PETITION TO LIST THE TEXAS KANGAROO RAT (*Dipodomys elator*) UNDER THE U.S. ENDANGERED SPECIES ACT

Photo: Texas Parks and Wildlife Department

Petition Submitted to the Secretary of Interior
Acting through the U.S. Fish and Wildlife Service

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303-573-4898

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WILDEARTH GUARDIANS
A FORCE FOR NATURE

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I. Introduction: Petition Request

WildEarth Guardians hereby petitions the Secretary of the Interior and the U.S. Fish and Wildlife Service ("FWS" or "the Service") to issue a rule listing the Texas kangaroo rat (*Dipodomys elator* Merriam 1894) as Threatened or Endangered under the Endangered Species Act, ("ESA") 16 U.S.C. § 1531 *et seq*. throughout its historic range and to designate critical habitat for the species. This petition is filed under 5 U.S.C. § 553(e), 16 U.S.C. § 1533(b)(3)(A) and 50 C.F.R. § 424.19 (1987), bestowing interested persons the right to petition for issuance of a rule.

The Texas kangaroo rat occupies a small and shrinking range in north-central Texas and southern Oklahoma close to the Red River. The species has declined in distribution and abundance since Europeans settled the Great Plains and the regions within its historic habitat. The species is also suffering from continued range fragmentation and habitat degradation (Linzey et al. 2008).

Texas kangaroo rats were adapted to the natural ecological processes and native vegetation that existed within its range before Europeans settled the Great Plains. Texas kangaroo rats benefited from bison (*Bison bison*) grazing, black-tailed prairie dog (*Cynomys ludovicianus*) colonization, and periodic fires that helped maintain areas of bare ground and short vegetation, which provided preferred burrowing sites for the species (Stangl et al. 1992a; Stangl et al. 1992b; Goetze et al. 2007; Linzey et al. 2008; Nelson et al. 2009). *D. elator* also prefers a mix of low shrubs and grasses for foraging.

Humans completely altered these processes and plant composition within the last 150 years. Humans extirpated bison within the Texas kangaroo rat range by the 1880s. We exterminated the prairie dogs in the region in the early 1900s. The species has lost over 60% of its habitat to cropland, development, and road encroachment. See Figures 3, 4, 5, and 6. Another significant portion of *D. elator*'s habitat has been lost to exotic grasses planted to benefit cattle. In many areas, monocultures of taller, denser grasses for cattle have pushed Texas kangaroo rats into more marginal habitat, such as mesquite stands that they would otherwise avoid. Once croplands and cattle were established within the species' range, humans suppressed naturally occurring fires that cleared out dense vegetation. Along with these historic and continuing threats, climate change is expected to destroy 48-80% of Texas kangaroo rat's remaining suitable habitat before 2040 (Cameron and Scheel 2001).

D. elator is in danger of extinction without protection under the ESA. The species is on the Texas Parks and Game Department's threatened species list. However, the Texas kangaroo rat population continues to decline (Linzey et al. 2008).

II. Species Characteristics[1]

A. Taxonomy

The Texas kangaroo rat is also known as the Loring's kangaroo rat (Davis 1942). It is a monotypic species with no known subspecies.

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[1] Unless noted otherwise, Carter et al. (1985) served as the source for relevant descriptive information about Texas kangaroo rats.

Table 1. Taxonomic Hierarchy (ITIS 2009)

Kingdom	*Animalia*
Phylum	*Chordata*
Subphylum	*Vertebrata*
Class	*Mammalia*
Subclass	*Theria*
Infraclass	*Eutheria*
Order	*Rodentia*
Suborder	*Myomorpha*
Family	*Heteromyidae*
Subfamily	*Dipodomyinae*
Genus	*Dipodomys*
Species	*Dipodomys elator* Merriam, 1894 -- Texas kangaroo rat

Researchers have debated the relationship of *D. elator* to other members of the *Dipodomys* genus (Davis 1942; Dalquest and Collier 1964; Best and Schnell 1974). Genetic analyses by Hamilton et al. (1987) and Mantooth et al. (2000) found *D. elator* most closely related to Phillip's kangaroo rat (*D. phillipsii*) than to others within the genus once believed to be close relatives, including banner-tailed kangaroo rat (*D. spectibilis*), Merriam's kangaroo rat (*D. merriami*), and *D. ordii*.

B. General Description

D. elator is a large kangaroo rat with the typical long back legs and large hind feet of its genus. Total length of the rodent ranges from 26.0-34.5 cm (10.2-13.6 in) tip to tail. Texas kangaroo rats usually weigh between 65.0-90 g (2.3-3.2 oz), but some individuals can reach over 100 g (3.5 oz). Its color is primarily buffy with some black wash on the upperparts and white underparts. The species has white thigh patches and facial markings with a black nose. *D. elator* has a long, thick, white-tipped tail that is about 160% of its head plus body length. Males are larger than females (Best 1987).

Kangaroo rats are noted for their hopping movement pattern. Single bounds can reach close to 100.0 cm (39.4 in), and the rodents can travel at speeds of 19.0 km (11.8 mi) per hour (Sjoberg et al. 1984). Kangaroo rats fight each other by jumping on opponents and puncturing them with their back toes and biting; these fights are often fatal (*Ibid.*).

The species is adapted to the arid environment and rarely drinks water (Linzey et al. 2008). The animals take dust baths to keep their fur and skin in good condition. Dust bathing allows them to leave territorial scent marks as well.

Texas kangaroo rats are primarily herbivores. They commonly eat grass seeds, annual forbs, immature fruits, perennial and cultivated plants. One study found insect parts in the cheek pouches of some animals, but insects are not believed to be a significant part of the species' diet (Chapman 1972). Studies of the animals' cheek pouches and food storage tunnels have found Johnsongrass (*Sorghum halepense*), redstem stork's bill (*Erodium cicutarium*), prickly pear cactus (*Opuntia sp.*), dozedaisy (*Aphanostephus sp.*), honey mesquite (*Prosopis glandulosa*), puncturevine (*Tribulus terrestris*), and common oat (*Avena sativa*) (Dalquest and Collier 1964; Roberts 1969; Chapman 1972). The animals store seeds in their burrows to prepare for periods of drought (Linzey et al. 2008). For more on food habits see Chapman (1972).

Texas kangaroo rats are nocturnal. Males and females have a home range size of approximately 0.08 ha (0.20 ac), which is small relative to other Dipodomys species (Roberts and Packard 1973), and may account for their small range. The average home range of other species is 0.20 ha (0.49 ac) (Sjoberb et al. 1984). They have been known to travel over 300 m along roadways. The animals are not colonial or social. Dalquest and Collier (1964) reported that they never found more than one individual at a time or found burrows within 50 ft of each other. Unlike *D. ordii*, whose range but not habitat overlaps *D. elator*, Texas kangaroo rats do not hibernate (Dalquest and Collier 1964). For more on Texas kangaroo rat behavior, see Goetze (2008).

Generally, members of the *Dipodomys* genus are active reproductively between February and August and can produce multiple litters in one year (Sjoberg et al. 1984). Litters are most common in early spring and late fall. The female can produce 2-3 young per litter after a 29-33 day gestation period (*Ibid*.).

C. Habitat

D. elator currently inhabits arid shrublands mixed with short grasses and forbs with a preference for open areas. Preferred habitat is characterized by sparse grass patches, short forbs, diffuse shrubs, and bare ground (Goetze et al. 2007). Grasses found within Texas kangaroo rat habitat include buffalo grass (*Bouteloua dactyloides*), little barley (*Hordium pusillum*), *Bothriochloa sacharoides*, purple threeawn (*Aristida purpurea*), rescuegrass (*Bromus unioloides*), tumble windmill grass (*Chloris verticillata*), Hall's panicgrass (*Panicum halli)*, spike dropseed (*Sporobolus cryptandrus*), and white tridens (*Tridens albescens*) (Dalquest and Collier 1964; Martin and Matocha 1972; Martin and Matocha 1991). Forbes included broomweed (*Gutierrezia dracunculoides*), hog potato (*Hoffmannseggia glauca*), western ragweed (*Ambrosia psilostachya*), Texas sleepydaisy (*Xanthisma texanum*), Indian rushpea (*Hoffmannseggia glauca*), Texas bindweed (*Convolvulus equitans*), plains blackfoot (*Melampodium leucanthum*), lemon beebalm (*Monarda citriodora*), lacy germander (*Teucrium laciniatum*), meadow flax (*Linum pratense*), groundcherry (*Physalis viscose*), western horsenettle (*Solanum dimidiatum*), and puncturevine (*Tribulus terrestri*).

