



A Texas Horned Lizard (*Phrynosoma cornutum*) in native grass at Tinker Air Force Base, Oklahoma.

Studying a Population of Texas Horned Lizards (*Phrynosoma cornutum*) in an Urban/Military Environment

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Photographs and graphics by the senior author.

Abstract.—University researchers from Southern Illinois (SIU), Oklahoma State (OSU), Virginia Tech (VT), and Federal agencies have come together as partners to learn more about the Texas Horned Lizard (*Phrynosoma cornutum*) at Tinker Air Force Base (AFB) in Oklahoma. Although listed as a state “Threatened” species in Texas, the lizard is a state “Species of Special Concern” in Oklahoma due to uncertainty regarding its status and lack of population data, making it a species of considerable conservation interest. Researchers at Tinker AFB are using tools such as handheld computers, passive integrated transponder (PIT) tags, global positioning systems (GPS), radio-telemetry, and geographic information systems (GIS) for gathering and interpreting biological data on Texas Horned Lizards. Over the last four years (2003–2006), 174 individual lizards have been captured and over 1700 capture locations and associated data have been recorded in the GIS lizard-tracking database. These data are beginning to reveal aspects of morphology, distribution, habitat requirements, home ranges, and hibernation characteristics as well as details of its myrmecophagous (primarily ants) diet. Population sizes (± 1 SE) within Tinker AFB’s urban wildlife reserve are estimated to be 53 ± 11 individuals with a density of 5.0 ± 1.0 lizards/ha. Utilization of these tools opens the door for different ways of studying horned lizard habitat requirements and population trends. They also provide powerful insights for better managing a sensitive species on a busy military installation as well as in an ever-changing urban setting.

A great wealth of knowledge is beginning to unfold about the Texas Horned Lizard (*Phrynosoma cornutum*) through partnerships and contributions from many agencies, universities, and conservation groups. On the frontline of this research is the United States Air Force!

Tinker Air Force Base (AFB) is the largest single-site employer in the State of Oklahoma and home to large-bodied aircraft such as the E-3 Sentry, E-6A, and the KC-135 refueling



Texas Horned Lizard (*Phrynosoma cornutum*), a Species of Special Concern in Oklahoma.



Military training on a busy Air Base. Both the lizard and the military require access to the base’s resources.

tanker. It is one of the world's largest aircraft depot maintenance facilities — but it is also home to the Texas Horned Lizard, an Oklahoma State Species of Special Concern and a Threatened species in Texas (ODWC 2006, TPW 2006).

The lizard is experiencing declines throughout its range, particularly in Texas (Price 1990) but also in Oklahoma (Carpenter et al. 1993). How then is it possible for a highly industrialized air force base nestled within a major metropolitan area to have a population of Texas Horned Lizards? A frequent comment heard in Oklahoma is: "I used to see them all the time." Is this just a reflection of people not getting out these days? That seems unlikely, however, considering the increasing popularity of outdoor activities such as wildlife watching.

U.S. Fish and Wildlife Service (1999) surveys indicate that wildlife-related activities doubled between 1980 and 1995. From 1991–2001, no significant statistical change occurred in these types of activities (USFWS 2001). So, could habitat loss and alteration from development be a more likely cause? Carpenter et al. (1993) surveyed new landowners who reported seeing horned lizards when they first moved into a new housing development followed by quick disappearance of the lizards. Or is the decline in populations a combination of other factors? Many authors have suggested that insecticides (direct effects and prey base alteration), agricultural practices, irrigation, mowing, till-

