, Childress, Hardeman, Motley, and Wichita, a combined area of 1,025,868 ha. He did not find *D. elator* in Oklahoma (Martin 2002). This concurs with other researchers who have been unable to locate any populations of *D. elator* in Oklahoma (Jones et al. 1988; Moss & Mehlhop-Cifelli 1990).

The apparent decline in *D. elator* has led to the International Union for Conservation of Nature (IUCN) listing *D. elator* as vulnerable on their Red List of Threatened Species in 1996. The IUCN cited habitat degradation and loss resulting from expanding agricultural and infrastructural development as the major threats to the continued existence of this species (Hafner 1996). Federally, *D. elator* was listed as a Category 2 candidate species under the Endangered Species Act of 1973 (Martin 2002). Category 2 candidates were formerly considered species of concern for the United States Fish and Wildlife Service (USFWS), and endangered or threatened status was possibly warranted. However, insufficient data existed to justify an elevated listing (USFWS 1996). In Texas, *D. elator* is listed as a threatened species by the Texas Parks and Wildlife Department (TPWD) (Martin 2002; Schmidly 2004). Reasons for *D. elator* being listed as a threatened species by the TPWD are based on scarcity of this species and the small geographic range from which it is known (Stangl & Schafer 1990). Most recently, WildEarth Guardians petitioned USFWS to federally list the Texas kangaroo rat (WildEarth Guardians 2010) and the USFWS responded with a 90-day finding that concluded the petition presents substantial scientific information indicating that listing the Texas kangaroo rat throughout its entire range may be warranted (USFWS 2011). This finding was based on the present or threatened destruction,

modification, or curtailment of the Texas kangaroo rat's habitat or range, and the inadequacy of existing regulatory mechanisms (USFWS 2011). Specifically, they found that the loss of burrowing habitat and genetic isolation of populations due to the conversion of native rangeland to agricultural cropland, and the inadequacy of existing regulatory mechanisms to protect against such land conversion, may pose a threat to the Texas kangaroo rat throughout all or a significant portion of its range (USFWS 2011). Now USFWS is required to gather data for one year and then make a determination regarding the status of the Texas kangaroo rat.

Whereas a relatively large number of studies have examined aspects of ecology (Dalquest & Collier 1964; Roberts & Packard 1973; Stangl & Schafer 1990; Jones et al. 1988; Diamond & Shaw 1990; Moss & Mehlhop-Cifelli 1990; Stangl et al. 1992; Martin 2002; Stasey 2005; Goetze et al. 2007; Goetze et al. 2008; Nelson et al. 2009; Stasey et al. 2010) and systematics (Merriam 1894; Johnson & Selander 1971; Hamilton et al. 1987; Dalquest et al. 1992; Mantooth et al. 2000), there have been no published investigations that examined historical populations using a combination of trapping and current ecological knowledge of burrows (Goetze et al. 2007; Nelson et al 2009; Stasey et al. 2010) to determine population numbers and size so that conservation status can be assessed. In an unpublished report, Martin (2002) provides evidence from driving surveys but, based on our work in Wichita County using burrow trapping methods, these estimates are inaccurate (Goetze et al. 2007; Nelson et al. 2009). However, Martin (2002) did create a database of historical localities for Texas kangaroo rats that needs to be examined to assess how many populations persist. Therefore, we used Martin's (2002) database of coordinates for historical populations as a guide to assess sites and inventory active Texas kangaroo rat populations. Using burrow trapping techniques over a two year period, we estimated numbers from as many of these populations as possible. In addition to conducting a status survey at localities from throughout much of the range of the Texas kangaroo rat, we collected vegetation data from all burrow sites from which Texas kangaroo rats were captured.

Methods.

In general, the following methods were used. In the burrow ecology of Wichita County and the Copper Breaks State Park sections of the report, more specific details are included. At sites reported by Martin (2002), that are accessible (roadsides, private land where we could secure permission, or state parks, for example), we surveyed the study site for burrows of the Texas kangaroo rat by walking over the area where historical sightings occurred. Burrows possibly belonging to *D. elator* were identified based on diameter and orientation of entrance/exit hole (see Fig. 3 in Stangl et al. 1992). Distinct trails and dust-bathing areas often lead away from these burrows and these runways sometimes connect to other distant burrows (Goetze et al. 2007, 2008). The specific location of each burrow was recorded in decimal degrees using a Garmin GPS-12 unit. A geo-referenced base map was produced with a *Manifold* 5.0 (Manifold System Ltd, 2003) GIS system using a digital orthophoto quadrangle obtained from *IntraSearch*, Denver, Colorado (Figures 1 and 2).

Trapping to test for burrow residence were conducted by placing three Sherman Live Traps within 0.10 to 0.50 m of each burrow entrance, with the open end of each trap facing the entrance (Cross & Waser 2000). If no burrows were present, traps were placed at coordinates from Martin (2002). Traps were baited with dry oatmeal each evening and checked each morning. Some animals were marked with hair dye (Maher 2004) so that recapture rates could be determined.

When possible, animals were marked and sexed. We lost two animals while handling them during trapping periods that coincided with extreme temperatures and decided to simply catch and release during excessively hot sampling periods.

Once active burrows were located, vegetation was sampled during May to allow direct comparisons of this investigation to previous ecological studies (Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010). A 1-m^2 quadrat was placed directly over burrows where *D. elator* was captured. Within each quadrat, vegetative richness was recorded as total number of species present. Percentage coverage of grass, forbs, bare ground, woody vegetation, and rocks or stumps within each quadrat was recorded, as was average herbaceous vegetation height (obtained by averaging the height of the herbaceous vegetation 15 cm interior to each corner of the quadrat). If woody vegetation was present, the height of its lowest branch was also recorded. Specimens of the dominant herbaceous and woody plants were collected and placed in a plant press. These vegetation vouchers were deposited in the herbarium of Tarleton State University (TAC).

Burrows were also classified according to their association in the landscape. Categories included: brush piles, fence row, honey mesquite, lotebush, mowed roadside, oil field pipe, oil storage tank berm, old oil field pump-jack pad, pond dam, prairie mound, and rail crosstie.

Averages, ranges, and standard deviations for burrow data as well as comparisons between years were calculated in Microsoft Excel. Comparisons between years were made using SigmaPlot 12 to calculate a Mann-Whitney Rank Sum Test.

Mark-Recapture data was used to estimate population sizes of the Texas kangaroo rat. We used the Lincoln-Peterson method and the following formula: $N = M (n + 1)/ R + 1$. In the formula, N is the estimated population number, M the number of individuals marked, n the sample of individuals taken after marking, and R the recaptured individuals (Brower et al. 1998).

Results & Discussion.

Survey of sites

We trapped a total of 15,530 trapnights for the sites surveyed (Appendix 1). There were 3901 trapnights for surveys in areas not reported by Martin (2002) and 11,629 in those surveyed by Martin (2002). No Texas kangaroo rats were caught at the sites reported by Martin (2002). Of the 48 sites surveyed by Martin (2002), 33 were trapped for a minimum of 10 trapnights (Appendix 1). Fifteen sites were not trapped because they occurred on private property or were poor habitat. At all the sites not trapped, there was no burrow activity and if there was bare ground available it was often due to plowing or road work. Over one-half (eight) of the sites that were not trapped were cultivated fields. These were often plowed to the roadside and had little to no vegetation. Three of the sites were on private property where we could not get within 0.3 mile of the Martin (2002) trapping locality. Two were behind locked gates and one was in the middle of an irrigated wheat field. Two sites were homesites and two were in areas where roadsides had high berms and had poor quality habitat with dense introduced grasses like Johnsongrass and Japanese brome.

Of the 33 sites that were trapped, no Texas kangaroo rats were caught. Six of these sites were located within the boundaries of Copper Breaks State Park in Hardeman County. Because this property is managed by Texas Parks and Wildlife Department (TPWD), we allotted a large proportion of trapnights to the park. In general, park vegetation was too dense and tall to support Texas kangaroo rats. Poor habitat in the park has been noted by others (Martin 2002; Best & Wahl 1985). The park habitat has declined due to lack of grazing and fire as well as mesquite and

juniper invasion. In the last several years, part of the Texas state longhorn herd has been pastured in the front part (near the entrance) of the park. Grazing and other disturbance by the longhorns has created habitat similar to that from sites where we have gathered ecological data on 54 active Texas kangaroo rat burrows in Wichita and Hardeman counties. Martin (2002) recommended the grassland at the entrance to the park for active management to reduce cover and create areas for Texas kangaroo rats to re-establish burrows within the park. We trapped in the area where longhorns grazed and did not catch any Texas kangaroo rats. However, the habitat was similar to that where we have caught them in Wichita County.

Of the 27 sites not in Copper Breaks State Park, 15 had 20% or less bare ground at the trap sites. This is a low amount of bare ground when compared to that found at burrows of 54 Texas kangaroo rats that we have captured and likely was a factor in our not catching Texas kangaroo rats at these sites. Two sites were at areas with active road grading and root plowing of adjacent mesquite pasture. These two sites had 90-100% bare ground and were likely disturbed too much for Texas kangaroo rats. The other 10 sites had similar amounts of bare ground and had habitats similar to those where we have caught Texas kangaroo rats. These included six sites in Hardeman County with two along Hamby Road near Quanah, Texas and four along Copper Breaks Road on the north side of Copper Breaks State Park. Three sites were in Childress County along County Road 24 and one was in Wichita County at North Fork Buffalo Creek Reservoir (NFBCR). These 10 sites as well as the seven new sites that we report (Appendix 1.) were the focus of the second year of trapping effort. Because six localities from Martin (2002) were near NFBCR and the property is owned by the City of Iowa Park, which could have potential as a management site for Texas kangaroo rats, we trapped around the reservoir for 6135 trapnights (Appendix 1, site 11). We caught no Texas kangaroo rats at NFBCR, however site "C" (Figure 1), which has a population of Texas kangaroo rats is near the reservoir property.

Based on the data gathered during this part of the investigation, Martin (2002) sites have likely changed over time and today may no longer provide suitable habitat for the Texas kangaroo rat. However, additional studies on private property near these areas should be conducted. NFBCR could serve as a possible site for reintroduction if the habitat were managed properly perhaps through a partnership formed with the City of Iowa Park.

Burrow Ecology for 54 Texas kangaroo rat burrows

Since 2005, we have caught 113 *Dipodomys elator* (71 individuals) from five locations and characterized the vegetative ecology of 54 burrows regarding vegetative ecology. Most of the burrows occurred near shrubs (37.3%) including honey mesquite (32.6%) and lotebush (4.7%; Table 1). Honey mesquite has been widely reported at burrow sites of Texas kangaroo rats whereas lotebush is rarer due to its more limited presence in the community. The shrubs accumulate soils at their base and the soil is used for burrow construction. As mesquite becomes larger and mature, its shade may change the vegetation composition sometimes favoring introduced grasses like Japanese brome, which grows densely and changes the habitat so that it is more suitable for other types of small mammals (Nelson et al. 2009). Prairie mounds were associated with burrows 14.0% of the time. Prairie mounds are slightly raised areas in grasslands (Diggs et al. 1999; Goetze et al. 2007) that are likely caused by swelling and shrinkage of clay soils or differential erosion. These raised areas are used by Texas kangaroo rats for burrow construction. Shrubs and prairie mounds comprise over one-half of the burrow characterizations

and may be natural components of the grassland ecosystem if one allows for cattle grazing to replace bison and for increases in shrub density due to lack of fire and overgrazing. The other burrow categorizations comprise slightly less than one-half of the burrow associations and include environments modified by man mainly due to fencing, clearing of brush, and oil field activities. To a lesser degree, road and reservoir construction have provided opportunistic habitats for Texas kangaroo rats.

Brush piles and fence rows comprise 20.9% of Texas kangaroo rat burrow characterizations (Table 1). Brush piles (11.6%) where Texas kangaroo rats have been found are about 30 years old and have never been burned. The wood has rotted and captured loose soil that forms a dome about 0.25 m in height. This provides raised, loose soil for burrow construction. Fence rows (9.3%) that are relatively old often collect a berm of soil around posts that is used for burrow construction. Abandoned cross ties, used for fencing or oil pad construction in grasslands, have been associated with burrows 7.0% of the time. Oil field pipe (2.3%), old pump-jack pads (9.3%), and oil storage tank berm (2.3%) associations indicate that oil field activity can provide opportunistic habitat for Texas kangaroo rats. Pond dams (2.3%) and mowed roadsides (4.7%) also have been used opportunistically by Texas kangaroo rats. Mowed roadsides can provide berms for burrow construction and mowing helps prevent tall, dense vegetation from becoming established. The single pond dam that contained a Texas kangaroo rat burrow was at a small man-made reservoir built to provide water for livestock. The dam had been breached by water from a heavy rainfall event and provided high, relatively loose soil for burrow construction.

The percentage of forbs for the burrows ranged from 0-67 with a mean of 17, percentage grass ranged from 1-60 with a mean of 23, and the percentage of woody vegetation ranged from 0-60 with a mean of 9.3 (Table 1). Bare ground ranged from 0-94% with a mean value of 46% (Table 1) and other materials found at burrows (for example rocks, stumps, oil field metal such as pipes and pump-jack counterweights as well as dead, woody vegetation) ranged from 0-38% with a mean of 5.1% (Table 2). Herbaceous vegetation height ranged from 0-53 cm. with a mean of 14 cm. and the lowest branch of woody vegetation present ranged from 0-121 cm. above the ground with a mean of 15 cm. (Table 2). Plant richness ranged from 1-12 with a mean of six (Table 3). Little barley was the most common dominant grass, Virginia peppergrass the most common dominant forb, and honey mesquite the most common dominant shrub (Table 3). Whorled dropseed, common broomweed, and lotebush were the second most dominant vegetation types (Table 3).

In conclusion, Texas kangaroo rats seem to prefer shrubs, prairie mounds, or anthropogenic disturbances that create loose mounds of soil for burrow construction. Burrow vegetation has about equal proportions of forbs and grasses with the most common being Virginia peppergrass and little barley. Honey mesquite is the most dominant shrub associated with the burrows, but is also extremely common due to its invasion of the ecosystem. It also appears that bare ground is important to *D. elator* to facilitate dust bathing and burrow construction.

Population Estimates in Wichita County

We have population estimates from four locations in Wichita County, Texas (Figure 1; Table 4). All populations were estimated at one or two in 2011. In two previous estimates (2005 and 2008) from two localities we no longer have the landowner's permission to continue trapping, population estimates were about the same (two), slightly higher (three to four) or higher (eight).