Unlike most kangaroo rat species that prefer sandy soils, Texas kangaroo rats are most common where firm clay-loam and loam soils can support their burrow structures (Bailey 1905; Roberts and Packard 1973; Martin and Matocha 1991; Goetze et al. 2007). Burrow mounds average 250.0 cm (98.4 in) long with a minimum of six tunnels and two openings. These burrow systems include one nest chamber at the base of the tunnels. Unlike other kangaroo rats, Texas kangaroo rats do not typically plug their burrow entrances during the day (Dalquest and Collier 1964). Roberts and Packard (1973) estimated their population densities to range from 8.6-24.7 individuals per ha (21.3-61.0 individuals per ac).

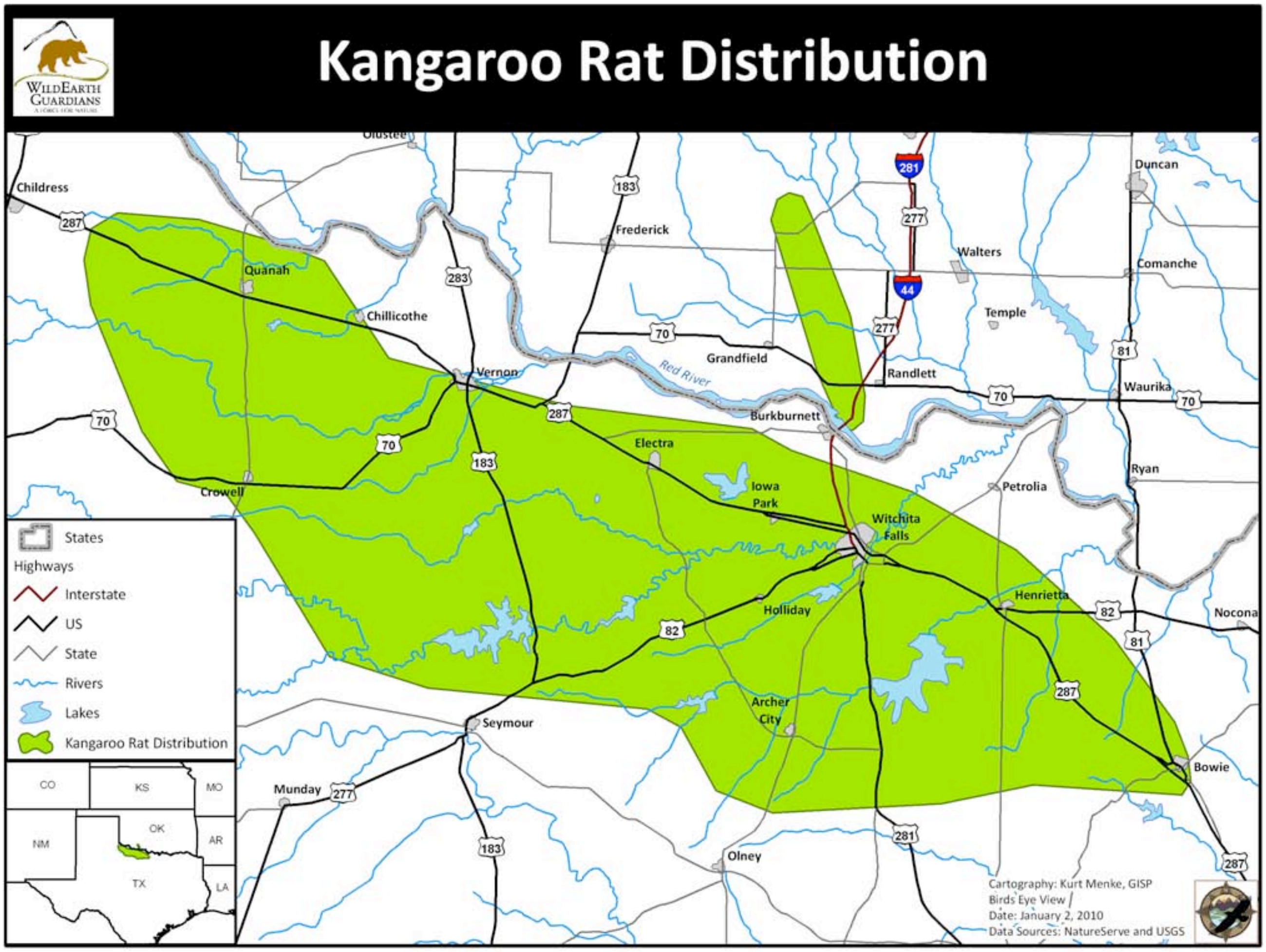
The scientific assumptions about *D. elator*'s native habitat have changed in recent years. Researchers once believed that the species was dependent on honey mesquite (Bailey 1905;

Dalquest and Collier 1964; Chapman 1972; Martin and Matocha 1972; Roberts & Packard 1973; Carter et al. 1985; Martin & Matocha 1991). However, recent studies have found that Texas Kangaroo rats prefer grazed mixed grass prairie with patches of bare ground (Stangl 1992b; Goetze 2001; Goetze et al. 2007; Nelson et al. 2009) that more closely characterize the historic biological process of the region including bison grazing and wallowing, fire, and prairie dog colonization.

Humans have completely altered the species' native habitat. Thus, *D. elator* can be found be found in some areas with plant compositions that did not exist before European settlement of the Great Plains, such as denser stands of mesquite. The animals may opportunistically use habitat disturbed by human use (Stangl et al. 1992b; Goetze et al. 2007) or may be forced to occupy alternative habitat degraded by humans.

D. elator's historic and current range has been infiltrated by crop agriculture that is interspersed with domestic livestock, particularly cattle, pastures. Unlike native bison and other native grazers, domestic livestock grazing increases woody and weedy shrub cover, including encroachment by mesquite (Parker et al. 2006). Given the propensity for cattle to increase mesquite, it is not surprising that researchers found Texas kangaroo rat burrows in stands of mesquite. For example, Martin and Matocha (1972) did not find animals more than 0.8 km (0.5 mi) from mesquite. Roberts and Packard (1973) found that the kangaroo rats built their burrows in mounds of soil at the base of mesquite shrubs or fencelines. Goetze et al. (2007) found that Texas kangaroo rats preferred to build their burrows on elevated mounds of clay soil or places where wind-blown clay soils had collected. The authors' study site—a cattle ranch in Wichita County, Texas—contained 30-year-old brush piles where clay had been deposited over the years. Furthermore, the authors found that mesquite regions were used least by the animals.

Figure 1. Texas Kangaroo Rat Range Map (NatureServe 2009)



III. Distribution and Population Status

A. Distribution

The species currently inhabits a small range in north-central Texas and possibly Oklahoma at the base of the Texas panhandle and extending east along the Red River. See Figure 1. This is a unique region on the edge of the Great Plains prairie; grass- and shrublands meet woodlands on the eastern edge of the species' range. Texas kangaroo rats are the only mammal endemic to this region (Dalquest 1968). Studies by Blair (1949), Dalquest and Collier (1964), Dalquest (1968), Packard and Judd (1968), and Martin and Matocha (1972) provide an estimated range of 1,429,674 ha (3,532,801 ac). However, a range map developed by NatureServe (2009) outlines a range area of 1,053,275 ha (2,602,698 ac). See Figures 2 and 3.

1. Oklahoma

No Texas kangaroo rats have been found in Oklahoma since 1969. Baumgardner (1987) reported on this specimen found north of the Red River in Cotton County, Oklahoma. The animal is part of a collection at the Midwestern State University. Prior to 1969, Bailey (1905) collected specimens near the town of Chattanooga in Comanche County, Oklahoma. Bailey (1905) believed the species to be widespread in the region. Bailey (1905: 149) stated, "While not numerous, they seem to be well distributed in the vicinity of Chattanooga. Nearly all of the settlers with whom I talked were acquainted with them and informed me that they lived about the premises of their homes." Stangl et al (1992a) reported that suitable habitat still existed for the species and suggested that monitoring for its existence should continue.

2. Texas

The majority of *D. elator*'s range historically existed and currently exists in Texas. Researchers have found the species in the following counties: Archer, Baylor, Childress, Clay, Coryell, Cottle, Foard, Hardeman, Matador, Montague, Motley, Wichita, and Wilbarger (Merriam 1894; Blair 1949; Dalquest and Collier 1964; Dalquest 1968; Packard and Judd 1968; Martin and Matocha 1972; Cokendolpher et al. 1979; Jones et al. 1988; Linzey et al. 2008).