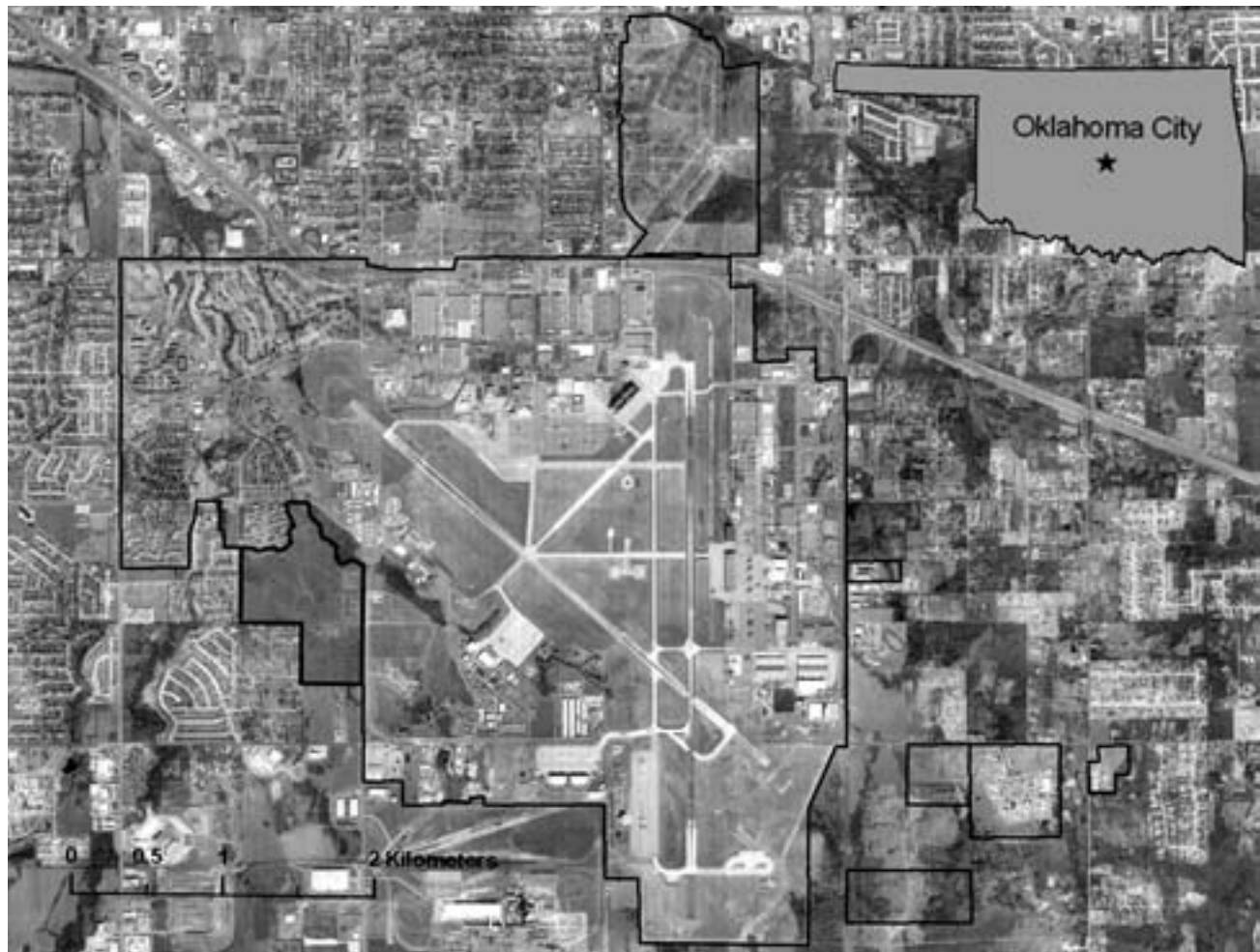
ing, over-collection for the pet trade, increased predation, and roadkill (Price 1990, Carpenter et al. 1993, Donaldson et al. 1994) are reasons for declines. Interestingly, all of these factors are connected to urban development, which seems to be the common link.

These factors and the fact that Tinker AFB has a healthy population of lizards raise many other questions for a natural resources biologist managing land resources on a busy military installation. That's part of what the research at Tinker is about — how can the lizard and the military mission coexist in harmony.

Study Site and Objectives

The 2,000-ha Tinker AFB is situated in a transition area between Oklahoma City and rural settings, with major metropolitan areas immediately north and suburban/rural areas to the south. This also is reflected on the base, with industrial and community settings concentrated in the north fading into airfield and fragments of developed and undeveloped land plots and relatively undisturbed greenways to the south. The focal point of the study is within and around a 15-ha Wildlife Reserve, part of the base's Urban Greenway.

The approximately 60-ha study site is characterized by prairie, patches of riparian vegetation, shrubs, and transitional woodlands. Dominant native species at the site include Little



Aerial view of Tinker Air Force Base and encroaching urban areas, a dark gray shaded area represents the 60-ha study site.

Bluestem (*Schizachyrium scoparium*), Big Bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and Maximilian Sunflower (*Helianthus maximiliani*). Other native species include Side Oats Grama (*Bouteloua curtipendula*), Eastern Red Cedar (*Juniperus virginiana*), and American Elm (*Ulmus americana*). Prominent non-native species include Oldworld Bluestem

(*Bothriochloa ischaemum*) and Tall Fescue (*Lolium* sp.), with some small patches of Chinese Lespedeza (*Lespedeza cuneata*) usually associated with Maximilian Sunflower (Dorr et al. 2003).

The major focus of the study was to better understand the ecology of the Texas Horned Lizard, particularly in fragmented urban type habitat. Specific objectives of the study included: (1) Determination of distribution, (2) determination of habitat requirements, (3) understanding behavior and demography, and (4) determination of population status and trends.