There had been a prolonged drought and higher than normal temperatures at all four locations in 2011, when our estimated population sizes were one or two animals. In 2012, we only had landowner permission to trap in two of the localities that were surveyed in 2011. Both these sites had higher numbers of Texas kangaroo rats in 2012 (three and 18). Future investigations are needed to examine burrow dynamics and obtain population estimates over longer periods of time.

If one combines the data from 54 burrows obtained in 2005, 2007, and 2008 and compares it to 2011 (Table 5), there are significant differences in percentage of forbs and bare ground with fewer forbs and more bare ground in 2011. Richness and herbaceous plant height were also significantly less in 2011. These changes in vegetation are likely related to hotter temperatures and less rain in 2011 when compared to previous years. In 2011, Wichita Falls had the most 100 degree temperatures in a calendar year (100 compared to 79 in 1980) and the second driest Spring and Summer as well as the fourth driest Winter on record (4.04 inches for that nine month period). Fewer forbs resulting in less richness as well as shorter height and more bare ground during 2011 may have resulted in lower populations of the Texas kangaroo rat. Prior to 2011, Texas kangaroo rats were hypothesized to prefer shorter vegetation with bare ground for burrow construction and dust-bathing (Goetze et al. 2007; Nelson et al 2009; Stasey et al. 2010). However the drought conditions in 2011, may have caused lower richness, fewer forbs, shorter vegetation, and more bare ground than is preferred by Texas kangaroo rats, which resulted in a population decline. Alternatively, excessive heat and dryness might have caused the animals to estivate. To date, vegetation data is limited and long term population dynamics are virtually unknown for this rare species.

In addition, although we did not catch any Texas kangaroo rats at the Martin (2002) sites, we want to emphasize that there are large amounts of potential habitat on private land that likely contain Texas kangaroo rats. We know of three instances in Wichita County where we have caught Texas kangaroo rats on private lands but the landowners would not give us permission to report the data. Similarly, we attempted to obtain permission from landowners that had allowed Martin (2002) to trap on their property, but ownership had changed and the new landowners declined permission.

Also, all the Martin (2002) sites, with the exception of those located in Copper Breaks State Park, are along roadsides. Trapping along roadsides may be problematic because Texas kangaroo rats may rarely move out of pasturelands onto roadsides. In 2011, to examine how trapping along a roadside near a known population within a pastureland affects capture rates, we trapped 250 trap nights along a roadside that is within 400 meters of a site where we caught Texas kangaroo rats (population estimate of two and three, respectively, in 2011 and 2012) and another 150 trap nights at a roadside where a Texas kangaroo rat was salvaged in 2011. In 2012, we were unable to trap on two private properties because of a change in ownership, so we trapped on their northern boundaries along the county road for 250 trap nights at each site. We caught one *Peromyscus leucopus* along the roadside and no *Dipodomys elator*. The most recent population estimates within these properties for Texas kangaroo rats was two at each site. These estimates were from 2011 when it was extremely dry and hot. In 2005, one of these localities had an estimate of four Texas kangaroo rats and in 2008 the other property had an estimate of 14. We obtained landowner permission to walk over the sites in 2012 and it appeared that the higher estimates (four and 14; Table 4) would be more accurate due to the number of burrows and dust bathing sites observed. At another site, we trapped 375 trapnights along a highway on the west side of the property and 375 trapnights within the property. We caught one Texas kangaroo rat along the highway,

adjacent to the property. Population estimates within the property were two in 2011, which was extremely dry and hot, but 18 in 2012, which was wetter and had more typical temperatures. These experiments were done to investigate whether the rats would leave the pastures and be caught along roadsides and are important because most of the Martin sites (2002) are localities along roadsides. For the combined 1650 trapnights that we conducted the experiments, only one Texas kangaroo rat was captured along roadsides. It appears that even if Texas kangaroo rats are near roads, they often stay within the interiors of the pasturelands where their burrows occur. Therefore it may be critical to have access to interiors of pasturelands and not depend on roadside sightings or trapping to accurately survey the animals. For instance, Martin (2002) reported only two Texas kangaroo rats from Wichita County after extensive night driving surveys. The four populations of 71 individuals that we report likely existed at the time of his night driving surveys as well as additional populations on other private land.

Burrow ecology of Texas kangaroo rats in Wichita County

The goals of this part of our investigation are to quantify vegetative characteristics of burrows in Wichita County and compare this data to that reported for *D. elator* burrows from Motley County (Martin & Matocha 1989) as well as those from line transects (Martin 2002) and two quadrats in Hardeman County.

Forty-six burrows were identified from Wichita County from four different localities (Figure 1). Trapping to test for burrow occupancy was conducted by placing three 7.5 x 8.8 x 30 cm Sherman Live Traps within 0.10 to 0.50 m of each burrow entrance, with the open end of each trap facing the entrance (Cross & Waser 2000).

Burrows were also classified according to their association in the landscape. Categories included: brush piles, fence row, honey mesquite, lotebush, mowed roadside, oil field pipe, oil storage tank berm, old oil field pump-jack pad, pond dam, prairie mound, and railroad crosstie (used for fencing material by the landowners).

Beginning in 2005 and continuing to 2012, we characterized the vegetation associated with 46 Texas kangaroo rat burrows from four locations in Wichita County and two burrows from a single location in Hardeman County. The two most common burrow associations were honey mesquite (30%) and fence rows (24%; Table 6). Most of the burrows occurred near shrubs (32%) including honey mesquite (32%) and lotebush (2.0%; Table 6). Prairie mounds were associated with burrows 9.0% of the time. Brush piles comprise 11% of Texas kangaroo rat burrow associations (Table 6). Abandoned crossties in grassland used for fencing or oil pad construction have been associated with burrows 7.0% of the time along with oil field pipe (2.0%), old pump-jack pads (11%), and oil storage tank berms (2.0%). Pond dams (2.0%) also have been used opportunistically by Texas kangaroo rats.

The percentage of forbs for the burrows ranged from 0-67 with a mean of 18, percentage grass ranged from 1.0-55 with a mean of 22.8, and the percentage of woody vegetation ranged from 0-60 with a mean of 18.6 (Table 6). Bare ground ranged from 0-94% with a mean value of 44% (Table 1) and other materials found at burrows (for example rocks, stumps, oil field metal such as pipes and pump-jack counterweights as well as dead woody vegetation) ranged from 0-30% with a mean of 5.5% (Table 7). Herbaceous vegetation height ranged from 0-59 cm. with a mean of 14 cm. and the lowest branch of woody vegetation present ranged from 0-121 cm. above the ground with a mean of 16 cm. (Table 7). Plant richness ranged from 1-12 with a mean of six

(Table 8). The most common dominants were little barley, Virginia pepper-grass, and honey mesquite (Table 8). Next in vegetation dominance were whorled dropseed, common broomweed, and lotebush (Table 8). Herbaceous heights at burrows ranged from 0-59 cm with a mean of 14 cm. Woody vegetation heights at burrows ranged from 0-121 cm with a mean of 16 cm.

The two active Hardeman County burrows were both associated with mowed roadside (Table 9). They both had 15% forbs, from 5-30% grass, no woody vegetation, and 55-80% bare ground. There were no other materials associated with the burrows. Richness was 7-10 with sleepy daisy as dominant forb and purple threeawn the dominant grass. Herbaceous vegetation height ranged from 4.6 -14 cm with a mean of 9.1 cm.

Burrow Associations and Dominant Vegetation

Honey mesquite has been widely reported at burrow sites of Texas kangaroo rats whereas lotebush is rarer due to its more limited presence in the community (Goetze et al. 2007). The shrubs, which account for 32% of burrow associations, accumulate soils at their base that are used for burrow construction. As mesquite becomes larger and mature, its shade may change the vegetation composition sometimes favoring introduced grasses like Japanese brome, which grows densely and changes the habitat to favor other types of small mammals (Nelson et al. 2009). In Wichita County, prairie mounds were associated with burrows 9.0% of the time. Prairie mounds are slightly raised areas in grasslands (Diggs et al. 1999; Goetze et al. 2007) that are likely caused by swelling and shrinkage of clay soils or differential erosion. These raised areas are used by Texas kangaroo rats for burrow construction. Shrubs and prairie mounds comprise slightly over 40% of the burrow characterizations and may be natural components of the grassland ecosystem if one allows for cattle grazing to replace bison and for increases in shrub density due to lack of fire and overgrazing.

The other burrow associations in Wichita County comprise almost 60% of the burrows and include environments modified by man mainly due to fencing, clearing of brush, and oil field activities. To a lesser degree, road, and reservoir construction have provided opportunistic habitats for Texas kangaroo rats.

Fence rows (24% of burrow associations in Wichita County) that are relatively old often collect a berm of soil around posts that are used for burrow construction. Brush piles (11% of burrow associations) where Texas kangaroo rats have been found are about 30 years old and have never been burned. The wood has rotted and captured loose soil that forms a dome about 0.25 m in height. This provides raised, loose soil for burrow construction. Abandoned crossties in pasturelands used for fencing or oil pump-jack pad construction have been associated with burrows 7.0% of the time along with oil field pipe (2.0%), old pump-jack pads (11%), and oil storage tank berms (2.0%). This indicates that oil field activity can provide opportunistic habitat for Texas kangaroo rats. Mowed roadsides can provide berms for burrow construction and mowing helps prevent tall dense vegetation from becoming established. The single pond dam in Wichita County that contained a Texas kangaroo rat burrow was at a small man-made reservoir built to provide water for livestock. The dam had been breached by water from a heavy rainfall event and provided high, relatively loose soil for burrow construction.

Dominant vegetation found at burrows in Wichita County was mostly native. All forbs and shrubs and most grasses were native. Little barley was the most dominant native grass with whorled dropseed being the second most common native grass. Introduced grasses dominated at 15.9 % of burrows and included Japanese brome, rescue grass, and jointed goat grass. As we surveyed historical sites for trapping locations, we often encountered dense concentrations of

introduced grasses such as Japanese brome. Increases of these introduced grasses likely will negatively affect the Texas kangaroo rat and is probably why many historical sites, especially along roadsides, no longer have Texas kangaroo rats. Dense vegetation likely impedes burrow construction, ease of movement, and prevents Texas kangaroo rats from locating potential predators. In addition, dense vegetation reduces bare patches needed for dust bathing (Goetze et al. 2008). Also, changes in land use that decrease grazing, such as conservation programs like the Conservation Reserve and Grassland Reserve programs, probably negatively affect Texas kangaroo rat populations.

Comparisons to Motley County

Ecological characteristics of burrows in Wichita County were different than those reported from Motley County (Martin and Matocha 1991). In the classification system used for burrows in Wichita County, the burrow in Motley County described by Martin & Matocha (1991) would have been classified as a fence line association. At the Motley County site, values reported for bare ground percentage (30.2%) is slightly lower than the mean (44.0%) from Wichita County but forb percentage (4.8% compared to 18.0% in Wichita County) were low and grass percentage was high (65% compared to 22.8% in Wichita County). These differences might be attributed to moderate to heavy grazing that occurred at the sites in Wichita County. The location of the Motley County burrow in a fence row berm may have provided the friable soil preferred for burrow construction. In addition, its location at the edge of a Sudan grass field adjacent to a gravel road may have provided enough disturbances to maintain bare patches for the dust bathing activities of *D. elator*.

Comparisons to Hardeman County

Martin (2002) reported that burrows in Hardeman County were typically associated with several species of shrub including honey mesquite, lotebush, and *Ephedra antisyphilitica* Berland. *ex* C. A. Mey (clapweed). Similarly 32% of the burrows in Wichita County were associated with shrubs with greatest number associated with honey mesquite. Only 2.0% were found with lotebush and none were found with clapweed. On average, the Hardeman County burrows had 18.9% bare ground, 75.5% grasses, and 15.8% forbs (Martin 2002). In Wichita County, bare ground is on average over twice as high (44.0%), grasses are only about one-fourth as much (22.2%), and forbs are slightly higher (18.0%). This could have been due to the moderate to heavy grazing associated with the Wichita County sites and the values reported from Motley County are similar to those reported from an ungrazed site in Wichita County (Stasey et al. 2010). However, the two burrows where we captured Texas kangaroo rats in Hardeman County had mean values more similar to those found in Wichita County with 67.5% bare ground, 17.5% grasses, and 15% forbs. These two burrows were associated with a mowed roadside, which might simulate grazing conditions associated with the Wichita County burrows. The Hardeman County burrows also had different dominant vegetation with purple threeawn and sleepy daisy dominating instead of little barley and Virginia pepper-grass that most commonly occured in Wichita County. Herbaceous height means in Hardeman County (9.1 cm verses 14.0 cm in Wichita County) were lower likely due to roadside mowing.

Copper Breaks State Park in Hardeman County

At the present time, there are only three tracts of public lands administered by the state of Texas within the range of *D. elator*. One tract is Lake Arrowhead State Park in Clay County, Texas in the eastern portion of *D. elator*'s range. A second tract of public land, located to the west

in Cottle County, Texas, is the Matodor Wildlife Management Area. The third tract of public land is Copper Breaks SP in Hardeman County, Texas (Fig. 2). The total area of Lake Arrowhead State Park is 212.05 ha. Copper Breaks SP encompasses 768.40 ha, and Matador Wildlife Management Area contains 11,405.66 ha. Therefore, a total of 12,386.11 ha within the range of *D. elator* is administered by the state of Texas. Of the three state properties, the Texas kangaroo rat has been reported only from Copper Breaks SP as a roadside sighting (Martin & Matocha 1998; Martin 2002).

The remainder of the land within the species' range is privately owned or, as in the case of some impounded water reservoirs, controlled by local, municipal authorities. Survey of the public lands within the range of *D. elator* and identification of suitable habitats within these tracts of land is vital to the survival and conservation of the Texas kangaroo rat. Past capture sites of *D. elator* and private lands within its range should also be studied. Regular surveys for this state threatened species will provide information to park managers, wildlife biologists, and privately sponsored organizations (such as the Nature Conservancy) and enable these personnel and entities to implement appropriate conservation and management strategies.

The goals of this portion of the study were to survey for *D. elator* in Copper Breaks SP and to note the vegetational structure at the park and compare it to a capture site of *D. elator* near the park.