3. *D. elator* is Extinct from a Significant Portion of Its Range

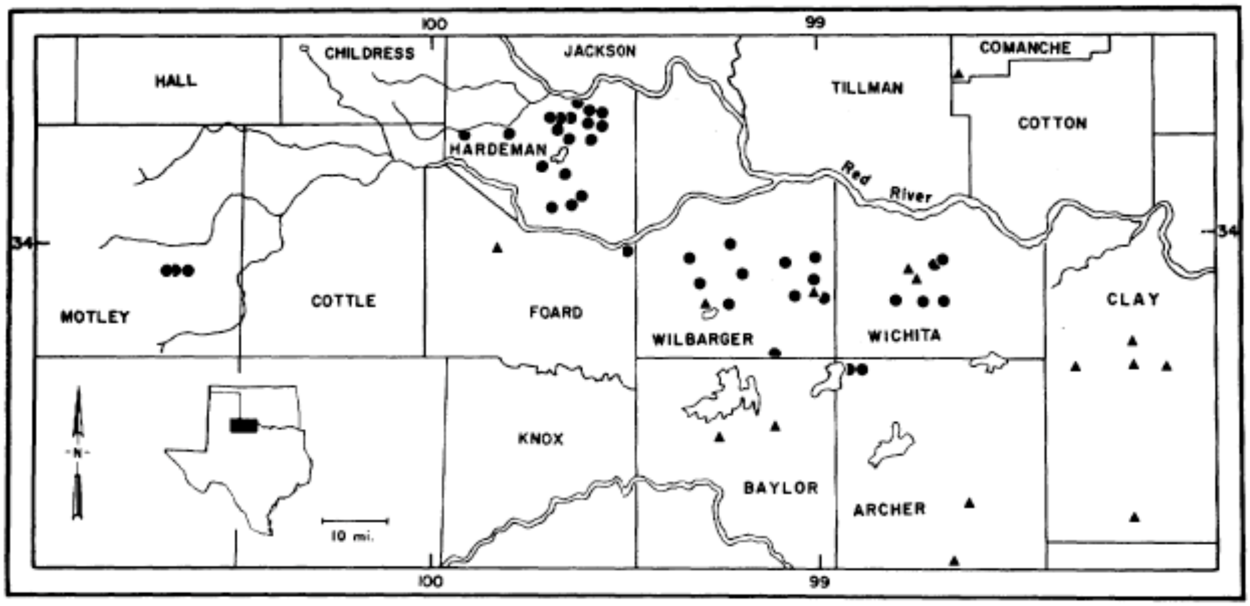
D. elator has been extirpated from a significant portion of its range in Texas, especially the southern extent, and likely all of its former range in Oklahoma. By the early 1960s, *D. elator* could not be found in Clay County, Texas (Martin and Matocha 1972). During their early 1970s surveys of the species, Martin and Matocha (1972) did not find any Texas kangaroo rats in Clay, Henrietta, and Baylor Counties in Texas or Comanche County, Oklahoma. The researchers stated, "The surveys in Clay and Comanche counties suggest that the species may not occupy all of its previously reported range" (Martin and Matocha 1972: 874). They added, "The lack of recent records of D. elator from previously reported areas (Chattanooga, Oklahoma, and Henrietta, Texas) suggests that some of the former range is no longer suitable for this species" (pg. 875). The species is likely extirpated in Archer and Montague Counties as well (Linzey et al. 2008). Moss and Mehlhop-Cifelli (1990) conducted a survey to locate Texas kangaroo rats in five Oklahoma counties, including Comanche and Cotton Counties, where the species had previously been observed. They found none. NatureServe (2009) reported:

> The distribution of this species has apparently decreased from 11 counties (including Oklahoma) to 6 counties. Areas that traditionally had stable populations or occurrences of Texas kangaroo rats in the late 1980s and early 1990s no longer seem to support an observable population. The vegetation in some of these traditional areas has become overgrown, and if individuals are present, they are in smaller, fragmented patches. However, this may be a normal cycling pattern for this species. Population sizes vary greatly over time, and literature from the late 1980s and early 1990s seem to indicate stable populations, but more recent surveys indicate a depression in numbers (Martin, pers. comm.). In addition, it is difficult to confirm colony sizes since they are known only from

private property, and access is often difficult to obtain.

Of the 15 counties in Oklahoma and Texas where researchers have found Texas kangaroo rats, the species has been reduced to just six counties in Texas.

Figure 2. Observations of Texas Kangaroo Rats Prior to 1972 (Martin and Matocha 1972)



Martin and Matocha (1972: 875): "Previous (triangles) and present (circles) distribution records of Dipodomys elator."

B. Population Status

D. elator is imperiled with a declining population (Linzey et al. 2009). Only three counties in Texas are known to have significant populations of Texas kangaroo rats: Hardeman, Wilbarger, and Wichita (Martin and Matocha 1972; Jones et al. 1988; Stangl 1992b). NatureServe (2009) ranked the Texas kangaroo rat as a G2 (Imperiled) species in 2006.

IV. Endangered Species Listing Factors

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The primary threat to Texas kangaroo rats is the historic and continued conversion of their shrub- and grassland habitat for agriculture (Carter et al. 1985). Urbanization, brush control to benefit livestock production, and livestock grazing also destroy and degrade habitat. Stangl et al. (2005: 135), however, noted:

> Seemingly suitable habitat for the species occurs throughout much of the Rolling Plains of north Texas (Jones et al., 1988; Stangl et al., 1992a) and southern

> Oklahoma (Moss and Melhop-Cifelli, 1990), and yet it presently occupies a restricted range of eight or fewer contiguous counties in north Texas (Dalquest and Horner, 1984; Jones et al., 1988).

The researchers did not speculate on why Texas kangaroo rats are not occupying what seems like suitable habitat across a larger range. What is known is that significant areas of the species' habitat have been destroyed. We discuss threats to *D. elator*'s habitat below.

1. Conversion of Native Habitat to Cropland

Martin and Matocha (1972) found that Texas kangaroo rats do not inhabit crop fields. Moss and Melhop-Cifelli (1990: 357) reported habitat losses from crop agriculture from their Texas kangaroo rat survey covering five Oklahoma counties:

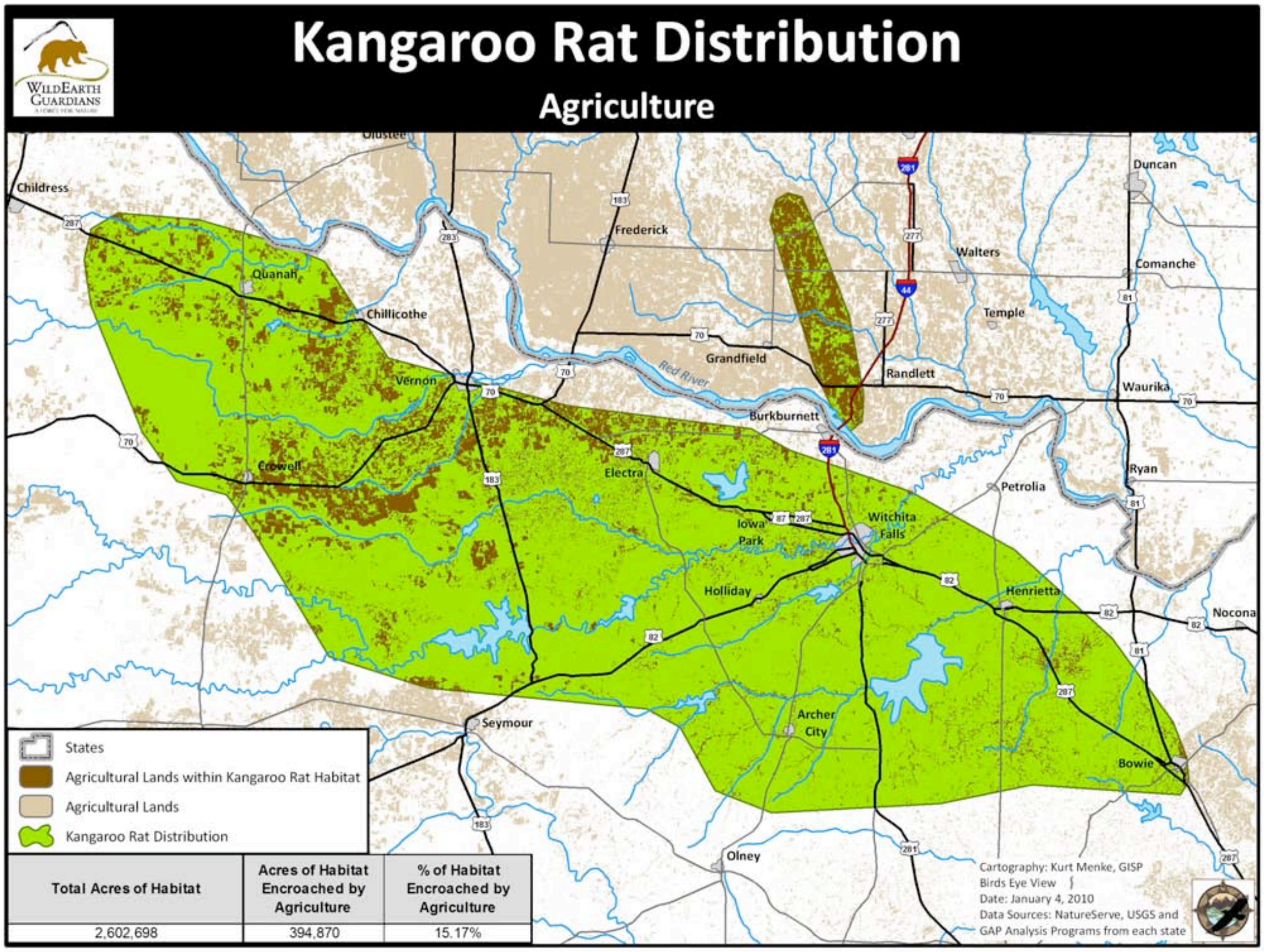
> Of the total area surveyed, only 2.6% consisted of potential habitat (…). At many sites, no suitable habitat was found during field surveys conducted subsequent to the initial identification of sites. Most of the clay loam soils are currently under cultivation, and, unlike sites in Texas, most of the rangeland we saw contained a dense cover of grasses and herbs with no bare ground. Few acres of native grassland remain at the two historical sites.
>
> While D. elator may never have been numerous in Oklahoma, it was thought to be widely distributed (Bailey, 1905), and suitable habitat was probably abundant. Agricultural practices in Oklahoma have depleted and fragmented the habitat severely since that time (Duck and Fletcher, 1943; Martin and Matocha, 1972; …). If D. elator continues to exist in Oklahoma, it is only in small remnant populations.