Materials and Methods

Horned lizards were captured by hand during fortuitous encounters on trails, roads, along areas of bare ground and in the brush. Morphological (sex, body mass, snout-vent length, and total length) and various habitat measurements were taken and if large enough, lizards were taken back to the lab for processing with tags and radio transmitters. Passive integrated transponder (PIT) tags were implanted for identification of individual lizards. One of two different sizes of transmitters (Holohil Inc., Model: BD-2, 1.8 and 1.3 g) was mounted on the lizard's back with superglue and an elastic collar (Hellgren et al. 2004). Over the last year silicone was substituted for superglue which seems to be less abrasive to the lizards and much easier to remove when exchanging transmitters. Select lizards that were too small for transmitters were tracked using fluorescent powder.



Measuring the total body length of a Texas Horned Lizard.



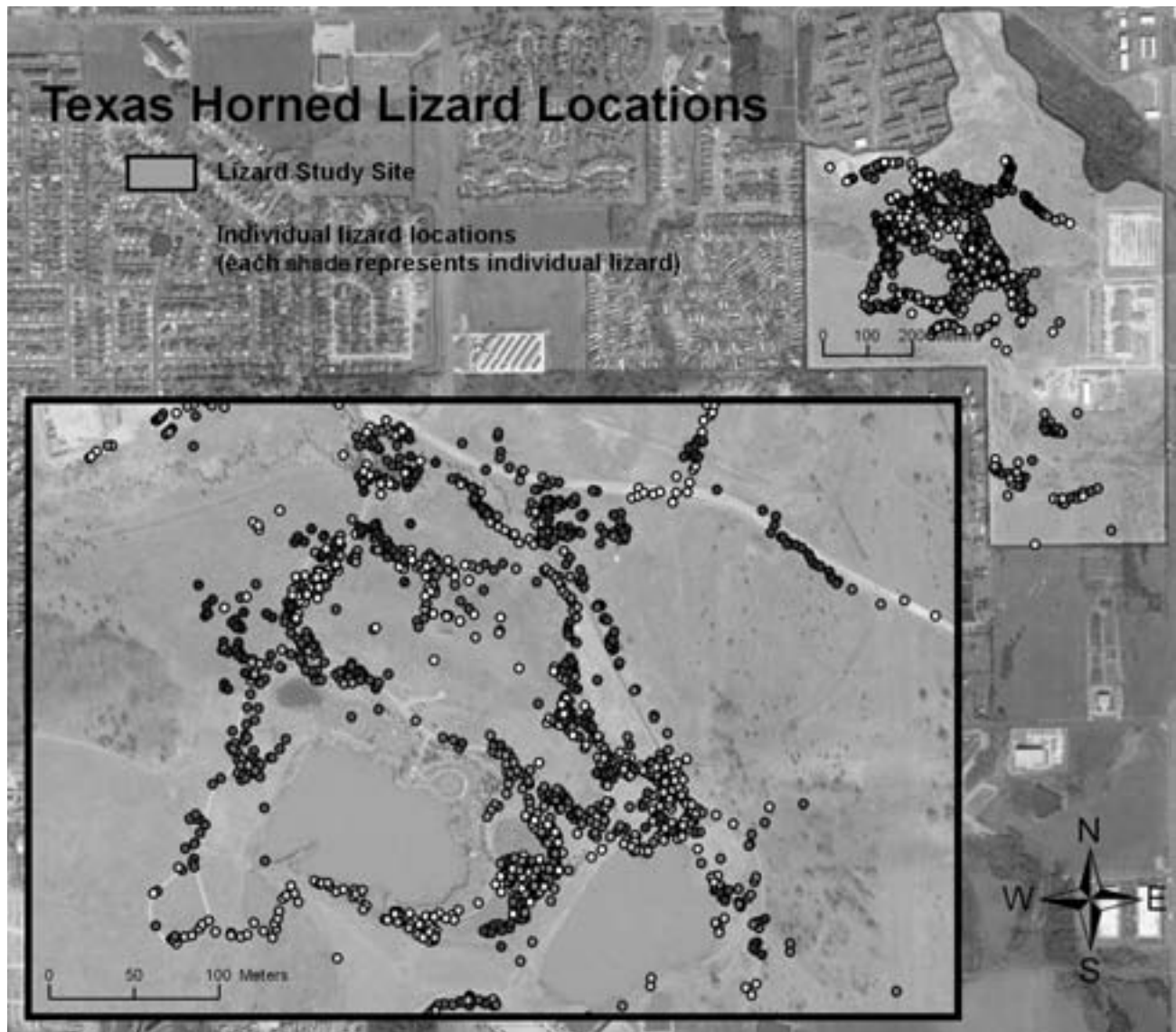
Texas Horned Lizard in hand showing an elastic collar and transmitter mounted on its back.