Field surveys for *D. elator* were conducted in Copper Breaks SP (Fig. 2) from 2006 to 2012. Martin (2002) reported six localities for *D. elator* in Copper Breaks SP. Trapping transects were established at these six sites, within the state park's longhorn enclosure, and in a centralized trapping grid. Decimal degree coordinates for trapping localities were obtained utilizing a *Magellan* GPS unit (Table 10). Sherman live traps were placed and baited with bird seed and rolled oats. Traps were set in late afternoon hours and were checked shortly after sunrise. Captured mammals were identified to species and released. The traps were closed during daylight hours to avoid inadvertent captures and trap mortalities.

Trap transects were established in the six sites reported by Martin (2002) with traps approximately 5 m apart on 15 March 2008; 19-20 May 2008; 13-18 March 2011; 16-17 April 2011; and 25-27 May 2011. Similar transects were established in the longhorn enclosure within the park from 19-20 May 2007; 13-18 March 2011; 16-17 April 2011; 28 May 2011; and 15-23 May 2012.

The 100 station, 10 m by 10 m trapping grid was established adjacent to three of the sites reported by Martin (2002) and sampled in 2006 on 30 June, 1-5 July, and 1, 6-8, 14-15 October. A final sample was conducted on 9 May 2007. Two Sherman live traps were placed at each station for a total of 200 trapnights per night. During our study, a total of 2,600 trapnights was conducted on the trapping grid and, when including the other seven sites a grand total of 5127 trapnights occurred during the study (Table 10).

Vegetation within the trapping grid at Copper Breaks SP was sampled during May 2008 within a 0.5 ha area. A 50 m by 50 m area within the grid was measured and woody vegetation quantified and identified (Nelson et al. 2009). Herbaceous vegetation was also sampled using a 1-m^2 quadrat made from PVC pipe placed and centered over a random number along a 100 m tape measure. Three random samples were chosen for the westernmost 100 m of the trapping grid, four along a tape measure centered in the grid, and three along the easternmost 100 m of the grid. Vegetative richness was recorded as total number of species present within each quadrat. Percentage coverage of grass, forbs, bare ground, woody vegetation, and rocks or stumps within

each quadrat were recorded, as was average herbaceous vegetation height (obtained by averaging the height of the herbaceous vegetation 15 cm interior to each corner of the quadrat). If woody vegetation was present, its height also was recorded. Specimens of the dominant herbaceous and woody plants were collected and placed in a plant press. Dominant vegetation at the site was identified using floral references for the state and for North Central Texas (Correll & Johnson 1970; Diggs et al. 1999). Voucher specimens were deposited in the Tarleton State University Herbarium (TAC). In the site outside the park (Table 10) where two *D. elator* were captured, the 1-m^2 quadrat was centered over the opening of the burrow and vegetation was sampled in the same manner as quadrats within the trapping grid.

Six genera and 10 species of mammals were collected during our study (Table 11). The most commonly collected mammals were the northern pygmy mouse (*Baiomys taylori*), Texas mouse (*P. attwateri*), and hispid cotton rat (*Sigmodon hispidus*).

The Texas kangaroo rat was only obtained outside of Copper Breaks SP at a nearby roadside that had been mowed. Two *D. elator* (one male, one female) and a white-footed mouse (*Peromyscus leucopus*) were trapped from separate burrow systems at this locality.

The dominant grass in the trapping grid at Copper Breaks SP was Japanese brome (*Bromus japonicus*), whereas purple threeawn (*Aristida purpurea*) was dominant at the site outside the park where Texas kangaroo rats were caught (Table 12). The dominant forb at Copper Breaks SP was western ragweed (*Ambrosia psilostachya*) while Texas sleepy daisy (*Xanthisma texanum*) was dominant outside the park (Table 12). Three of the ten quadrats at Copper Breaks SP had woody vegetation dominated by Texas prickly-pear (*Opuntia engelmannii*) (Table 12).

At the site where kangaroo rats were captured, richness was higher, herbaceous vegetation was shorter, there was more bare ground, more forbs, less grass, and no woody vegetation (Table 12). Within the trapping grid at Copper Breaks SP, 139 mesquites per ha were recorded.

The northern pygmy mouse, hispid cotton rat, fulvous harvest mouse (*Reithrodontomys fulvescens*), and plains harvest mouse (*R. montanus*) prefer grassy or riparian areas of moderate to heavy vegetation cover (Schmidly 2004). The northern pygmy mouse and hispid cotton rat were the most common mammals within Copper Breaks SP, and the two species of *Reithrodontomys* were also abundant. The presence of these rodents on the trapping grid and transects within Copper Breaks SP indicates that these locations would not be favorable for *D. elator*. The Texas kangaroo rats caught outside the park occurred in habitat with light vegetation. In studies of *D. elator* in Wichita County (Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010) light vegetation and associated bare ground, likely caused by cattle grazing or other disturbances, always occurred at burrow sites.

Also, the presence of *S. hispidus* likely is indicative of a significant change in the original vegetation within the park. Hispid cotton rats often prefer areas of dense vegetation whenever available (Schmidly 2004). Dense vegetation is usually avoided by *D. elator* (Stangl et al. 1992; Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010), thus the Texas kangaroo rat may now be excluded from these sites.

The site where *D. elator* was obtained had an herbaceous vegetation cover that was lower than coverage values sampled along grid transects within Copper Breaks SP (Table 12). The percent bare ground at the capture sites was higher than within Copper Breaks SP (Table 12) as-well-as that reported by Martin and Matocha (1989) for a more westward capture site in Motley County, Texas. The percent bare ground reported from sites in Wichita County, Texas by Goetze et al. (2007) was somewhat lower than at the Hardeman County sites. The two Texas kangaroo rat

burrows did not occur near mesquite; instead occurring in open, slightly raised areas between a road and pasture fence. Opportunistic use of human-mediated disturbances such as fences and roadsides as well as burrow utilization in areas without mesquite have been well documented in Wichita County (Stangl et al. 1992; Goetze et al. 2007; Nelson et al. 2009).

In conclusion, absence of grazing from most of Copper Breaks SP and limited habitat disturbances within the park likely have allowed vegetative cover to increase. Texas kangaroo rats favor areas of reduced vegetation cover and utilize disturbed areas within their range (Stangl et al. 1992; Schmidly 2004; Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010). The presence of nonnative Japanese brome as a dominant at the Copper Breaks SP grid site may also contribute to poor habitat, and dense Japanese brome coverage has been implicated in limiting Texas kangaroo rat population size in Wichita County (Nelson et al. 2009). Considering these factors, much of the current habitat within Copper Breaks SP may be unsuitable for *D. elator* because of dense coverage by native grasses as well as encroachment of some introduced grasses like Japanese brome.

Grazing effects may play an important role in the current ecology and distribution of *D. elator* (Stangl et al. 1992; Goetze et al. 2007; Nelson et al. 2009; Stasey et al. 2010). Based upon our survey results outside of Copper Breaks SP (Nelson & Goetze 2011), livestock grazing, on at least some properties within Hardeman County, has also been reduced. Absence or reduction of this ecological factor may have caused a decline in *D. elator* populations in these areas.

If no populations of *D. elator* are found within Copper Breaks SP in future surveys, perhaps management strategies to reduce vegetative cover and create disturbed habitats within the park might be implemented to increase favorable habitats for this threatened species. The Texas kangaroo rat might then be reintroduced to Copper Breaks SP from Hardeman County populations outside the state park.

Literature Cited

Best, T. L. & C. R. Wahl. 1985. Field survey of the Texas kangaroo rat (*Dipodomys elator*). Unpublished report to Texas Natural heritage Program, Austin, Texas.

Brower, J. E., J. H. Zar, & C. N. von Ende. 1998. Field and laboratory methods for general ecology, fourth edition. William C. Brown and McGraw-Hill, Boston.

Carter, D. C., W. D. Webster, J. K. Jones JR., C. Jones, & R. D. Suttkus. 1985. *Dipodomys elator*. American Society of Mammalogists, Mammalian Species 232:1-3.

Correll, D.S. & M.C. Johnston. 1970. *Manual of the vascular plants of Texas*. Texas Research Foundation. Renner, Texas.

Cross, C. L. & P. M. Waser. 2000. Estimating population size in the banner-tailed kangaroo rat. Southwestern Naturalist 45:176-183.

Dalquest, W. W. & G. Collier. 1964. Notes on *Dipodomys elator*, a rare kangaroo rat. Southwestern Naturalist 9:146-150.

Dalquest, W. W. & N. V. Horner. 1984. Mammals of north-central Texas. Midwestern State University Press, Wichita Falls, Texas.

Dalquest, W. W., J. V. Grimes & F. B. Stangl, Jr. 1992. Characters of the upper premolar of five species of *Dipodomys* and evidence for diphyly in the genus. Southwestern Naturalist 37:231-246.

Diamond, D. D. & D. M. Shaw. 1990. GIS and remote sensing for Texas kangaroo rat habitat characterization. Project E-1-2. Unpublished report prepared for the Texas Parks and Wildlife, Austin, Texas.

Diggs, G. M., B. L. Lipscomb & R.J. O'Kennon. 1999. Shinners & Mahler's Illustrated Flora of

North Central Texas. Fort Worth, TX: Botanical Research Institute of Texas.
Goetze, J. R., W. C. Stasey, A. D. Nelson & P. D. Sudman. 2007. Mapping burrows of Texas kangaroo rats to examine soil types, vegetation, and estimate population size on an intensely grazed pasture in Wichita County, Texas. Texas Journal of Science 59:11-22.
Goetze, J. R., A. D. Nelson & C. Stasey. 2008. Notes on behavior of the Texas kangaroo rat (*Dipodomys elator*). Texas Journal of Science 60:309-316.
Hafner, D. J. 1996. *Dipodomys elator*. In: IUCN 2004. 2004 IUCN Red List of Threatened Species. www.redlist.org (Accessed 19 March 2012).
Hamilton, M. J., R. K. Chesser & T. L. Best. 1987. Genetic variation in the Texas kangaroo rat, *Dipodomys elator* Merriam. Journal of Mammalogy 68:775-781.
Johnson, W. E. & R. K. Selander. 1971. Protein variation and systematics in kangaroo rats (genus *Dipodomys*). Systematic Zoology 20:377-405.
Jones, C., M. A. Bogan & L. M. Mount. 1988. Status of the Texas kangaroo rat (*Dipodomys elator*). Texas Journal of Science 40:249-258.
Maher, C. R. 2004. Intrasexual territoriality in woodchucks (*Marmota monax*) Journal of Mammalogy 85:1087-1094.
Manifold Net Ltd. 2003. *Manifold* System 5.50 SP2. CDA International Ltd.. Carson City, Nevada.
Mantooth, S. J., C. Jones & R. D. Bradley. 2000. Molecular systematics of *Dipodomys elator* (Rodentia: Heteromyidae) and its phylogeographic implications. Journal of Mammalogy 81:885-894.
Martin, R. E. 2002. Status and long term survival of the Texas kangaroo rat, *Dipodomys elator*, Sect. 6, Project 70. Unpublished report prepared for Texas Parks and Wildlife Department, Austin, Texas.
Martin, R. E. & K. G. Matocha. 1991. The Texas kangaroo rat, *Dipodomys elator*, from Motley Co., Texas, with notes on habitat attributes. The Southwestern Naturalist 56:354-356.
Martin, R. E. & K. G. Matocha. 1998. *Dipodomys elator* Merriami 1894: Texas kangaroo rat. pp. 69-70 *in* North American rodents: Status survey and conservation action plan. (D. J. Hafner, Yensen, and G. L. Kirkland, Jr. eds.) IUNC.
Merriam, C. H. 1894. Preliminary descriptions of eleven new kangaroo rats of the genera *Dipodomys* and *Perodipus*. Proceedings of the Biological Society of Washington 9:109-116.
Moss, S. P. & P. Mehlhop-Cifelli. 1990. Status of the Texas kangaroo rat, *Dipodomys elator* (Heteromyidae), in Oklahoma. Southwestern Naturalist 35:356-358.
Nelson, A. D., J. R. Goetze, E. Watson & M. Nelson. 2009. Changes in vegetation patterns and its effect on Texas Kangaroo Rats (*Dipodomys elator*). Texas Journal of Science 61:119-130.
Roberts, J. D. & R. L. Packard. 1973. Comments on movements, home range and ecology of the Texas kangaroo rat, *Dipodomys elator* Merriam. Journal of Mammalogy 54:957-962.
Schmidly, D. J. 2004. The mammals of Texas. Texas Parks and Wildlife Press, Austin, Texas, USA.
Stangl Jr., F. B. & T. S. Schafer. 1990. Report on the current status of the Texas kangaroo rat, *Dipodomys elator*, in north-central Texas. Unpublished report prepared for Texas Parks and Wildlife Department, Austin, Texas.
Stangl Jr., F. B., T. S. Schafer, J. R. Goetze & W. Pinchak. 1992. Opportunistic use of modified and disturbed habitat by the Texas kangaroo rat (*Dipodomys elator*). Texas Journal of Science 44:25-35.
Stasey, W. C. 2005. An evaluation of Texas kangaroo rat (*Dipodomys elator*): Biological habits and population estimation. Unpublished Masters Thesis. Tarleton State University.
Stasey, W. C., J. R. Goetze, P. D. Sudman & A. D. Nelson. 2010. Differential use of grazed and ungrazed plots by *Dipodomys elator* (Mammalia: Heteromyidae) in North Central Texas. Texas Journal of Science 62:3-14.
U.S. Fish and Wildlife Service. 1996. Candidate notice of review, endangered species. http://endangered.fws.gov/96cnorwt.html. (Accessed 19 March 2012).

U.S. Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the Texas kangaroo rat as endangered and threatened. Federal Register 76(45):12683-12690.

WildEarth Guardians. 2010. Petition to list the Texas kangaroo rat (*Dipodomys elator*) under the U.S. Endangered Species Act. WildEarth Guardians. Denver Colorado.

Figure 1. Map showing four locations in Wichita County where burrow data was obtained.