Additionally, Goetze et al. (2007:18) stated:

> At present, habitat as described above usually is not typical for Wichita County, Texas. Nearly all tillable land is under cultivation within the range of D. elator. Routine tilling and resulting monocultures of these fields render these areas uninhabitable for Texas kangaroo rats (Stangl et al. 1992).

Stangl (1992b) reported that areas suitable for cropland are mostly in monocultures of wheat and some cotton. Figure 3 below shows that over 15% of D. elator's habitat in cropland agriculture. See Figure 3.

Figure 3. Texas Kangaroo Rat Habitat Destroyed by Cropland



2. Loss of Historic Ecological Processes

Human activities have altered the natural ecological processes within *D. elator*'s native mixed grass prairie habitat. Goetze (2001) described how current livestock grazing practices have and the loss of fire have change the vegetational composition toward mesquite stands and taller grasses, normally avoided by the species:

> At present, the counties where the Texas kangaroo rat resides are dominated by mesquite pasturelands. However, this was not always the case. Historic vegetation of the region was a mixed grass prairie. Range fires kept brushy, invading species, such as mesquite, in check. Photographs of the region from as late as 1940 show a distinct lack of large mesquite trees in knownistinct [*sic*] lack of large mesquite trees in known D. elator habitats. Mesquite quickly invaded pasturelands after the incidence of range fires declined and better methods to control these blazes were developed. In the past, heavy seasonal grazing by bison and cattle kept native bluestem, grama, and buffalo grasses short and provided buffalo wallows for the kangaroo rats to dust bathe. Most present-day stockmen prefer lighter grazing regimes that allow grasses to proliferate. As a result, ground cover in many areas is close to 100 percent. Additionally, many species of grasses presently found in the area are taller invaders that have replaced the original native grasses.

The loss of bison grazing, prairie dog grazing and colonization, and fire to the Texas kangaroo rat's range likely had a significant negative impact on the species (Stangl 1992b; Goetze 2007). Stangl et al. (1992b: 32-33) reported:

> Given the ready exploitation of disturbed or altered habitat by the Texas kangaroo rat, and its recent disappearance from Hardeman County rangelands allowed to return to fallow, it is entirely likely that brush control methods and local grazing practices are now reproducing the ideal habitat for *D. elator* once created and maintained by naturally occurring factors that have been eliminated or are controlled by man.
>
> Two likely candidates are the bison (*Bison bison*) and black-tailed prairie dog (*Cynomys ludovicianus*). Both species are capable of exerting considerable influence on their immediate surroundings, and together may have contributed to conditions closely approximating those that now can be found supporting *D. elator* in Wichita County. The remains of bison and prairie dog are abundant in late Pleistocene and Holocene sediments throughout north Texas where cattle now are the dominant grazers.

Bison, prairie dogs, and fire helped maintain the native short grasses and shrubs and created areas of short vegetation and bare patches preferred by Texas kangaroo rats. The three processes acted together to create Texas kangaroo habitat. For example, Stangl et al. (1992b: 33) stated:

> The vast and numerous [prairie dog] towns probably were marked by worn trails and wallows left by the migratory bison that seasonally grazed here. Trails were wide enough for covered wagons to follow that sometimes were cut up to two meters into the ground, and wallows for dust bathing, up to five meter across and

> a half meter deep are often so numerous as to overlap (Cahalane 1961).

Bison and prairie dogs are keystone species. Keystone species enrich ecosystem function uniquely and significantly through their activities, and their impact is larger than predicted relative to their biomass (Paine 1980; Terborgh 1988; Mills et al. 1993; Kotliar et al. 1999; Miller et al. 1998/1999).

a. Bison

Bison were completely extirpated from *D. elator*'s range by the late 1800s (Isenberg 2000). Before that time, the ungulates served as keystone species of short- and midgrass prairies that typified the native habitat of Texas kangaroo rats before settlement of the Great Plains by Europeans. By the 1940s, researchers understood the importance of bison to maintaining shortgrass prairie habitat (Larson 1940). Bison disturbance (grazing, trampling, and wallowing) no longer exerts control of native vegetation and species composition over large scales as it once did (Truett et al. 2001). Grazing by native species kept the natural vegetative composition in balance. Bison grazing no longer promotes the mosaic of vegetative structure that provided habitats for many other species. Bison carcasses no longer create rich patches of nutrients for vegetative growth (Freilich 2003).

Despite arguments to the contrary, domestic, non-native cattle are not a sufficient substitute for wild bison. Cattle differ from bison in significant ecological ways; they graze differently and have different water needs, for example. Cattle overgrazing has been linked with brush encroachment, while bison roaming and grazing patterns are a natural part of prairie ecology. Bison wallows created patches of bare ground that may have served as important habitat for Texas kangaroo rats (Goetze et al. 2007). The invasion of habitat by non-native vegetation is a major threat to Texas kangaroo rats. A 2006 study found that the replacement of native herbivores with non-natives in general, and bison with cattle in particular, exacerbates encroachment of weeds. Parker et al. (2006: 1456) stated:

> … plants are especially susceptible to novel, generalist herbivores that they have not been selected to resist. Thus, native herbivores provide biotic resistance to plant invasions, but the widespread replacement of native with exotic herbivores eliminates this ecosystem service, facilitates plant invasions, and triggers an invasional 'meltdown'.

The loss of ecological services that bison once provided has negatively affected wildlife species across the Great Plains. This may be especially true for Texas kangaroo rats.

b. Prairie Dogs

"Prairie dogs create improved habitat conditions for the Texas kangaroo rat, and extirpation of most prairie dogs from within the range of *D. elator* may have negatively affected populations of the kangaroo rat," reported Linzey et al. (2008). The role of prairie dogs as a keystone species is now well-established scientifically (Kotliar et al. 1999; Kotliar 2000; Miller et al. 2000). Prairie dogs are functionally unique; they perform roles within their ecosystem not performed by other species or processes. The scientific literature that supports the argument that prairie dogs fulfill all the requirement of keystone species is growing (Coppock et al. 1983a, b; Detling and Whicker 1988; 1993; Kotliar et al. 1997; Kotliar 2000).

Prairie dogs substantially alter their environment and create habitat for other wildlife species, such as Texas kangaroo rats. Studies have found higher rodent species richness, density, and diversity on prairie dog colonies compared with surrounding grasslands in Chihuahua, Mexico (Ceballos and Pacheco 1997; Ceballos et al. 1999). Prairie dogs also have a large effect on vegetation structure, productivity, nutrient cycling, and ecosystem processes (Coppock et al. 1983; Detling and Whicker 1988; Whicker and Detling 1993; Weltzin et al. 1997). The activities of prairie dogs, especially their grazing and clipping of tall vegetation, result in changes in plant composition (Bonham and Lerwick 1976; Coppock et al. 1983, Detling and Whicker 1988; Whicker and Detling 1988; 1993; Weltzin et al. 1997; Detling 1998). In general, the vegetation on prairie dog colonies is characterized by lower biomass and a greater preponderance of annual forbs and short grasses compared to tall grasses and shrubs, but is higher in nitrogen content than vegetation from surrounding areas (Bonham and Lerwick 1976; Coppock et al. 1983, Weltzin et al. 1997; Detling 1998). Prairie dogs negatively impact some plant species, reducing the prevalence and controlling the spread of taller grasses and several shrubs, such as mesquite (*Prosopis* spp.), sagebrush (*Artemisia* spp.), and longleaf jointfir (*Ephedra trifurca)* (Bonham and Lerwick 1976; Coppock et al. 1983; List 1997; Weltzin et al. 1997). Ironically, prairie dogs are poisoned for livestock interests, but these shrubs reduce grass available for cattle, and mesquite makes roundups more difficult (Weltzin et al. 1997).

c. Fire

Fire was once a natural part of the prairie ecosystem that hosted Texas kangaroo rats. Stangl et al. (1992b: 33) described the fire regime within the species' range:

> Naturally occurring and unchecked fires probably were important in brush control prior to settlement of the region. Grass fires started by lightning storms were regular (about every five to six years) and often extensive events in Wichita County during the late 1800s and early 1900s. …
>
> The effects of fires today usually are minimized by roadways, firebreaks, and rapid response by teams of firefighters, but when they occur, the resulting accumulation of dead wood and grass thatch permit fires of intensity that can destroy mesquite trees.

As Europeans settled the Great Plains and American southwest, they increasingly extinguished fires created by the mix of lightning and dry vegetation. Every few years fires cleared out dead vegetation and burnt off woody shrubs and young trees, keeping grasslands open. Without fire, shrubs and trees have been able to gain a foothold in many areas of once open grassland. Fire also controls the spread of some weeds. Goetze et al. (2007:18) reported that within *D. elator*'s range, "Areas not in crop production are developed for gas and oil exploration or used as rangeland." The authors added:

> The use of fire to control woody species is precluded by presence of oil field equipment, and costs of mechanical brush control often are prohibitive. These circumstances may allow areas to develop dense stands of mature honey mesquite, wherein the herbaceous vegetation becomes tall and dense. (pg. 19)

3. Domestic Livestock Grazing

Domestic livestock grazing has historically been a threat to Texas kangaroo rats but may benefit the species when particular management techniques are practiced and maintained (Hafner 1998; Goetze et al. 2007; Linzey et al. 2008). In his survey of the status of southwestern rodents Hafner (1998: 16) stated that livestock grazing has had a negative impact on Texas kangaroo rats:

> The prolonged and widespread practice of livestock grazing on open range has certainly modified grasslands, particularly those that were already marginal and suffering from reduced annual precipitation. However, most arid grassland rodents have broad geographic ranges, and the gradual degradation of grasslands has probably resulted in an overall reduction in densities rather than reduced distribution. This more subtle effect is more obvious in taxa with small geographic distributions. In central New Mexico, for example, the hispid pocket mouse, *Chaetodipus hispidus*, persists in patches of grassland along railroads and at the base of the Sandia Mountains in the Rio Grande Valley, but has been eliminated from most of the valley by a combination of overgrazing and reduced precipitation. Two taxa with limited distributions that appear to suffer from, or are vulnerable to, grazing pressures are included in this report, *Dipodomys elator* and *D. microps leucotis*, the Texas kangaroo rat and the House Rock Valley kangaroo rat.

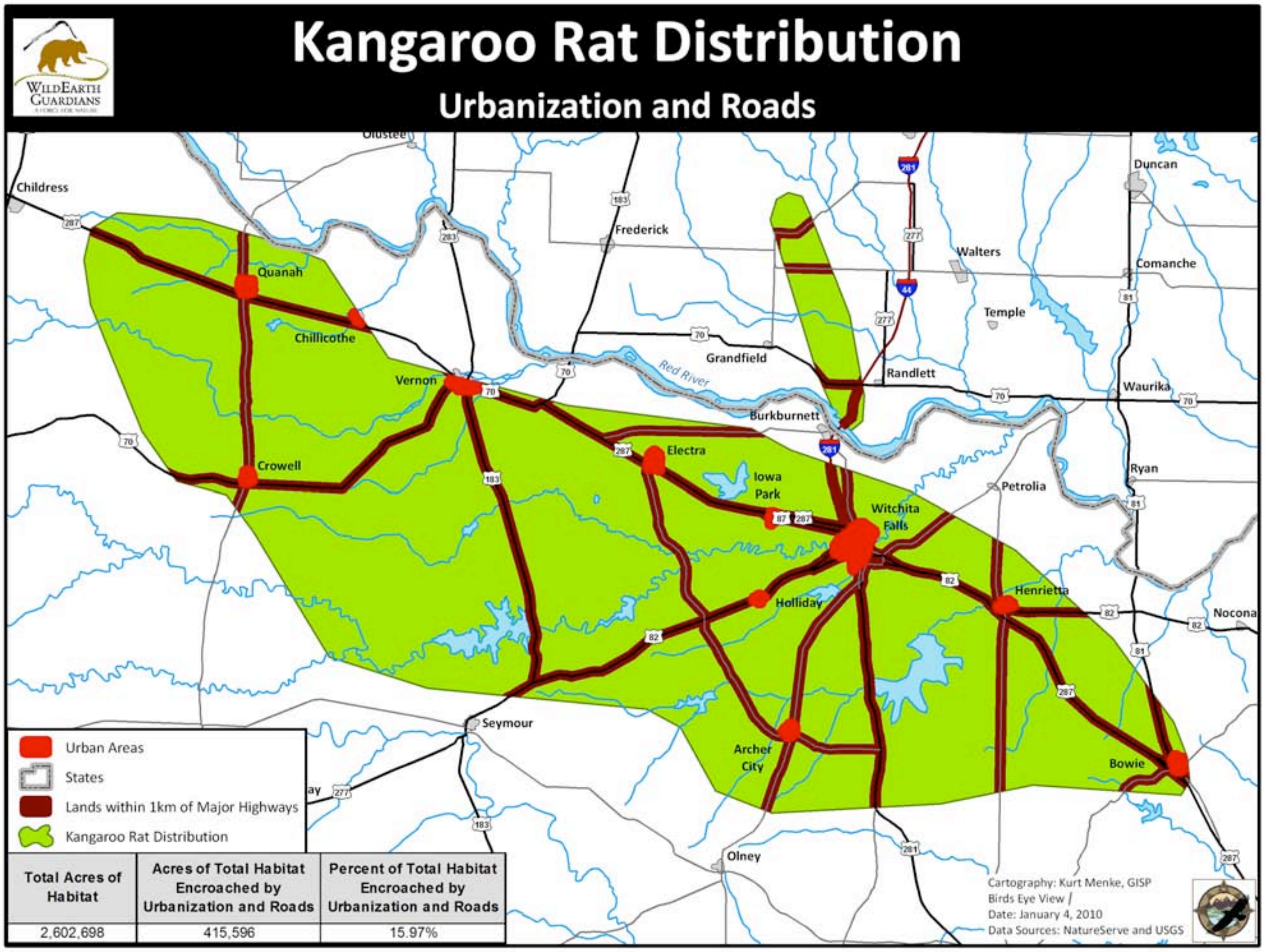
The rodents prefer heavily grazed areas to maintain short vegetation and create areas of bare ground. Since the early 1990s, some researchers have proposed that heavy cattle grazing can serve as a tool to restore Texas kangaroo rat habitat (Stangl et al. 1992a; Goetze 2001; Goetze et al. 2007; Nelson et al. 2009).

However, as noted above, cattle grazing comes with risks and additional threats that are not associated with bison. These include the encroachment of weeds and woody shrubs and the failure to produce bare ground wallows. Domestic livestock grazing as a management tool to conserve Texas kangaroo rats must be practiced with extreme care in a way that provides for the species' needs of native vegetation, open areas, low vegetation, sufficient seed production for food, and some bare ground.

4. Development and Roads

Development and roads have encroached on Texas kangaroo rat habitat. As Dalquest and Collier (1964) stated of the species' range: "The area where it lives has a large human population and is easily accessible by train and road." See Figures 4, 5, and 6.