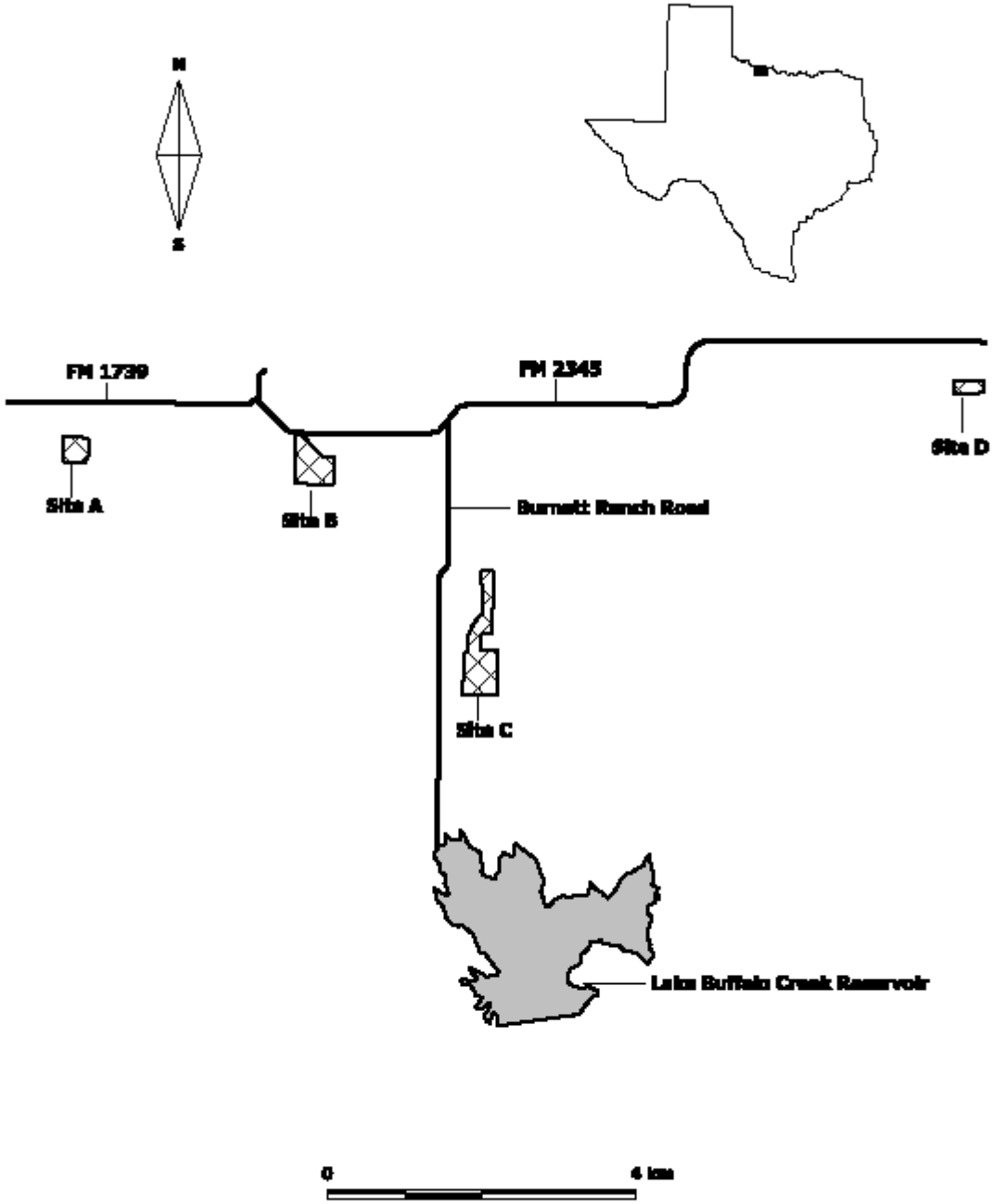

Fig. 2. Trapping locations within Copper Breaks State Park and Hardeman County, Texas. Inset shows the location of Hardeman County within Texas.

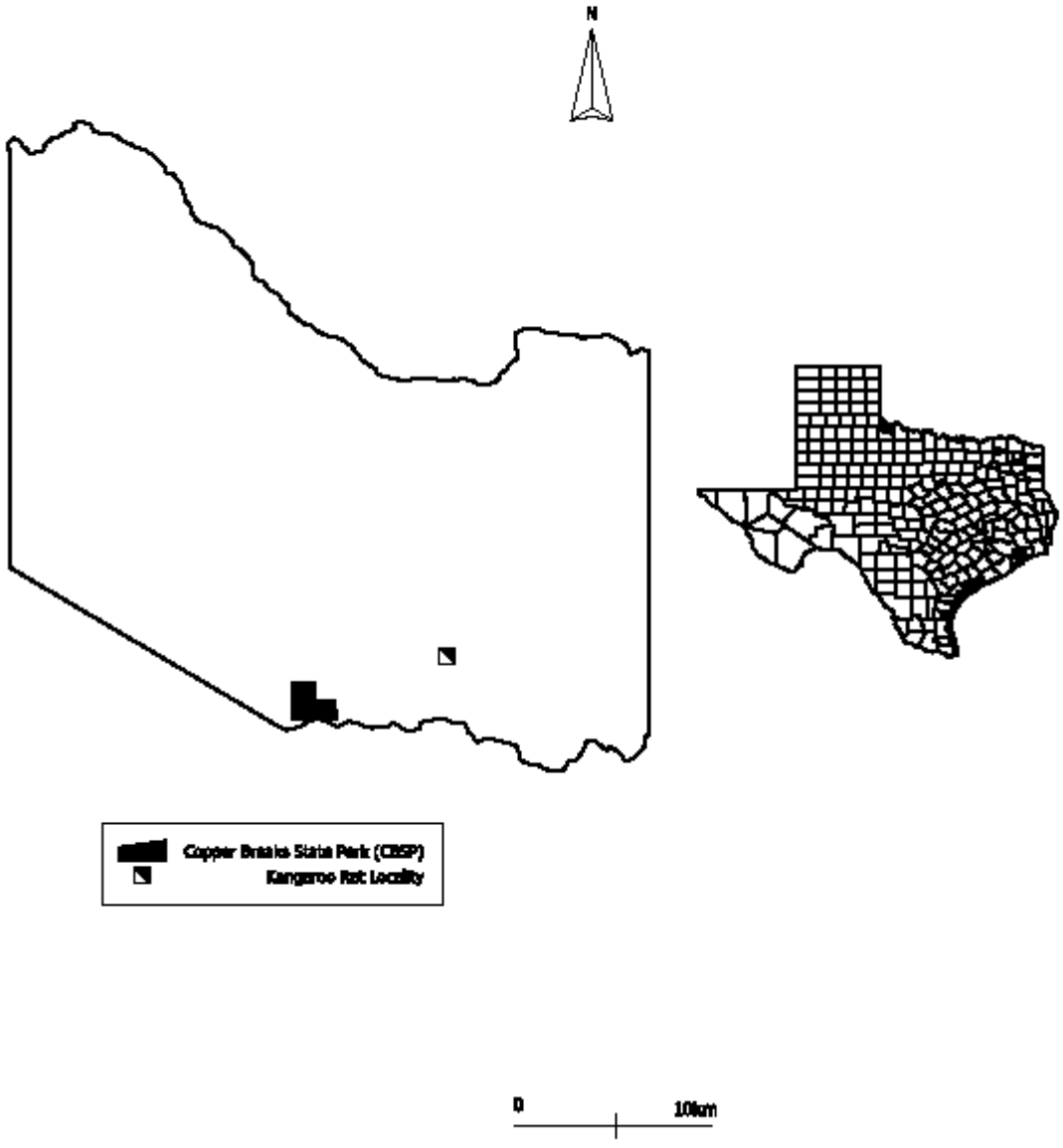

Table 1. Data on burrow association and percentages of forbs, grass, woody vegetation, and bare ground for 54 active Texas kangaroo rat burrows. If percentages were not measured, unknown (unk.) is used. Range, mean, and standard deviation are provided at the end of the table.

Number	Burrow Association	Forb%	Grass%	Woody%	Bare%
1	lotebush	1	49	50	0
2	prairie mound	5	35	0	60
3	prairie mound	35	15	0	50
4	fence row	29	1	0	70
5	brush pile	15	15	0	70
6	brush pile	30	10	0	60
7	honey mesquite	5	5	10	80
8	brush pile	30	40	0	30
9	brush pile	10	21	0	49
10	brush pile	5	55	0	30
11	honey mesquite	67	15	3	15
12	honey mesquite	67	15	3	15
13	honey mesquite	67	15	3	15
14	honey mesquite	34	1	50	15
15	honey mesquite	5	25	60	10
16	honey mesquite	5	25	60	10
17	honey mesquite	15	45	20	20
18	fence row	60	35	5	0
19	fence row	30	10	0	60
20	honey mesquite	25	10	50	15
21	honey mesquite	0	unk.	unk.	40
22	prairie mound	0	50	0	50
23	oil field pipe	2	30	0	30
24	rail crosstie	0	1	0	69
25	honey mesquite	unk.	unk.	unk.	unk.
26	prairie mound	unk.	unk.	unk.	80
27	lotebush	unk.	unk.	unk.	30
28	honey mesquite	unk.	unk.	unk.	30
29	rail crosstie/metal	25	5	0	50
30	rail crosstie/metal	25	5	0	50
31	breached pond dam	2	38	0	45
32	mowed roadside	15	5	0	80
33	mowed roadside	15	30	0	55
34	old oil pump-jack pad	0	1	0	94
35	old oil pump-jack pad	2	20	0	70
36	old oil pump-jack pad	1	10	0	59
37	fence row	0	3	0	60
38	old oil pump-jack pad	2	20	0	70
39	oil storage tank berm	1	15	0	84
40	prairie mound	0	40	0	60

Table 1. (cont.)

Number	Burrow Association	Forb%	Grass%	Woody%	Bare%
41	honey mesquite	0	30	25	45
42	honey mesquite	0	10	50	40
43	prairie mound	1	30	0	69
44	fence row	25	40	0	35
45	honey mesquite	2	43	35	20
46	fence row	10	45	0	45
47	fence row	10	45	0	45
48	honey mesquite	30	25	20	25
49	fence row	25	30	0	45
50	fence row	20	30	0	45
51	honey mesquite	30	20	10	40
52	fence row	35	5	0	60
53	fence row	50	25	0	25
54	old oil pump-jack pad	5	40	0	50
Range		0-67	1-60	0-60	0-94
Mean		17	23	9.3	46
Standard Deviation		19	15	37.9	23

Table 2. Data on percentage of other materials found at burrows (rocks, stumps, oil field metal such as pipes and pump-jack counterweights as well as dead vegetation and holes other than the burrow), herbaceous (four measurements), and woody vegetation height (as many as two measurements if more than one shrub present in quadrat, if not than non-applicable (N/A)) in centimeters for 54 active Texas kangaroo rat burrows. If not measured, then unknown (unk.) is used. Range, mean, and standard deviation are provided at the end of the table.

Number	Other%	Herbaceous vegetation height				Woody vegetation height	
		#1	#2	#3	#4	#1	#2
1	0	31	15	17	40	121	N/A
2	0	3	3	2	4.5	0	N/A
3	0	0	2.5	10.5	7	0	N/A
4	0	4.9	3	4.5	5.4	0	N/A
5	0	5.5	4	7.5	3	0	N/A
6	0	0	4	13	3	0	N/A
7	0	0	5	7	3	57	19
8	0	13	2	14	9	0	N/A
9	20	11	6	4	2	37	N/A
10	10	7	2	4	2	20	N/A
11	0	32	27	17.8	41	112	N/A
12	0	32	27	17.8	41	112	N/A
13	0	32	27	17.8	41	112	N/A
14	0	13	18	32.5	53	36	N/A
15	0	29	29	25	24	14	N/A
16	0	29	29	25	24	14	N/A
17	0	19	17	45.5	30	54	N/A
18	0	33	32	18	34	0	N/A
19	0	17	15	2.3	1.6	0	N/A
20	0	9	4.5	22	36	21	N/A
21	unk.	unk.	unk.	unk.	unk.	unk.	unk.
22	0	unk.	unk.	unk.	unk.	0	N/A
23	38	0	0	9.2	30	0	N/A
24	30	0	0	0	0	0	N/A
25	unk.	unk.	unk.	unk.	unk.	unk.	unk.
26	unk.	unk.	unk.	unk.	unk.	unk.	unk.
27	unk.	unk.	unk.	unk.	unk.	unk.	unk.
28	unk.	unk.	unk.	unk.	unk	unk.	unk.
29	20	10	9.8	0	0	0	N/A
30	20	10	9.8	0	0	0	N/A
31	15	0	0	0	15	0	N/A
32	0	8.5	4.6	8.8	8	0	N/A
33	0	5.2	14	10	12	0	N/A

34	5	0	0	0	0	0	N/A
35	8	0	0	0	24	0	N/A
36	30	0	0	6	3	0	N/A

Table 2. (cont.)

Number	Other%	Herbaceous vegetation height				Woody vegetation height	
		#1	#2	#3	#4	#1	#2
37	37	0	0	0	35	0	N/A
38	8	0	0	0	24	0	N/A
39	0	0	0	1	1.6	0	N/A
40	0	0	0	2.2	8.7	0	N/A
41	0	0	0	0	28	8	N/A
42	0	0	10	7	19	12	N/A
43	0	0	0	31	30	0	N/A
44	0	40	7.5	42	0	0	N/A
45	0	41	47	22	0	10	N/A
46	0	12	17	33	29	0	N/A
47	0	12	17	33	29	0	N/A
48	0	0	0	32	40	9	N/A
49	0	32	17	0	0	0	N/A
50	5	47	0	0	15	0	N/A
51	0	21	17	32	0	1	13
52	0	0	0	32	0	0	N/A
53	0	24	59	27	33	0	N/A
54	5	12	0	0	32	0	N/A
Range	0-38	0-53				0-121	
Mean	5.1	14				15	
Standard Deviation	10.3	14				32	

Table 3. Data on plant richness and dominant forb, grass, and woody vegetation found at 54 active Texas kangaroo rat burrows. Range, mean, and standard deviation for richness is provided at the end of the table.