Figure 4. Encroachment on *D. elator's* Range by Roads and Development



Total Acres of Habitat	Acres of Total Habitat Encroached by Urbanization and Roads	Percent of Total Habitat Encroached by Urbanization and Roads
2,602,698	415,596	15.97%

Figure 5. Roads within *D. elator*'s Range

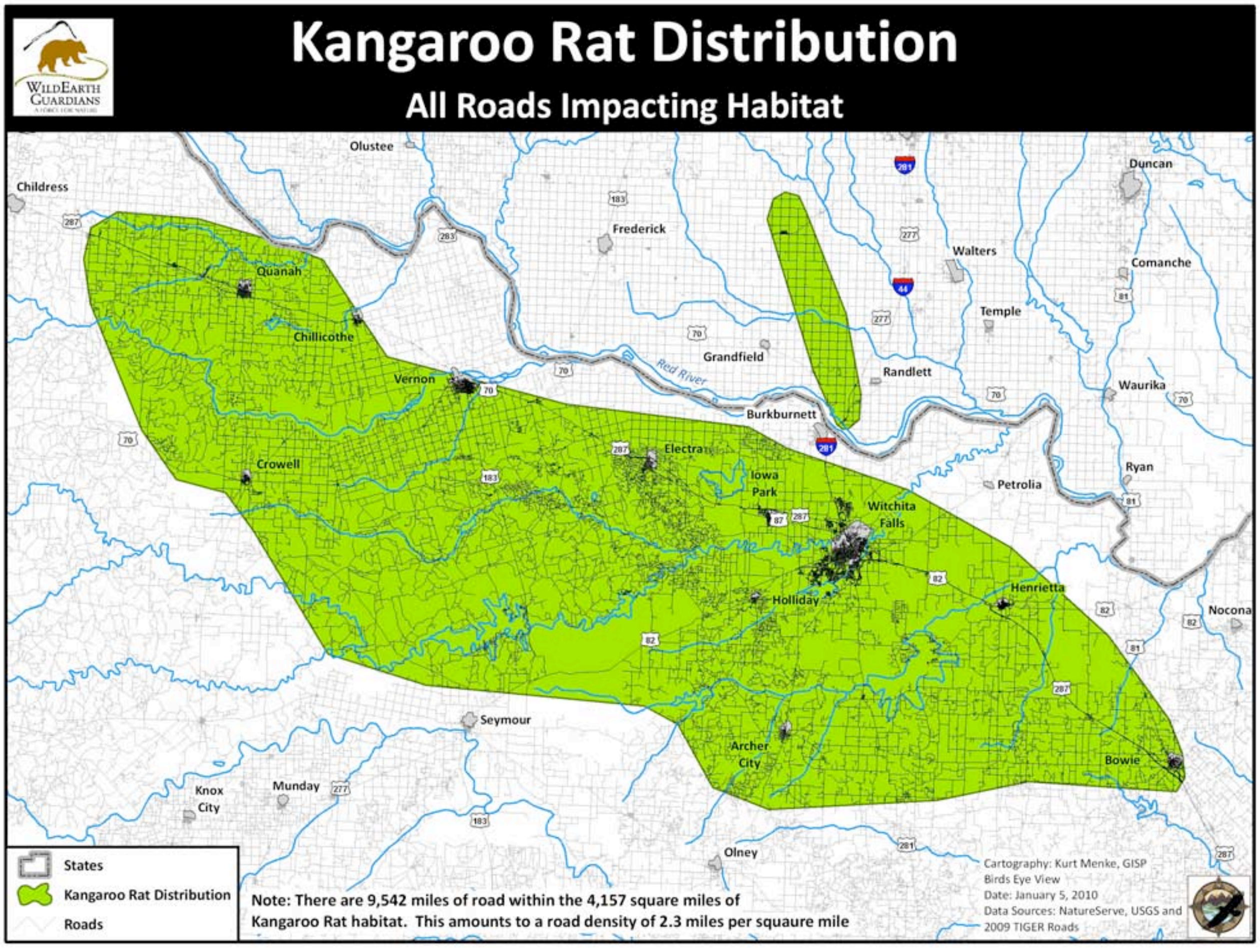
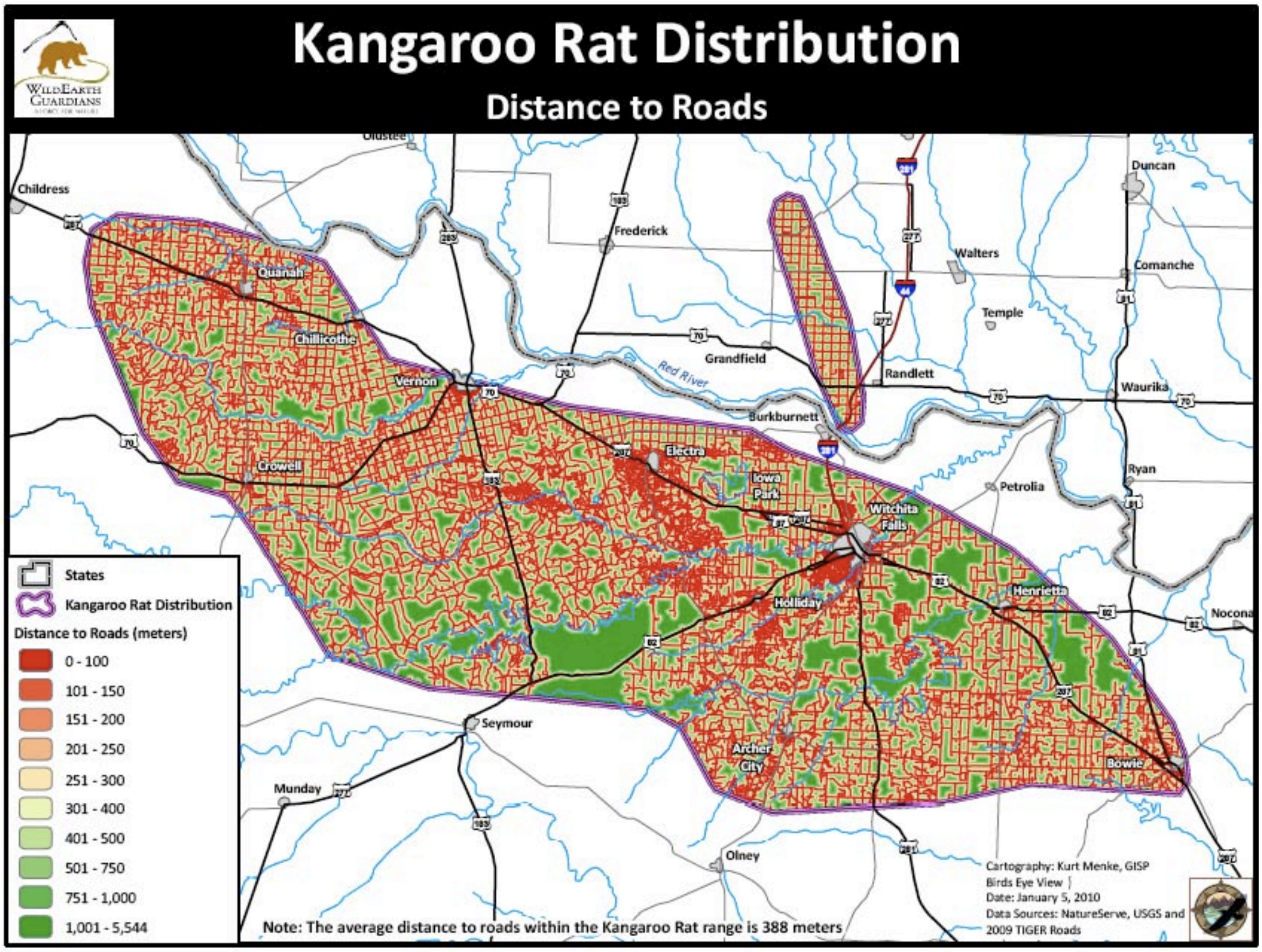


Figure 6. Distance to Roads within *D. elator*'s Range



5. Brush Control

Some researchers have blamed to control of mesquite and other woody shrubs on the decline of Texas kangaroo rats. For example, Hamilton et al. (1987: 775) stated: "Within the past 50 years, habitat available to D. elator has been greatly reduced by clear-cutting and brush control." Similarly Chapman (1972: 879) found:

> Brush control projects may adversely affect *D. elator* populations. Little evidence of kangaroo rats was found on an area treated with brush control chemicals (2,4-D). The food and cover composition had been perceptibly altered. Especially obvious was the lack of living mesquite and several annual species such as stork's bill and bladder pod. *D. elator* were also absent in agricultural areas where brushy fence rows had been removed.

As discussed earlier, the lack of this stands of mesquite may not be a limiting factor for *D. elator* based on more recent studies of the species' habitat (Stangl et al. 1992b; Goetze et al. 2007; Nelson et al. 2009). Texas kangaroo rats are often found in areas with low vegetation and bare ground. However, chemical control, as described in the passage by Chapman (1972) above, may be the culprit in destroying and degrading Texas kangaroo rat habitat.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Though research methodologies have changed in recent years to be more cognizant of the effects on animal treatment and collection on imperiled species, it is possible that early research that involved collecting and preserving *D. elator* specimens may have had a permanent impact on range contraction. Bailey (1905) discussed collection efforts in Oklahoma, where Texas kangaroo rats are likely extirpated. Chapman (1972) discussed collecting 213 animals for scientific purposes. Dalquest and Collier (1964: 147) reported:

> We were unable to catch the species in traps, and all of our specimens were shot on moonless nights, in the beam of a hunting light. However, we have no doubt that more intensive efforts with traps would have resulted in captures.

Hamilton et al. (1987) and Pfaffenberger and Best (1989) used 21 live-trapped specimens that were later preserved at Texas Tech University.

C. Disease or Predation

1. Disease

Studies have identified parasites associated with Texas kangaroo rats. Ectoparasites found on the species include mites (*Androlaelaps sp.*), sucking lice (*Fahrenholzia pinnata*), ticks (*Amblyoma anicanum*), and fleas (*Meringis arachis*) (Thomas et al. 1990). Pfaffenberger and Best (1989) identified a trichurid endoparasite (*Trichuris elatoris*) in *D. elator*. However, disease is not known currently to be a major cause of *D. elator* mortality.

However, sylvatic plague (*Yersinia pestis*) is a major killer of black-tailed prairie dogs (Cully and Williams 2001), which were historically important for maintaining Texas kangaroo rat habitat (see above). The Fish and Wildlife Service should investigate the potential for plague to affect Texas kangaroo rats.

2. Predation

Researchers have no records of natural predation on Texas kangaroo rats (Stangl et al. 2005), though Bailey (1905) once witnessed a rattlesnake trying to swallow a rat caught in snap trap. However, researchers have observed the results of rat burrow excavations by striped skunks (*Mephitis mephitis*), badger (*Taxidea taxus*) and coyote (*Canis latrans*).

D. The Inadequacy of Existing Regulatory Mechanisms

The U.S. Fish and Wildlife Service listed *D. elator* as a Category II Endangered Species Act candidate species from 1982-1994 (47 Federal Register 58454-58460, December 30, 1982; 59 Federal Register 58982-59028, November 15, 1994). However, Fish and Wildlife Service ended its Category II and Category III species designations in 1996 (61 Federal Register 7595-7613, February 28, 1996). Texas kangaroo rats received no federal regulatory protection.

The kangaroo rat is a Category II Species of Special concern in Oklahoma. The Oklahoma Department of Wildlife Conservation ranked the species as a Priority II species on a three-tiered scale with Tier I being the highest priority level (ODWC undated). These designations impart no regulatory protection.

D. elator is listed as a state Threatened species for Texas (Texas Parks and Wildlife Code – Chapter 68, Endangered Species). However, this designation is not preventing Texas kangaroo rat population declines and range contraction. Additionally, this state listing does not prevent that destruction and degradation of the species' habitat whereas the ESA definition of "take" includes negative impacts to habitat. The Texas Department of Wildlife Resources listed the Texas kangaroo rat as a Medium conservation priority in its Comprehensive Wildlife Strategy, which is operable from 2005-2010 (TDWR 2005).

NatureServe (2009) ranks the Texas kangaroo rat as a G2 (Imperiled) species. It ranks the species as S1 (Critically Imperiled) in Oklahoma and S2 (Imperiled) in Texas.

The IUCN Red List ranks *D. elator* as Vulnerable (Linzey et al. 2008). The international institution lists the species population status as declining.

E. Other Natural or Manmade Factors Affecting its Continued Existence

1. Climate Change

Climate change poses a fundamental challenge for species survival in coming years and decades. Climate change is already causing a rise in temperatures across the United States and an increase in extreme weather events, such as droughts and increased rainfall (Parmesan et al. 2000; NSC

2003; CCSP 2008; Karl et al. 2009). Temperatures during the latter period of warming have increased at a rate comparable to the rates of warming that conservative projections predict will occur during the next century with continued increases of greenhouse gases. A 2007 report from the Intergovernmental Panel on Climate Change described the rising temperature trend (IPCC 2007: 30):

> Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). The 100-year linear trend (1906-2005) of 0.74 [0.56 to 0.92]°C is larger than the corresponding trend of 0.6 [0.4 to 0.8]°C (1901-2000) given in the TAR (Figure 1.1). The linear warming trend over the 50 years from 1956 to 2005 (0.13 [0.10 to 0.16]°C per decade) is nearly twice that for the 100 years from 1906 to 2005.

As climate change progresses, maximum high and minimum low temperatures are expected to increase, as are the magnitude and duration of regional droughts (IPCC 2001). The most recent IPCC report (IPCC 2007: 48) predicted the follow impacts on ecosystems from climate change:

- The resilience of many ecosystems is *likely* to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. landuse change, pollution, fragmentation of natural systems, overexploitation of resources).

- Over the course of this century, net carbon uptake by terrestrial ecosystems is *likely* to peak before mid-century and then weaken or even reverse16, thus amplifying climate change.

- Approximately 20 to 30% of plant and animal species assessed so far are *likely* to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5°C (*medium confidence*).

- For increases in global average temperature exceeding 1.5 to 2.5°C and in concomitant atmospheric CO_2 concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions and shifts in species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services, e.g. water and food supply.

In the Texas kangaroo rat's Great Plains range, climate change is expected to cause more extreme and frequent weather events that include droughts, heavy rainfall, and heat waves (Karl et al. 2009). Temperatures are expected to increase significantly. See Figure 7. The species may not be able to adapt to these changes. Karl et al. (2009: 126) described the predicted affects of climate change impacts to Great Plains ecosystems:

> Climate-driven changes are likely to combine with other human-induced stresses to further increase the vulnerability of natural ecosystems to pests, invasive

> species, and loss of native species. Changes in temperature and precipitation affect the composition and diversity of native animals and plants through altering their breeding patterns, water and food supply, and habitat availability. In a changing climate, populations of some pests such as red fire ants and rodents, better adapted to a warmer climate, are projected to increase.

Fischlin et al. (2007) proposed that the productively, structure, and carbon balance of grassland ecosystems are extremely sensitive to climatic shifts. Fischlin et al. (2007: 241) stated, "The likely synergistic impacts of climate change and land-use change on endemic species have been widely confirmed." Changes that threaten the Texas kangaroo rat include:

- losses of existing habitat will occur during vegetation shifts,
- reductions in habitat patch size support fewer species, and,
- in semi-arid landscapes, the quality and quantity of aquatic, riparian, and mesic upland ecosystems decline with decreased water availability.

Root and Schneider (2001: 29) addressed how climate is likely to affect animals tied to particular vegetation types, such as the Texas kangaroo rat:

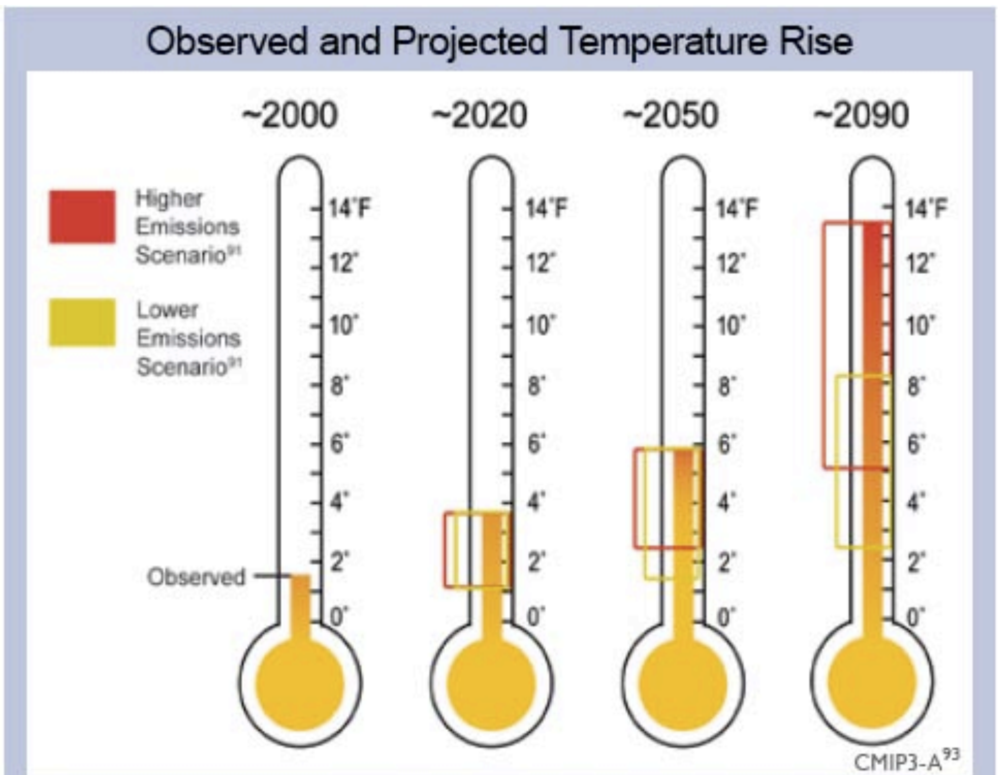
> The anticipated changes in plant ranges will probably have dramatic effects on animals, both on the large biogeographic scale and on the local scale. The ranges of many animals are strongly linked to vegetation. … Consequently, the ranges of various animals that rely on specific vegetation will change as the ranges of these plants shift, assuming that some other factor is not limiting these animals. If the climate changes more rapidly than the dispersal rates of the plants, it could result is extensive plant die-offs in the south or downslope before individuals can disperse and become established in the north and upslope. Thus the ranges of animals relying on these plants could become compressed, and in some instances, both the plants and the animals could become extinct.

Allen and Breshears (1998) also predicted that climate change would cause unprecedented rates of vegetation shifts due to die off, especially along boundaries of semi-arid ecosystems. The entire Texas kangaroo rat range is within a semi-arid ecosystem. The IPCC (2001) predicts the upward elevation and latitudinal migration of individual species' distributions. Many species respond to warming by shifting their ranges to the north or to higher elevations. The IPCC (2007) report also predicted that species ranges will shift. However, this adaptation is not possible for all species. For some species, human development and other habitat changes have cut off natural migration routes, while others will become extinct if they cannot find suitable habitat (NSC 2000). This would likely be the case for the Texas kangaroo rat, which now exists in habitat that has been increasingly fragmented due to habitat degradation.

Climate change will constrict the already very contracted *D. elator* range. Cameron and Scheel (2001) used two models to predict effects of climate change on Texas rodents within the next 40 years under scenarios of wetter and drier conditions. Under both models, temperatures across the state are expected to rise an average of 3-4ºC (5.4-7.2ºF). The Geophysical Fluid Dynamics Laboratory (GFDLR30) model, where conditions are expected to get wetter, *D. elator* is predicted to lose an estimated 80% of existing suitable habitat. The Canadian Climate Center model, where conditions are expected to get drier, *D. elator* is predicted to lose an estimated 48% of existing suitable habitat.

Climate change will present a significant challenge and threat to the long-term survival of the Texas kangaroo rat. Global warming can only make this rodent's current range more unsuitable as temperatures increase and conditions shift further away from those amenable to development of the species' biotic community.

Figure 7. Predicted Temperature Increases in the Great Plains Due to Climate Change (Karl et al. 2009)



The average temperature in the Great Plains already has increased roughly 1.5°F relative to a 1960s and 1970s baseline. By the end of the century, temperatures are projected to continue to increase by 2.5°F to more than 13°F compared with the 1960 to 1979 baseline, depending on future emissions of heat-trapping gases. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible.

2. Roads

Texas kangaroo rats opportunistically use dirt roads as travel corridors and site their colonies near dirt roads (Roberts and Packard 1973; Brock and Kelt 2004). Brock and Kelt (2004) asserted that their study comparing gravel and dirt road use by the Stephans' kangaroo rat (*D. stephansi*), supported observations that *D. elator* also avoids gravel roads but is attracted to dirt roads. Because the two kangaroo rat species use roads similarly, negative impacts of roads to the Stephans' kangaroo rat would apply to the Texas kangaroo rat. The authors stated:

> Although these results provide general support for the hypothesis that dirt roads serve to link habitats for *D. stephensi*, such corridors may also have negative impacts on populations (Simberloff et al., 1992; Trombulak and Frissell, 2000; but see Beier and Noss, 1998), and we emphasize four of these as they apply to this species. First, as noted above, traffic could result in increased vehicle related mortality. Second, dirt roads might also increase *D. stephensi* exposure to predation. If predators preferentially move along dirt roads, these could lead to elevated encounters between predator and prey. Supporting this, eastern diamondback rattlesnakes (*Crotalus adamanteus*) lie in wait for their prey along corridors (Mann and Plummer, 1995). The clearing provided by roads may also make *D. stephensi* more visible and vulnerable to predation by owls and coyotes. Third, dirt roads could facilitate invasion by exotic grasses, which in Riverside County create dense grassland habitat that is disfavored by *D. stephensi* (U.S.F.W.S., 1997). There is evidence from other systems that different habitat corridors (Forman, 1991; Hobbs and Hopkins, 1991), including roads (Tyser and Worley, 1992; Wein et al., 1992), facilitate exotic species invasions. Fourth, soil compaction associated with use and maintenance of dirt roads could collapse burrows and impede burrowing by *D. stephensi*. (pgs. 638-639)

Dalquest and Collier (1964: 146) noted that collected Texas kangaroo rat specimens have come from road kills:

> To the best of our knowledge, it [*D. elator*] occurs only in Comanche County, Oklahoma, and Clay, Wichita, Baylor, Wilbarger and Archer counties, Texas. The Archer County record is based on a smashed specimen, seen on the highway about 3 miles south of Archer City by the senior author. The Baylor County record is similarly based on a highway-killed specimen, seen by the junior author about five miles north of Seymour.

See Figures 4, 5, and 6 regarding road encroachment into the Texas kangaroo rat range.

5. Extermination Programs

Historic campaigns to exterminate a variety of kangaroo rat species also may have contributed to the decline of *D. elator*. Sjoberg et al. (1984: 13) commented on these eradication efforts:

> Kangaroo rats attracted interest in the 1920's and 1930's when drought and

> improper grazing affected many desert ranges. Many believed that these small mammals were partially at fault for the deterioration of the range. Studies on these deteriorated sites were completed by the U.S. Biological Survey, now known as the U.S. Fish and Wildlife Service, and many other studies have been completed since. In the Southwest, it was especially apparent that the bannertail kangaroo rat (*D. spectabilis*) and its extensive mound system was causing a loss of forage availability due to the surface disturbance on the range. Various methods were devised to remove the offending rodent, including use of poison grain similar to methods used for prairie dog control. In the absence of these animals, range grasses tended to return but the economic implication was that it was not cost effective to improve degraded rangeland by this method when degradation could have been avoided in the beginning, with sound grazing practices and management.
>
> The results of most studies have shown that detrimental effects by kangaroo rats occur in cases where the range is already in a deteriorated condition. Problems caused by these rodents are considered only to be additive to the existing situation and not due entirely to their actions.
>
> On the other hand, the kangaroo rat can be very helpful in its own way to the land that provides it a living. In good seed years, rodents favorably affect seed dispersal and germination of large seeded perennial grasses and tall, shrubby plants. Recovery of desired range vegetation might be enhanced by the differential feeding pressure of certain rodents. Soil quality too can be affected by kangaroo rats. Their burrowing and caching promotes water infiltration and retention, thus improving soil moisture. This favorably affects the survivability of seedlings in arid regions and could be important in the natural maintenance and improvements of our rangelands.

V. Conclusion

Yensen et al. (1989) listed the Texas kangaroo rat as a conservation priority in IUCN's Rodent Specialists Group report on conservation strategies for North American rodents. The Texas kangaroo rat merits listing as a Threatened or Endangered species under the Endangered Species Act.

1. Requested Designation

WildEarth Guardians hereby petitions the U.S. Fish and Wildlife Service under the Department of Interior to list the Texas kangaroo rat (*Dipodomys elator*) as an Endangered or Threatened species pursuant to the Endangered Species Act. This listing action is warranted, given the numerous threats this species faces, as well as its loss across a significant portion of its range. Texas kangaroo rats are threatened by at least three of the five listing factors: present and threatened destruction, modification and curtailment of habitat and range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence.

2. Critical Habitat

Given that habitat destruction is a significant threat, Petitioner requests that critical habitat be designated for this species concurrent with final ESA listing.

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