Number	Richness	Dominant Forb	Dominant Grass	Dominant Woody
1	5	Virginia peppergrass	little barley	lotebush
2	5	Virginia peppergrass	little barley	none
3	4	Virginia peppergrass	little barley	none
4	3	unknown	little barley	none
5	5	Virginia peppergrass	little barley	none
6	8	common broomweed	little barley	none
7	10	hog potato	little barley	honey mesquite
8	7	Virginia peppergrass	little barley	none
9	10	western ragweed	little barley	none
10	5	Virginia peppergrass	little barley	none
11	6	common broomweed	little barley	honey mesquite
12	6	common broomweed	little barley	honey mesquite
13	6	common broomweed	little barley	honey mesquite
14	8	common broomweed	little barley	honey mesquite
15	6	Virginia peppergrass	little barley	honey mesquite
16	6	Virginia peppergrass	little barley	honey mesquite
17	10	common broomweed	buffalo grass	honey mesquite
18	10	common broomweed	little barley	none
19	7	common broomweed	rescue grass	none
20	6	common broomweed	little barley	honey mesquite
21	2	none	little barley	honey mesquite
22	2	none	buffalo grass	none
23	4	western ragweed	little barley	none
24	1	none	whorled dropseed	none
25	unk.	western ragweed	little barley	honey mesquite
26	unk.	silverleaf nightshade	buffalo grass	none
27	unk.	hog potato	little barley	lotebush
28	unk.	mock cypress	little barley	honey mesquite
29	12	sagebrush	rescue grass	none
30	12	sagebrush	rescue grass	none
31	3	Virginia peppergrass	little barley	none
32	7	sleepy daisy	purple threeawn	none
33	11	sleepy daisy	purple threeawn	none
34	1	none	whorled dropseed	none
35	4	silverleaf nightshate	white tridens	none
36	4	silverleaf nightshade	whorled dropseed	none

37	2	none	whorled dropseed	none
38	4	silverleaf nightshade	white tridens	none

Table 3. (cont.)

Number	Richness	Dominant Forb	Dominant Grass	Dominant Woody
39	3	silverleaf nightshade	purple threeawn	none
40	1	none	buffalo grass	none
41	2	none	whorled dropseed	honey mesquite
42	2	none	whorled dropseed	honey mesquite
43	3	hog potato	whorled dropseed	none
44	6	thick-leaf goosefoot	little barley	none
45	4	Virginia peppergrass	rescue grass	honey mesquite
46	12	Virginia peppergrass	jointed goat grass	none
47	12	Virginia peppergrass	jointed goat grass	none
48	5	Virginia peppergrass	little barley	honey mesquite
49	7	Virginia peppergrass	little barley	none
50	9	thick-leaf goosefoot	little barley	none
51	6	Virginia peppergrass	little barley	honey mesquite
52	6	Virginia peppergrass	little barley	none
53	4	Virginia peppergrass	rescue grass	none
54	7	Virginia peppergrass	little barley	none

Range	1-12
Mean	6
Standard Deviation	3

Table 4. Population estimates for Texas kangaroo rats at four sites in Wichita County Texas (Figure 1).

Dates	Site Name/Coordinates	Population Estimate
May 17-19, 2005	Site C/34.06497N, 98.70709W	2
June 20-22, 2005		3
July 5-7, 2005		4
May 17-19, 2011		2
May 16-18, 2008	Site B/34.05446N, 98.78699W	8
May 16-18, 2011		2
May 16-18, 2011	Site A/34.05423N, 98.781721W	1
March 12-14, 2012		18
May 15-17, 2011	Site D/34.05756N, 98.69716W	2
March 12-14, 2012		3

Table 5. Burrow data from samples taken in 2005, 2007, and 2008 compared to 2011 for average percentages of forbs, grass, woody vegetation, and bare ground as well as average richness and herbaceous height in Wichita County Texas. Standard deviations are provided in parentheses. P-values are from a Mann-Whitney Rank Sum Test.

	2005, 2007, and 2008	2011	*P*-value
Forb%	22 (21.9)	0.7 (0.8)	<0.001
Grass%	22 (16.7)	17.9 (12.6)	0.619
Woody%	12.1 (21.4)	7.5 (16.9)	0.285
Bare ground%	37.8 (23.5)	65.1 (16.3)	0.002
Richness	6.3 (3.0)	4.6 (1.2)	<0.001
Herbaceous height	14.2 (13.5)	5.8 (10.5)	<0.001

Table 6. Data on burrow association and percentages of forbs, grass, woody vegetation, and bare ground for 46 active Texas kangaroo rat burrows. Range, mean, and standard deviation are provided at the end of the table.

Burrow #	Burrow Association	Forb%	Grass%	Woody%	Bare%
1	lotebush	1	49	50	0
2	prairie mound	5	35	0	60
3	prairie mound	35	15	0	50
4	fence row	29	1	0	70
5	brush pile	15	15	0	70
6	brush pile	30	10	0	60
7	honey mesquite	5	5	10	80
8	brush pile	30	40	0	30
9	brush pile	10	21	0	49
10	brush pile	5	55	0	30
11	honey mesquite	67	15	3	15
12	honey mesquite	67	15	3	15
13	honey mesquite	67	15	3	15
14	honey mesquite	34	1	50	15
15	honey mesquite	5	25	60	10
16	honey mesquite	5	25	60	10
17	honey mesquite	15	45	20	20
18	fence row	60	35	5	0
19	fence row	30	10	0	60
20	honey mesquite	25	10	50	15
21	oil field pipe	2	30	0	30
22	rail crosstie	0	1	0	69
23	rail crosstie/metal	25	5	0	50
24	rail crosstie/metal	25	5	0	50
25	breached pond dam	2	38	0	45
26	old oil pump-jack pad	0	1	0	94
27	old oil pump-jack pad	2	20	0	70
28	old oil pump-jack pad	1	10	0	59
29	fence row	0	3	0	60
30	old oil pump-jack pad	2	20	0	70
31	oil storage tank berm	1	15	0	84
32	prairie mound	0	40	0	60
33	honey mesquite	0	30	25	45

34	honey mesquite	0	10	50	40
35	prairie mound	1	30	0	69

Table 6. (cont.)

Burrow #	Burrow Association	Forb%	Grass%	Woody%	Bare%
36	fence row	25	40	0	35
37	honey mesquite	2	43	35	20
38	fence row	10	45	0	45
39	fence row	10	45	0	45
40	honey mesquite	30	25	20	25
41	fence row	25	30	0	45
42	fence row	20	30	0	45
43	honey mesquite	30	20	10	60
44	fence row	35	5	0	60
45	fence row	50	25	0	25
46	old oil pump-jack pad	5	40	0	50
Range		0-67	1-55	0-60	0-94
Mean		18.0	22.8	9.9	44.0
Standard Deviation		20.0	15.2	18.6	23.0

Table 7. Data on percentage of other materials found at burrows (rocks, stumps, oil field metal such as pipes and pump-jack counterweights as well as dead vegetation and holes other than the burrow), herbaceous (four measurements), and woody vegetation height (as many as two measurements if more than one shrub present in quadrat, if not than non-applicable (N/A)) in centimeters for 46 Texas kangaroo rats. If not measured, then unknown (unk.) is used. Range, mean, and standard deviation are provided at the end of the table.

Burrow #	Other%	Herbaceous vegetation height				Woody vegetation height	
		#1	#2	#3	#4	#1	#2
1	0	31	15	17	40	121	N/A
2	0	3	3	2	4.5	0	N/A
3	0	0	2.5	10.5	7	0	N/A
4	0	4.9	3	4.5	5.4	0	N/A
5	0	5.5	4	7.5	3	0	N/A
6	0	0	4	13	3	0	N/A
7	0	0	5	7	3	57	19
8	0	13	2	14	9	0	N/A
9	20	11	6	4	2	37	N/A
10	10	7	2	4	2	20	N/A
11	0	32	27	17.8	41	112	N/A
12	0	32	27	17.8	41	112	N/A
13	0	32	27	17.8	41	112	N/A
14	0	13	18	32.5	53	36	N/A
15	0	29	29	25	24	14	N/A
16	0	29	29	25	24	14	N/A
17	0	19	17	45.5	30	54	N/A
18	0	33	32	18	34	0	N/A
19	0	17	15	2.3	1.6	0	N/A
20	0	9	4.5	22	36	21	N/A
21	38	0	0	9.2	30	0	N/A
22	30	0	0	0	0	0	N/A
23	20	10	9.8	0	0	0	N/A
24	20	10	9.8	0	0	0	N/A
25	15	0	0	0	15	0	N/A
26	5	0	0	0	0	0	N/A
27	8	0	0	0	24	0	N/A
28	30	0	0	6	3	0	N/A
29	37	0	0	0	35	0	N/A
30	8	0	0	0	24	0	N/A

31	0	0	0	1	1.6	0	N/A

Table 7. (cont.)

Burrow #	Other%	Herbaceous vegetation height				Woody vegetation height	
		#1	#2	#3	#4	#1	#2
32	0	0	0	2.2	8.7	0	N/A
33	0	0	0	0	28	8	N/A
34	0	0	10	7	19	12	N/A
35	0	0	0	31	30	0	N/A
36	0	40	7.5	42	0	0	N/A
37	0	41	47	22	0	10	N/A
38	0	12	17	33	29	0	N/A
39	0	12	17	33	29	0	N/A
40	0	0	0	32	40	9	N/A
41	0	32	17	0	0	0	N/A
42	5	47	0	0	15	0	N/A
43	0	21	17	32	0	1	13
44	0	0	0	32	0	0	N/A
45	0	24	59	27	33	0	N/A
46	5	12	0	0	32	0	N/A
Range	0-30	0-59				0-121	
Mean	5.5	14.0				16.0	
Standard Deviation	10.5	14.0				33	

Table 8. Data on plant richness and dominant forb, grass, and woody vegetation found at 46 active Texas kangaroo rat burrows. Range, mean, and standard deviation for richness is provided at the end of the table.

Burrow #	Richness	Forb	Grass	Woody vegetation
1	5	*Lepidium virginicum* L. (Virginia pepper-grass)	*Hordeum pusillum* Nutt. (little barley)	*Ziziphus obtusifolia* (Hook.) Torr. & A. Gray) A. Gray (lotebush)
2	5	Virginia pepper-grass	little barley	none
3	4	Virginia pepper-grass	little barley	none
4	3	unknown forb	little barley	none
5	5	Virginia pepper-grass	little barley	none
6	8	*Gutierrezia dracunculoides* (DC) S. F. Blake (common broomweed)	little barley	none
7	10	*Hoffmannseggia glauca* (Ortega) Eifert (hog potato)	little barley	*Prosopis glandulosa* Torr. (honey mesquite)
8	7	Virginia pepper-grass	little barley	none
9	10	*Ambrosia psilostachya* DC. (western ragweed)	little barley	none
10	5	Virginia pepper-grass	little barley	none
11	6	common broomweed	little barley	honey mesquite
12	6	common broomweed	little barley	honey mesquite
13	6	common broomweed	little barley	honey mesquite
14	8	common broomweed	little barley	honey mesquite
15	6	Virginia pepper-grass	little barley	honey mesquite
16	6	Virginia pepper-grass	little barley	honey mesquite
17	10	common broomweed	*Buchloe dactyloides* (Nutt.) Engelm. (buffalo grass)	honey mesquite
18	10	common broomweed	little barley	none
19	7	common broomweed	*Bromus catharticus* Vahl (rescue grass)	none
20	6	common broomweed	little barley	honey mesquite

Table 8. (cont.)

Burrow #	Richness	Forb	Grass	Woody vegetation
21	4	western ragweed	little barley	none
22	1	none	*Sporobolus pyramidatus* (Lam.) Hitchc. (whorled dropseed)	none
23	12	*Artemesia ludoviciana* Nutt. (sagebrush)	rescue grass	none
24	12	sagebrush	rescue grass	none
25	3	Virginia pepper-grass	little barley	none
26	1	none	whorled dropseed	none
27	4	*Solanum elaeagnifolium* Cav. (silverleaf nightshade)	*Tridens albescens* (Vasey) Wooton & Standl. (white tridens)	none
28	4	silverleaf nightshade	whorled dropseed	none
29	2	none	whorled dropseed	none
30	4	silverleaf nightshade	white tridens	none
31	3	silverleaf nightshade	*Aristida purpurea* Nutt. (purple threeawn)	none
32	1	none	buffalo grass	none
33	2	none	whorled dropseed	honey mesquite
34	2	none	whorled dropseed	honey mesquite
35	3	hog potato	whorled dropseed	none
36	6	*Chenopodium pratericola* Rybd. (thick-leaf goosefoot)	little barley	none

Table 8. (cont.)

Burrow #	Richness	Forb	Grass	Woody vegetation
37	4	Virginia pepper-grass	rescue grass	honey mesquite
38	12	Virginia pepper-grass	*Aegilops cylindrica* Host (jointed goat grass)	none
39	12	Virginia pepper-grass	jointed goat grass	none
40	5	Virginia pepper-grass	little barley	honey mesquite
41	7	Virginia pepper-grass	little barley	none
42	9	thick-leaf goosefoot	little barley	none
43	6	Virginia pepper-grass	little barley	honey mesquite
44	6	Virginia pepper-grass	little barley	none
45	4	Virginia pepper-grass	rescue grass	none
46	7	Virginia pepper-grass	little barley	none
Range	1-12			
Mean	6			
Standard Deviation	3			

Table 9. Data on burrow association and percentages of forbs, grass, woody vegetation, bare ground, and other as well as herbaceous and woody vegetation height, richness, and dominant burrow species for two Texas kangaroo rats from Hardeman County, Texas.

Burrow #	Burrow Association	Forb%	Grass%	Woody%	Bare%
1	mowed roadside	15	5	0	80
2	mowed roadside	15	30	0	55

Other%	Herbaceous vegetation height				Woody vegetation height		Richness
0	8.5	4.6	8.8	8	0	N/A	7
0	5.2	14	10	12	0	N/A	10

Dominant Forb	Dominant Grass	Dominant Woody
Xanthisma texanum DC. (sleepy daisy)	purple threeawn	none
sleepy daisy	purple threeawn	none

Table 10. Trapping localities at Copper Breaks State Park (CBSP) and one site outside the park where the Texas kangaroo rat was captured. Numbered site localities are taken from Martin (2002). Geographic coordinates are in decimal degrees (DDC).

Trap site	**DDC**	**Trapnights**
CBSP		
8607061	34.11845N, 99.75390W	270
861201	34.11868N, 99.75730W	300
861203	34.11817N, 99.75943W	250
8710241	34.11015N, 99.75630W	250
9311121	34.10624N, 99.75653W	444
861202	34.11770N, 99.75468W	25
Longhorn enclosure	34.11216N, 99.74036W	988
Trapping Grid	34.10857N, 99.75618W	2600
Texas kangaroo rat site	34.15218N, 99.62694W	285

Table 11. Mammalian species arranged alphabetically by family and numbers of captures in Copper Breaks SP (CBSP) and a site outside the park where the Texas kangaroo rat was captured.

Species	**Number of captures**
CBSP	
Heteromyidae	
Chaetodipus hispidus	11
Muridae	
Baiomys taylori	114
Neotoma leucodon	2
Neotoma micropus	2
Peromyscus attwateri	89
Peromyscus leucopus	11
Peromyscus maniculatus	7
Reithrodontomys fulvescens	33
Reithrodontomys montanus	10
Sigmodon hispidus	97
Texas kangaroo rat site	
Heteromyidae	
Dipodomys elator	3
Muridae	
Peromyscus leucopus	1

Table 12. Dominant vegetation and average herbaceous height, percent coverage of bare ground, forbs, grasses, woody, and richness at in the Copper Breaks State Park (CBSP) trapping grid and outside the park where two Texas kangaroo rats were caught. Ranges are enclosed in parentheses. Dominant forbs are western ragweed (*Ambrosia psilostachya*) and Texas sleepy daisy (*Xanthisma texanum*). Dominant grasses are Japanese brome (*Bromus japonicus*) and purple threeawn (*Aristida purpurea*). Woody vegetation includes sugarberry (*Celtis laevigata*) and Texas prickly-pear (*Opuntia engelmanii*).

	CBSP Quadrats	**Outside Park Quadrats**
	(*n*=10)	(*n*=2)
Dominant Forb	western ragweed	Texas sleepy daisy
Dominant Grass	Japanese brome	Purple threeawn
Dominant Woody Veg.	Texas prickly-pear	None
Avg. Herb. Height (cm)	19.5 (0-37.5)	8.7 (4.6-13.5)
Avg. % Bare Ground	5.3 (0-30)	67.5 (55-80)
Avg % Forbs	2.7 (0-4)	15 (15-15)
Avg % Grasses	90.3 (70-98)	17.5 (5-30)
Avg.% Woody veg.	2.1 (0-10)	0 (0-0)
Avg. Richness	4.2 (3-5)	9 (7-11)

Appendix 1. Sites surveyed for presence of *Dipodomys elator* (Texas kangaroo rat), abbreviated field notes, number of trapnights, and animals captured during status survey.

Martin (2002) sites (9029 trapnights)

1. Martin's (2002) Record # 8607061. March 15, 2008. TX, Hardeman Co. Copper Breaks State Park. Near Big Pond Lake at Group Camp Site # 46 (34.118450N, 99.753900W). Sandstone outcrops with thin soil. Bare areas surrounded by dense vegetation. Dominant shrub is juniper and dominant herb is little bluestem. No active burrows, runs (trails between burrows), or dust bathing sites. 100 trapnights. Catch: Two *Peromyscus leucopus*, six *P. maniculatus*, 10 *Sigmodon hispidus*, and six *Baiomys taylori*. March 13, 2011. 40 trapnights. Catch: Five *P. attwateri* in areas of little bluestem and juniper with 20-60% bare ground. April 16, 2011. 130 trap nights. Within 200 meters of Martin site. Catch 19 *P. attwateri*, one *P. maniculatus*, five *Reithrodontomys fulvescens*, two *S. hispidus*, one *B. taylori*, and one *Neotoma leucodon*. **Total Trapnights: 270**

2. Martin's (2002) Record # 861201. March 13-18, 2011. TX, Hardeman Co. Copper Breaks State Park. About 100 meters north of parking area for equestrian area near old windmill (34.118687N, 99.757301W). Rocky, thin soil. Not as rocky as Group Camp Site # 46 but with large amounts of small rock mixed with soil. Dominant shrubs are juniper and some mesquite, and dominant herb is sideoats grama. No active runs, burrows, or dust bathing sites. 250 trapnights. Catch: 28 *Peromyscus attwateri* mostly near junipers with 30-80% bare ground; three *Sigmodon hispidus* in 100% covered areas near mesquite, prickly pear, or no shrubs; one *Baiomys taylori* in 100% cover near juniper; and three *Reithrodontomys fulvescens* in 70-90 % cover near juniper or prickly pear. May 25-27, 2011. 50 trapnights. Catch: Two *P. attwateri*, one *R. fulvescens*, one *R. montanus* and two *Chaetodipus hispidus*. **Total Trapnights: 300**

3. Martin's (2002) Record # 861203. March 13-18, 2011. TX, Hardeman Co. Copper Breaks State Park. About 0.3 miles northwest of intersection of Park Road 62 at Comanche Camping Area entrance sign. South side of road just east of green electrical box (34.11817N, 99.759433W). Loamy, relatively thick soil. Mesquite grassland with many grass species but possibly vine mesquite as dominant grass. Dominant shrub is mesquite with a few scattered junipers. No active runs, burrows, or dust bathing sites. 250 trapnights. Catch: Two *Peromyscus attwateri* mostly near junipers with 30% bare ground; three *P. leucopus* in 0-10% bare ground near mesquite, juniper, and allthorn, respectively; 20 *Sigmodon hispidus* in 0-20% bare areas; six *Baiomys taylori* with 0 % bare ground; and one *Reithrodontomys montanus*, as well as four *R. fulvescens* with 0-30% bare ground near mesquite or less often juniper. **Total Trapnights: 250**

4. Martin's (2002) Record # 8710241. March 13-18, 2011. TX, Hardeman Co. Copper Breaks State Park. About 0.09 miles northwest of intersection of Park Road 62 at Comanche Camping Area entrance sign, South side of road on curve (34.110150N, 99.756300W). Loamy, relatively thick soil. Mesquite grassland with many grass species

but possibly vine mesquite as dominant grass. Dominant shrub is mesquite with no junipers. No active runs, burrows, or dust bathing sites. 250 trapnights. Catch: 16 *Sigmodon hispidus* with 0% bare areas near mesquite, prickly pear, or no shrubs; 20 *Baiomys taylori* in 0 % bare ground near mesquite, prickly pear, or rarely no shrubs; and six *Reithrodontomys fulvescens* in 0-30% cover near mesquite or less often prickly pear. **Total Trapnights: 250**

5. Martin's (2002) Record # 9311121. June 30, 2006-May 9, 2007 (not continuous). Trapping grid. See Table 12 for vegetative characteristics. No active runs, burrows, or dust bathing sites. 2600 trapnights. Catch: Eight *Chaetodipus hispidus*, 75 *Baiomys taylori*, one *Reithrodontomys fulvescens*, and eight *R. montanus*. May 19-20, 2008. TX, Hardeman Co. Copper Breaks State Park. About 30 meters north of Bull Canyon Hiking Trail sign on north side of road (34.106246N, 99.756539W). Clay-loam, relatively thick soil. Mesquite and juniper grassland with little bluestem as dominant grass. About equal numbers of mesquite and juniper. 24 trapnights. Catch: 14 *Sigmodon hispidus*, one *Peromyscus leucopus*, and two *Neotoma micropus*. March 13-18, 2011. 250 trapnights. Catch: 23 *S. hispidus* in with 0% bare areas mostly near mesquite and juniper but a few near allthorn, prickly pear, and ephedra; two *B. taylori* with 0 % bare ground mostly near mesquite; and two *R. fulvescens* in areas with 0% bare ground. April 17, 2011. 120 trap nights. Within 200 meters of Martin site. Catch 12 *P. attwateri*, four *P. leucopus*, three *R. fulvescens*, four *S. hispidus*, and one *N. leucodon*. May 25-27, 2011. 50 trapnights. Catch: Two *S. hispidus* and one *C. hispidus*. **Total Trapnights: 3044**

6. Martin's (2002) Record # 861202. March 15-18, 2011. TX, Hardeman Co. Copper Breaks State Park. Area just behind Camp Site # 40 in Equestrian Camping Area (34.1177080N, 99.754684W). Sandstone outcrops with thin soil. Bare areas surrounded by dense vegetation. Dominant shrub is juniper and dominant herb is little bluestem. No active runs, burrows, or dust bathing sites. 25 trapnights. Catch: 12 *Peromyscus attwateri* in 10-60% bare areas near junipers and/or rock outcrops. **Total Trapnights: 25**

7. Martin's (2002) Record # 9608181. May 18, 2011. TX, Archer Co. Intersection of Cemetery Road and North Parkey Ranch Road (33.72695N, 98.895367W). Clay soil. Road side adjacent to mesquite pasture with fire break. Bare areas in fire break surrounded by fairly dense vegetation with about 10% bare ground. Dominant shrub in adjacent pasture is mesquite and dominant herb is broomweed. No indication of burrows, runs, or dust bathing near fence. 15 trapnights. Catch: One *Reithrodontomys fulvescens*. **Total Trapnights: 15**

8. Martin's (2002) Record # 0008241. May 18, 2011. TX, Archer Co. About 200 yards from southeast corner of Dundee Cemetery along North Parkey Ranch Road adjacent to pastureland across from wheat field beside cemetery (33.72682N, 98.88364W). Clay soil. Roadside adjacent to mesquite pasture with fairly dense vegetation with about 10% bare ground. Dominant shrub in adjacent pasture is mesquite and dominant herb is broomweed. No indication of burrows, runs, or dust bathing near fence. 15 trapnights. Catch: One *Chaetodipus hispidus*. **Total Trapnights: 15**

9. Martin's (2002) Record # 9908131. March 18, 2011. TX, Wilbarger Co. On Harrold Lane, about 2.4 miles intersection of Highway 287 and Harrold Lane (34.04217N, 99.015951W). Clay soil. Road side adjacent to mesquite pasture currently being root-plowed. Dominant shrub in adjacent pasture is mesquite. Because of root-plowing and road grading there was little herbaceous vegetation with 90-100% bare ground. Saw some holes in old fence line but no indication of burrows, runs, or dust bathing near fence. Observed wild hogs along road. 10 trapnights. Catch: No animals captured.
   Total Trapnights: 10

10. Martin's (2002) Record # 9908134. March 18, 2011. TX, Wilbarger Co. On Harrold Lane, about 2.4 miles intersection of Highway 287 and Harrold Lane (34.04217N, 99.015951W). Clay soil. Road side adjacent to mesquite pasture currently being root-plowed. Dominant shrub in adjacent pasture is mesquite. Because of root-plowing and road grading there was little herbaceous vegetation with about 90% bare ground. Saw some holes in old fence line but no indication of burrows, runs, or dust bathing near fence. Observed wild hogs along road. 10 trapnights. Catch: No animals captured.
    Total Trapnights: 10

11. Site reported by Martin (2002) as an unplottable locality for Buffalo Creek Reservoir. Mesquite grassland. May 23-24, 2011. TX, Wichita County. Buffalo Creek Reservoir. Northwest corner of reservoir land boundary at entrance gate and along west boundary fence. Coordinates at entrance gate: 34.00937N, 98.76695W). Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrub is mesquite. Dominant herb is silverleaf nightshade and grass is little barley. 35 trapnights. Catch: One *Peromyscus maniculatus*. Surveyed for burrows on south and north entrance areas. North entrance area was good habitat with grazing and bare ground and it was surveyed for burrows from entrance gate to near back side of reservoir property. Bare ground was often 40-60%. No burrows were found but because the habitat was good and Martin had reported six unplottable localities as Buffalo Creek Reservoir or Buffalo Lake, trapping was done though no active burrows, runs, or dust bathing sites were located. June 30-July 3, 2011. Locality at northwest boundary of reservoir as well as southwest, northeast and southeast localities. 300 trapnights. Catch: Four *P. maniculatus*, one *Reithrodontomys montanus*, and one *Neotoma leucodon*. July 14-July 17, 2011. 300 trapnights. Catch: Two *P. maniculatus*, one *P. leucopus*, and one *Sigmodon hispidus*. August 4-August 7, 2011. 300 trapnights. Catch: One *R. montanus*. August 18-August 21, 2011. 300 trapnights. Catch: Two *P. maniculatus* and one *P. leucopus.* September 1-4. 300 trapnights. Catch: Three *P. maniculatus.* September 22-25, 2011. 300 trapnights. Catch: Nine *P. maniculatus.* September 29-October 2, 2011. 300 trapnights. Catch: One *P. maniculatus.* October 13-October 16, 2011. 300 trapnights. Catch: Three *P. maniculatus.* November 3-November 6, 2011. 300 trapnights. Catch: Four *P. maniculatus.* November 10-November 13, 2011. 300 trapnights. Catch: One *S. hispidus*. December 1-December 4, 2011. 300 trapnights. Catch: One *P. maniculatus.* December 15-December 18, 2011. 300 trapnights. Catch: One *P. maniculatus.* January 10-January 13, 2012. 300 trapnights. Catch: No animals captured. January 27-January 30, 2012. 300 trapnights. Catch: 13 *P.*

maniculatus. February 3-February 6, 2012. 300 trapnights. Catch: Two *P. maniculatus.* February 17-February 20, 2012. 300 trapnights. Catch: Three *P. maniculatus.* March 2-March 5, 2012. 300 trapnights. Catch: Four *P. maniculatus.* March 16-March 19, 2012. 300 trapnights. Catch: Three *P. maniculatus.* April 13-April 16, 2012. 300 trapnights. Catch: Five *P. maniculatus.* April 27-April 30. 300 trapnights. Catch: Two *P. maniculatus.* May 3-4, 2012. 100 trapnights. Catch: One *Chaetodipus hispidis*. **Total Trapnights: 6135**

12. Martin's (2002) Record # 9708053. May 25-27, 2011. TX, Hardeman Co. Near entrance to Copper Breaks State Park about six steps north of the Quanah/Altus road sign on east side of Highway 6 (34.114072N, 99.731298W). Road side adjacent to cultivated field. Dominant vegetation was Johnsongrass with no shrubs or herbaceous vegetation. Field was surrounded by fire break. No active burrows, runs, or dust bathing sites observed and there was little bare ground likely less than 5%. 10 trapnights. Catch: No animals captured. **Total Trapnights: 10**

13. Martin's (2002) Record # 87072523. May 25-27, 2011. TX, Hardeman Co. Near intersection of Star Valley Road and Highway 6, about 25 yards east of stop sign on north side of Star Valley Road (34.128517N, 99.73250W). Road side adjacent to ungrazed field with roadside having similar vegetation to field. Dominant vegetation was mesquite and a few small junipers with little bluestem and ragweed. No active burrows, runs, or dust bathing sites observed and there was up to 60% bare ground. 10 trapnights. Catch: Two *Peromyscus maniculatus* and one *Chaetodipus hispidis*. **Total Trapnights: 10**

14. Martin's (2002) Record # 983101. May 25-27, 2011. TX, Hardeman Co. 0.2 miles west of intersection of Highway 6 and Copper Breaks Road. At double gates of ranch on north side of Copper Breaks Road. Martin site is actually about 10 steps into private land on north side of road (34.128914N, 99.73657W). Trapped on each side of gate on county road right-of-way. Road side adjacent to pastureland with roadside having similar vegetation. Dominant vegetation was mesquite and junipers with some lotebush with dropseed and broomweed. No active burrows, runs, or dust bathing sites observed and there was up to 60% bare ground. 10 trapnights. Catch: One *Baiomys taylori*. May 14-23, 2012. 80 trapnights. Catch: One *Neotoma micropus*, two *Perognathus merriami*, and one *Peromyscus maniculatus*. **Total Trapnights: 90**

15. Martin's (2002) Record # 982102. May 25-27, 2011. TX, Hardeman Co. 0.2 miles west of intersection of Highway 6 and Copper Breaks Road. Across from double gates of ranch on south side of Copper Breaks Road. Martin site is actually about 80 steps into private land on south side of road (34.128015N, 99.73612W). Trapped on county road right-of-way. Road side adjacent to pastureland with roadside having similar vegetation. Dominant vegetation was mesquite, prickly pear, and junipers with some ephedra and lotebush with sideoats grama and broomweed. No active burrows, runs, or dust bathing sites observed and there was up to 50% bare ground. There were some mammal runways extending under juniper and around prickly pear. 10 trapnights. Catch: One *Peromyscus attwateri* and one

Neotoma micropus near prickly pear and juniper. May 14-23, 2012. 80 trapnights. Catch: One *N. micropus*. **Total Trapnights: 90**

16. Martin's (2002) Record # 932101. May 25-27, 2011. TX, Hardeman Co. 0.2 miles west of intersection of Highway 6 and Copper Breaks Road. Across from double gates of ranch on south side of Copper Breaks Road. Martin site is actually about 80 steps into private land on south side of road (34.128015N, 99.73612W). Trapped on county road right-of-way. Road side adjacent to pastureland with roadside having similar vegetation. Dominant vegetation was mesquite, prickly pear, and junipers with some ephedra and lotebush with sideoats grama and broomweed. No active burrows, runs, or dust bathing sites observed and there was up to 50% bare ground. There were some mammal runways extending under juniper and around prickly pear. 10 trapnights. Catch: One *Peromyscus attwateri* and two *Neotoma micropus* near prickly pear and juniper. May 14-23, 2012. 80 trapnights. Catch: One *N. micropus*. **Total Trapnights: 90**

17. Martin's (2002) Record # 932102. May 19-21, 2008. TX, Hardeman Co. 0.2 miles west of intersection of Highway 6 and Copper Breaks Road. Across from double gates of ranch on south side of Copper Breaks Road. Martin site is actually about 80 steps into private land on south side of road (34.128028N, 99.73672W). Trapped on county road right-of-way. Road side adjacent to pastureland with roadside having similar vegetation. Dominant vegetation was mesquite, prickly pear, and junipers with some ephedra and lotebush with sideoats grama and broomweed. No active burrows, runs, or dust bathing sites observed and there was up to 50% bare ground. Traps placed around mesquite and prickly pear. 65 trapnights. Catch: 10 *Peromyscus leucopus,* one *P. maniculatus*, one *Chaetodipus hispidus*, and 13 *Neotoma micropa*. May 25-27, 2011. 10 trapnights. Catch: Two *P. attwateri* and one *Baiomys taylori*. May 14-23, 2012. 80 trapnights. Catch: Three *N. micropus*. **Total Trapnights: 155**

18. Martin's (2002) Record # 87072522. May 25-27, 2011. TX, Hardeman Co. Near intersection of Wolf Hunt Road and Highway 6 near stop sign on north side of Wolf Hunt Road (34.21190N, 99.74021W). Road side adjacent to pastureland with little grazing. Dominant vegetation at roadside was hackberry with dropseed and thistles. No active burrows, runs, or dust bathing sites observed and there was little bare ground, probably less than 20% over most of trap site. 10 trapnights. Catch: Two *Peromyscus leucopus* and one *P. attwateri*. **Total Trapnights: 10**

19. Martin's (2002) Record # 87072521. May 25-27, 2011. TX, Hardeman Co. About 0.1 miles north of the intersection of Wolf Hunt Road and Highway 6 on east side of Highway 6 (34.212850N, 99.740217W). Road side adjacent to pastureland with little grazing. Dominant vegetation at roadside was lotebush and mesquite with dropseed and sensitive-briar. No active burrows, runs, or dust bathing sites observed and there was less than 20% bare ground. 10 trapnights. Catch: Five *Peromyscus attwateri*. **Total Trapnights: 10**

20. Martin's (2002) Record # 87072524. May 25-27, 2011. TX, Hardeman Co. 0.2 miles north of the intersection of Stepp Road and Highway 6 on east side of Highway 6

(34.229200N, 99.739650W). Road side adjacent to pastureland with little grazing. Dominant vegetation at roadside was juniper with dropseed and few forbs. No active burrows, runs, or dust bathing sites observed and there was less than 5% bare ground. 10 trapnights. Catch: One *Peromyscus leucopus.* **Total Trapnights: 10**

21. Martin's (2002) Record # 87072525. May 25-27, 2011. TX, Hardeman Co. 0.4 miles north of the intersection of Stepp Road and Highway 6 on east side of Highway 6 (34.231950N, 99.739650W). Road side adjacent to pastureland with little grazing. Dominant vegetation at roadside was mesquite with Johnsongrass and few forbs. No active burrows, runs, or dust bathing sites observed and there was less than 5% bare ground. 10 trapnights. Catch: Three *Peromyscus leucopus*, one *Baiomys taylori*, and one *Sigmodon hispidus.* **Total Trapnights: 10**

22. Martin's (2002) Record # 913101. May 25, 2011. TX, Hardeman Co. 0.16 miles north of the intersection of Bynum Road and Highway 6 in irrigated cropland (34.257467N, 99.736417W). Did not trap at site as it was in field on private property and the habitat was poor. Current crop was wheat and there was irrigation at the site. Possible that this was once pasture land that was converted to cropland in recent history. **Total Trapnights: 0**

23. Martin's (2002) Record # 86072526. May 25, 2011. TX, Hardeman Co. 0.12 miles south of the First United Methodist Church in Quanah on the east side of Highway 6 (34.283967N, 99.742800W). Area near two houses (one relatively new) and modified into a horse pen. Horses had removed most vegetation. Did not trap due to poor habitat and proximity of houses. Possible this was once pastureland that was converted to houses and horse pens in recent history. **Total Trapnights: 0**

24. Martin's (2002) Record # 87072525. May 25, 2011. TX, Hardeman Co. Intersection of Highway 133 (Hamby Road) and FM 2560 (34.231950N, 99.739650W). Area at fence corner with tall Johnsongrass adjacent to recently plowed cropland. Did not trap due to poor habitat. Possible this was once pastureland that was converted to cropland in recent history. **Total Trapnights: 0**

25. Martin's (2002) Record # 8607292. May 25, 2011. TX, Hardeman Co. Intersection of Highway 133 (Hamby Road) and FM 2560 (34.299533N, 99.719733W). Area at fence corner with tall Johnsongrass adjacent to recently established yard with mobile home. Mesquite pastureland north of mobile home but had not been grazed and there was no evidence of burrows, runs, or dust bathing sites. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a homesite in recent history. **Total Trapnights: 0**

26. Martin's (2002) Record # 8607281. May 25, 2011. TX, Hardeman Co. 0.36 miles from intersection of Highway 133 (Hamby Road) and FM 2560 on north side of Hamby Road (34.299533N, 99.714017W). Area at narrow roadside with steep berm. Adjacent to ungrazed tall dropseed and mesquite pastureland. No burrow activity, runs, or dust bathing

sites and little bare ground. Because of steepness of road berm and poor habitat the area was not trapped.
Total Trapnights: 0

27. Martin's (2002) Record # 86071215. May 25-27, 2011. TX, Hardeman Co. South of intersection of Highway 133 (Hamby Road) and FM 2560 at railroad right-of-way where it crosses FM 2560 (34.29666N, 99.719950W). Area at fence corner with tall little barley and dense growth of tumbleweed adjacent to cropland. No active burrows, runs, or dust bathing sites observed and there was less than 5% bare ground. 10 trapnights. Catch: One *Peromyscus maniculatus* and four *Sigmodon hispidus*. **Total Trapnights: 10**

28. Martin's (2002) Record # 0008281. June 13, 2011. TX, Motley Co. 0.7 miles east intersection of County Road 423 and 404 on County Road 404 (33.980129N, 100.763644W). Cultivated fields on both sides of road with roadside dominated by Japanese brome with few forbs. No burrow activity, runs, or dust bathing sites with only 10-20% bare ground. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

29. Martin's (2002) Record # 9908141. June 13, 2011. TX, Motley Co. 0.06 mile east intersection of County Road 423 and 404 on County Road 404 (33.980357N, 100.773983W). Cultivated cotton fields on both sides of road with field plowed to roadside with little vegetation. No burrow activity, runs, or dust bathing sites with 90-100% bare ground due to plowing. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

30. Martin's (2002) Record # 9908142. June 13, 2011. TX, Motley Co. 0.06 mile east intersection of County Road 423 and 404 on County Road 404 (33.980357N, 100.773983W). Cultivated cotton fields on both sides of road with field plowed to roadside with little vegetation. No burrow activity, runs, or dust bathing sites with 90-100% bare ground due to plowing. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

31. Martin's (2002) Record # 0008282. June 13, 2011. TX, Motley Co. 0.06 mile east intersection of County Road 423 and 404 on County Road 404 (33.980160N, 100.774035W). Cultivated cotton fields on both sides of road with field plowed to roadside with little vegetation. No burrow activity, runs, or dust bathing sites with 90-100% bare ground due to plowing. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

32. Martin's (2002) Record # 0008283. June 13, 2011. TX, Motley Co. North of (0.06 mile) the east intersection of County Road 423 and 404 on County Road 404 on private land in cultivated field (33.983044N, 100.774095W). Cultivated cotton fields on both sides of road with field plowed to roadside with little vegetation. No burrow activity, runs, or dust bathing sites at road and unlikely in field on private land with 90-100% bare ground due to

plowing. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

33. Martin's (2002) Record # 0008284. June 13-14, 2011. TX, Motley Co. 0.3 miles west intersection of County Road 433 and 422 on County Road 422 (33.995135N, 100.744901W). Cultivated fields on both sides of road with roadside dominated by Japanese brome and bermuda with few forbs and no woody vegetation. No burrow activity, runs, or dust bathing sites with only 10-20% bare ground. 10 trapnights. Catch: No animals captured.
    Total Trapnights: 10

34. Martin's (2002) Record # 9608142. June 13, 2011. TX, Motley Co. 5.3 miles northeast intersection of County Road 247 and Highway 62/70 on County Road 247 (34.051728N, 100.633105W). Matador Ranch gate blocked road at about 5.0 miles and employees said that the road past the gate was ranch road and no longer county road. Did not trap as was on private property. **Total Trapnights: 0**

35. Martin's (2002) Record # 9608142. June 13, 2011. TX, Motley Co. at about 5.5 miles northeast intersection of County Road 247 and Highway 62/70 on County Road 247 (34.054369N, 100.632919W). Matador Ranch gate blocked road at about 5.0 miles and employees said that the road past the gate was ranch road and no longer county road. Did not trap as was on private property. **Total Trapnights: 0**

36. Martin's (2002) Record # 19960814. June 13-14, 2011. TX, Motley Co. 2.2 miles north intersection of County Road 247 and Highway 62/70 on County Road 247 (34.039259N, 100.650482W). Mesquite pasture with little to no grazing and new fence. Cultivated fields on opposite side of road with roadside dominated by Japanese brome with few forbs and no woody vegetation. No burrow activity, runs, or dust bathing sites with only 5% bare ground. 10 trapnights. Catch: No animals captured. **Total Trapnights: 10**

37. Martin's (2002) Record # 0008285. June 13-14, 2011. TX, Motley Co. Intersection of County Road 433 and Highway 62 on south side Highway 62 (34.009701N, 100.738702W). Cultivated fields surrounded by new fence on both sides road with roadside dominated by oats and dropseed with few forbs and no woody vegetation. No burrow activity, runs, or dust bathing sites with only 5% bare ground. 10 trapnights. Catch: No animals captured.
    Total Trapnights: 10

38. Martin's (2002) Record # 9908152. June 13, 2011. TX, Childress Co. 1.6 miles north intersection of County Road 24 and County Road Z on County Road 24 (34.414375N, 100.020134W). Cultivated fields on both sides of road with field plowed to roadside ditch with little vegetation. Deep roadside ditch filled with sunflowers. No burrow activity, runs, or dust bathing sites with 0% bare ground. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

39. Martin's (2002) Record # 9708051. June 13, 2011. TX, Childress Co. Intersection of County Road 21 and County Road EE (34.319379N, 100.075531W). Cultivated fields on all sides of roads with field plowed to roadsides with little vegetation. Roadside ditch with scattered Bermuda grass and sunflowers. No burrow activity, runs, or dust bathing sites with 90-100% bare ground due to plowing to road edge. Did not trap due to poor habitat. Possible this was once pastureland that was converted to a cultivated field in recent history. **Total Trapnights: 0**

40. Martin's (2002) Record # 970852. June 13-14, 2011. TX, Childress Co. 0.7 miles west intersection of Ranch Road 2638 and County Road AA on County Road AA (34.378751N, 100.103523W). Cultivated wheat fields surrounded on both sides road with roadside dominated by Japanese brome, some ragweed, with a few prickly pears in the fence. Old fence with a berm. No burrow activity, runs, or dust bathing sites with only 10-20% bare ground. 10 trapnights. Catch: No animals captured. **Total Trapnights: 10**

41. Martin's (2002) Record # 9806211. June 13-14, 2011. TX, Childress Co. 0.17 miles north intersection of County Road 24 and County Road Z on County Road 24 (34.393736N, 100.020419W). Mesquite pasture surrounded by old fence with pasture grazed. No active burrows, runs, or dust bathing sites. 10 trapnights. Catch: No animals captured. May 15-23, 2012. 122 trapnights. Catch: One *Peromyscus maniculatus* and one *P. leucopus*. **Total Trapnights: 132**

42. Martin's (2002) Record # 0007271. June 13-14, 2011. TX, Childress Co. 0.17 miles north intersection of County Road 24 and County Road Z on County Road 24 (34.393736N, 100.020419W). Mesquite pasture surrounded by old fence with a good berm. Dropseed and threeawn with few forbs and 40-60% bare areas. Adjacent pasture grazed. No active burrows, runs, or dust bathing sites. 10 trapnights. Catch: No animals captured. May 15-23, 2012. 123 trapnights. Catch: One *Peromyscus maniculatus.* **Total Trapnights: 133**

43. Martin's (2002) Record # 9908151. June 13-14, 2011. TX, Childress Co. 0.52 miles north intersection of County Road 24 and County Road Z on County Road 24 (34.398857N, 100.020611W). Mesquite pasture surrounded by old fence with a good berm. Fence with some yucca and large rocks. Dropseed and buffalograss with few forbs and 30-40% bare areas. No active burrows, runs, or dust bathing sites. Adjacent pasture grazed. 10 trapnights. Catch: No animals captured. May 15-23, 2012. 175 trapnights. Catch: Four *Peromyscus maniculatus.* **Total Trapnights: 185**

44. Martin's (2002) Record # 9607091. June 13-14, 2011. TX, Childress Co. 0.6 miles intersection of Highway 287 and Farm to Market Highway 2875, south on 2875 (34.362050N, 100.021833W). Cultivated fields surrounded by older fence on both sides road with roadside dominated by Johnsongrass with few forbs and no woody vegetation. Road paved and roadside mowed. No burrow activity, runs, or dust bathing sites. with 0-10% bare ground. 10 trapnights. Catch: No animals captured. **Total Trapnights: 10**

45. Martin's (2002) Record # 9607091. June 14, 2011. TX, Hardeman Co. 3.36 miles intersection of Highway 287 and Farm to Market Highway 268, north on 268 (34.405533N, 99.967017W). Ungrazed mesquite pasture on east side of road and cultivated field on west side road. East roadside dominated by Johnsongrass with few forbs and no woody vegetation. Road paved and roadside mowed. No burrow activity, runs, or dust bathing sites with 0% bare ground. 10 trapnights. Catch: One *Sigmodon hispidus*. **Total Trapnights: 10**

46. Martin's (2002) Record # 8607291. June 18, 2011. TX, Hardeman Co. 1.39 miles east intersection of Hamby Road (133) and Farm to Market Highway 2568, east on Hamby Road (34.299533N, 99.69593W). Ungrazed mesquite pasture. Roadside dominated by dropseed and buffalograss with a few ragweeds and mesquite in older fence. No burrow activity, runs, or dust bathing sites with 70-80% bare ground. 10 trapnights. Catch: No animals captured. May 15-23, 2012. 140 trapnights. Catch: One *Neotoma micropus.* **Total Trapnights: 150**

47. Martin's (2002) Record # 8607301. June 18, 2011. TX, Hardeman Co. 1.8 miles east intersection of Hamby Road (133) and Farm to Market Highway 2568, east on Hamby Road (34.299533N, 99.688833W). Ungrazed mesquite pasture. Roadside dominated by dropseed and ragweed with no mesquite in older fence. No burrow activity, runs, or dust bathing sites with 0% bare ground. 10 trapnights. Catch: No animals captured. May 15-23, 2012. 140 trapnights. Catch: Two *Peromyscus leucopus* and four *P. maniculatus.* **Total Trapnights: 150**

48. Martin's (2002) Record # 8707252. June 18, 2011. TX, Hardeman Co. 0.02 mile northeast intersection of Bursey Road and Farm to Market Highway 2568, in abandoned field (34.278417N, 99.720433W). Ungrazed abandoned field south of relatively new home and adjacent to older home. Roadside dominated by Johnsongrass with a few ragweed. Older fence paralleling paved highway that was mowed. No burrow activity, runs, or dust bathing sites with 5% bare ground. Did not trap because of proximity to homes and poor habitat. **Total Trapnights: 0**

Non-Martin (2002) Sites (3901 trapnights)

1. Goetze and Nelson (2011). Burrows along oil field road and salt scald (bare area caused by salt water spillage during oil extraction) in mesquite grassland. May 15-19, 2011. TX, Wichita County. Goetze Farm. Snow Place. 0.5 miles intersection Highway 2345 and Hall Road (coordinates at entrance gate: 34.05756N, 98.69716W). Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrub is mesquite and herbs are silverleaf nightshade, white tridens, and whorled dropseed. Burrows, runs, and dust bathing sites visible. 132 trapnights. Catch: 12 (five individuals and seven recaptures; four females and one male) *Dipodomys elator* in 78-97% bare ground near oil field pipe, road berms, and in fence lines. Also caught two *Chaetodipus hispidus*, three *Neotoma leucodon*, four *Peromyscus leucopus*, seven *P. maniculatus*, and two *Sigmodon hispidus*. June 30-July 6, 2011. Roadside ditch dominated by Johnsongrass and

bermudagrass and no forbs, One hackberry in fence with 0% bare ground except for those traps along gravel road edge, which is completely bare on one side of about five of the traps. No active burrows, runs, or dust bathing sites. 150 trapnights at gate entrance around gate and fence at intersection of oil field and Hall Road. Catch: Nine *P. leucopus.* August 3-August 7, 2011. Roadside ditch dominated by Johnsongrass and bermudagrass and no forbs. One hackberry in fence with 0% bare ground except for those traps along gravel road edge, which is completely bare on one side for five of the traps. No active burrows, runs, or dust bathing sites. 100 trapnights at gate entrance around gate and fence at intersection of oil field and Hall Road. Catch: 13 *P. leucopus* and one *S. hispidus*. March 13-15, 2012. Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrub is mesquite and herbs are silverleaf nightshade, white tridens, and whorled dropseed. Active burrows, runs, and dust bathing sites observed. 48 trapnights. Catch: Six (three individuals and three recaptures; two females and one male) *D. elator* in 25%-60% bare ground near oil field pipe, road berms, and in fence lines. Also caught five *P. leucopus* and two *P. maniculatus*. May 4, 2012. 24 trapnights. Catch: Two *P. maniculatus*. **Total Trapnights: 454 (204 inside pasture and 250 outside at fence and gate adjacent to Hall Road)**

2. Nelson, Nelson, and Goetze site (2007). May 17-19, 2007. TX, Hardeman County. 5.1 miles east of Intersection of Highway 6 and Hurst Williams Road on Hurst Williams Road until it becomes Highway 3295. Then 1.4 miles on Highway 3295 on north side of road (34.15163N, 99.64107W). Roadside adjacent to ungrazed little bluestem pastureland. Area along fence with little bluestem, side oats grama, purple threeawn, and Texas sleepy daisy, and 55-80% bare ground. Two active burrows observed. 50 trapnights. Catch: One *Peromyscus leucopus* and three (two individuals and one recapture; one female and one male) *Dipodomys elator*. March 25-27, 2011. Area along fence with little bluestem, side oats grama, few herbs, and 20-60% bare ground. No active burrows observed. 20 trapnights. Catch: No animals captured. June 18, 2011. No active burrows, runs, or dust bathing sites observed. 40 trapnights. Catch: No animals captured. May 15-23, 2012. No active burrows, runs, or dust bathing sites observed. 175 trapnights. Catch: No animals captured. **Total Trapnights: 285**

3. Nelson, Nelson, and Goetze 2007. Longhorn enclosure fenceline. May 19-20, 2007. TX, Hardeman Co. Copper Breaks State Park. West end of fence-line around longhorn enclosure, 0.2 miles from park entrance (34.11216N, 99.74036W). Loamy soil. Dominant shrubs are juniper and some mesquite, and dominant herb is sideoats grama on grazed side of fence and little bluestem on ungrazed side. Grazed side as more bare areas and is more like catch-sites for Texas kangaroo rat than other areas of the park. No active burrows, runs, or dust bathing sites. 105 trapnights. Catch: No animals caught. March 13-18, 2011. 100 trapnights. Catch: Nine *Peromyscus attwateri* mostly near junipers with 5-30% bare areas; one *P. leucopus* in 20% bare areas near juniper; and five *Reithrodontomys fulvescens* with 0-10 % bare ground mostly near mesquite. April 16-17, 2011. Longhorn Pasture at second gate after passing through park maintenance area. Traps set parallel to cross fence beginning at gate (34.11068N, 99.73571W). Area grazed by longhorns with 30-50% bare ground. Dominant shrub was mesquite and dominant grass was sideoats

grama that had been grazed mostly to less than 12 cm in height. No active burrows, runs, or dust bathing sites. 460 trap nights. Catch: three *R. fulvescens*, three *Sigmodon hispidus*, and three *Baiomys taylori*. May 28, 2011. 50 trapnights. At site mentioned above for April 16-17, 2011 and on east boundary fence on both sides of entrance gate into longhorn enclosure (34.11029N, 99.73326W). Catch: No animals captured. May 15-23, 2012. 273 trapnights. Catch: None. **Total Trapnights: 988**

4. Goetze 2008. Burrows in pastureland with one near oil storage battery. Mesquite and lotebush grassland. May 15-17, 2008. TX, Wichita County. Goetze Farm. Eades Place. 0.4 miles east of intersection of Highway 1739 and Highway 2345. (coordinates at entrance gate: 34.05446N, 98.78699 W). Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrubs are mesquite and lotebush. Herbs are silverleaf nightshade, purple threeawn, and buffalo grass. Active runs, burrows, and dust bathing sites observed. 160 trapnights. Catch: nine *Peromyscus leucopus*, nine *Neotoma micropus*, and twelve (11 individuals and one recapture; five females and six males) *Dipodomys elator*. May 17-19, 2011. 72 trapnights. Catch: Three (two individuals and one recapture; one female and one male) *D. elator* in 60-74% bare areas near oil storage tank and prairie mound. Active runs, burrows, and dust bathing sites observed. July 13-July 22, 2012. North side of place on either side of entrance gate adjacent to Highway 2345. Roadside and fenceline dominated by Japanese brome. No active burrows, runs, or dust bathing sites observed. 250 trapnights. Catch: No animals caught. Also walked over area inside property and observed active burrows, runs, and dust bathing sites but was unable to trap as new owner did not give permission after property changed ownership in 2012. **Total Trapnights: 482 (232 inside pasture and 250 outside at fence and gate adjacent to Hall Road)**

5. Goetze 2007. Burrows in pasture land. Mesquite and lotebush grassland. March 11, 2007. TX, Wichita County. Goetze Farm. Overall Place. Intersection of Highway 1739 and Highway 2345. (coordinates at entrance gate: 34.05423N, 98.781721W). Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrubs are mesquite and lotebush. Herbs are silverleaf nightshade, whorled dropseed, and buffalo grass. Active burrows, runs, and dust bathing sites observed. 30 trapnights. Catch: 10 (10 individuals; six females and four males) *Dipodomys elator.* May 17-19, 2011. Active burrows, runs, and dust bathing sites observed. 108 trapnights. Catch: Two (one individual and one recapture; one female) *D. elator* in 40-45% bare areas near low growing, small mesquites. Also caught one *Chaetodipus hispidus* and four *Peromyscus leucopus.* March 12-14, 2012. Active burrows, runs, and dust bathing sites observed. 144 trapnights. Catch: Eleven (10 individuals and one recapture; six females and four males) *D. elator* in 20%-45% bare areas near low growing, small mesquites. Also caught three *P. leucopus* and 11 *P. maniculatus.* May 3-4, 2012. Active burrows, runs, and dust bathing sites observed. 72 trapnights. Catch: One *D. elator* (female). July 13-July 22, 2012. Inside pasture at about same localities as above with dominant vegetation little barley and buffalograss. Active burrows, runs, and dust bathing sites observed. 375 trapnights. Catch: Eight (six individuals and zero recaptures; sex not determined) *D. elator* in fence row and near low growing, small mesquites. Also caught two *C. hispidus.* July 13-July 22,

2012. On either side of entrance gate adjacent to Highway 1739. Roadside and fenceline dominated by dense Japanese brome. No active burrows, runs, and dust bathing sites observed. 375 trapnights. Catch: One *D. elator* (sex not determined) in fence row adjacent to salt scald near low growing, small mesquites. Also caught two *C. hispidus,* one *Sigmodon hispidus,* and three *P. leucopus.*
Total Trapnights: 1004 (629 inside pasture and 375 outside at fence and gate adjacent to Hall Road)

6. Goetze 2005. Burrows in pasture land. Mesquite and lotebush grassland. May 21-July 22, 2005 (not continuous). TX, Wichita County. Goetze Farm. Home Place. On Goetze Road about 3.5 miles east of intersection of Goetze Road and Highway 2345 (coordinates at entrance gate: 34.06497N, 98.70709W). Clay soil with sandstone bedrock. Bare areas surrounded by short vegetation. Dominant shrubs are mesquite and lotebush. Herbs are silverleaf nightshade, hog potato, whorled dropseed, and buffalo grass. Active burrows, runs, and dust bathing sites observed. 996 trap nights. Catch: 45 *Dipodomys elator* (18 individuals and 37 recaptures; nine females and nine males), 10 *Chaetodipus hispidus*, four *Neotoma micropus*, and two *Peromyscus leucopus*. May 17-20, 2011. Active burrows, runs, and dust bathing sites observed. 72 trapnights. Catch: One (male) *D. elator* in 69% bare area at prairie mound. Also caught one *C. hispidus* and one *Baiomys taylori*. May 3-4, 2012. Goetze Road that intersects site on north end (34.03843N, 98.76068W). Roadside and fenceline dominated by dense Japanese brome. No active burrows, runs, and dust bathing sites observed. 10 trapnights. Catch: No animals caught. July 13-July 22, 2012. Same as May 3-4, 2012 site. 250 trapnights. Catch: One *P. leucopus*. Also walked over area inside property and observed active burrows, runs, and dust bathing sites but was unable to trap as new owner did not give permission after property changed ownership in 2012. **Total Trapnights: 1328 (1078 inside pasture and 260 outside at fence and gate adjacent to Hall Road)**

7. Goetze 2011. Salvaged dead *Dipodomys elator* on Hall Road. June 25, 2011. TX, Wichita County. About 150 yards intersection Highway 2345 and Hall Road (coordinates at 34.06412N, 98.69678W). June 30-July 6, 2011. Trapped on east side of road in ditch at these coordinates. Adjacent area is mesquite pasture. Roadside ditch and fence with two mesquites in fence and dominated by silver bluestem and Johnsongrass. Few to no forbs and 10% bare ground. No active burrows, runs, and dust bathing sites observed. 150 trapnights. Catch: Four *Peromyscus leucopus*. **Total Trapnights: 150**