Biologist Ray Moody with Debora Endriss locates a Texas Horned Lizard within Wildlife Reserve 3 using radiotelemetry.



Debora Endriss records microhabitat data and GPS coordinates for lizard locations.



Expanded view of individual lizard locations at the study site; dots of different shades represent localities for individual lizards. Many lizard locations are stacked on top of one another at this scale, which maps over 1700 locations.

Movements of individual lizards were monitored through radiotelemetry. Lizards were relocated 1–5 times per week during the summer months and once per week or less during the fall until they entered hibernation. Global Positioning System (GPS) coordinates and microhabitat characteristics (%–grass, forb, shrub, tree, bare ground, rock, litter) for each lizard location were determined and entered into the GIS lizard tracking database. Hibernation sites were also marked and data recorded for site characteristics (e.g., depth, soil type, slope, aspect). Data were recorded using hand-held computers (IPAQ and GeoXT) equipped with GPS (Trimble GPS Pathfinder Pocket Receiver) and customized ArcPad 6.02 software. Data were differentially corrected and imported into ArcMap 9.1 (ArcGIS Version 9), which was used to develop a GIS layer for the lizards at Tinker. Once lizards entered and stayed in hibernation sites, wire mesh cages were placed above them for capture and release with new transmitters when they emerged from hibernation in the spring (Endriss 2006).

Results and Discussion

Researchers collected data over four years starting in the summer of 2003, focusing on the active summer months and also tracking lizards into the fall and start of the hibernation period. Population sizes (± 1 SE) within Tinker AFB's urban wildlife reserve are estimated to be 53 ± 11 individuals with a density of 5.0 ± 1.0 lizards/ha. The lizard GIS layer has 174 individual lizards with over 1700 capture/relocation points, which readily portray macrohabitat use, home ranges, nesting and hibernation sites on high-resolution digital ortho-quad color aerial photographs (9 cm/pixel resolution).

Some observations that have potential management implications are starting to emerge. For instance, lizards at Tinker were much smaller (average snout vent length for females was 68.4 mm; for males 59.4 mm) than those that have been studied farther south (Hellgren et al. 2004). These findings contradict Bergmann's rule, which proposes an increase in animal body sizes with an increase in latitude (Ashton and Feldman 2003).



Texas Horned Lizard cooling itself on gravel nature trail.



Texas Horned Lizard peering over Oldworld Bluestem.



Texas Horned Lizard just prior to emergence from hibernation.



Texas Horned Lizard peering through native Bluestem.



Texas Horned Lizard resting in small tree.



Five Texas Horned Lizards sluggish after removal from hibernacula on a cool spring morning.



Texas Horned Lizard with an old-style transmitter and pack at nest entrance.



Hatchling Texas Horned Lizards emerging from nest site.

Stark (2000) and Burrows et al. (2001) found lizards to utilize a mosaic of vegetation types from bare ground to areas densely vegetated with forbs and grasses. Fair and Henke (1998) and Burrows et al. (2001) indicated that Texas Horned Lizards require a mixture of open and vegetated habitats to meet thermoregulatory requirements. This was apparent in our study, with lizards using grasses, forbs, shrubs/small trees, and bare ground. When lizard locations were compared with GIS vegetation layers, no preference was shown regarding vegetation type, other than an apparent avoidance of Red Cedar shrubland. In addition, some areas that were known to be more densely vegetated and isolated from bare ground and trails were lacking in lizard locations. GIS layers also showed home ranges to be closely associated with graveled nature trails and paved walking/jogging trails (Endriss 2006). Vegetation structure and availability of bare ground seems to be more important to lizards than the vegetation species type (i.e., whether native or not). Therefore, gravel and paved trails within the study site are likely very important for thermoregulation and movement between habitat resources.

Lizard home ranges were determined with the aid of the GIS layer. They averaged 0.84 ha for adult females and 0.90 ha for adult males (95% fixed kernel method, Arc View 3.3 extension). Sixteen lizards were tracked to hibernation sites, where characteristics such as hibernation period (5.5–7.0 months), slope aspects (facing south-southwest), and soil depths (2–12 mm) were recorded. Ten lizards were tracked to nesting locations, where nest depths of 5.0–7.5 cm were found (Endriss 2006). Characteristics such as these are important factors to consider for planning land management activities such as prairie restoration efforts (e.g., spraying, mowing, tilling, disking, and prescribed burning).



Land managers often use prescribed burning for prairie management. Timing of these events is very important for Texas Horned Lizard management.

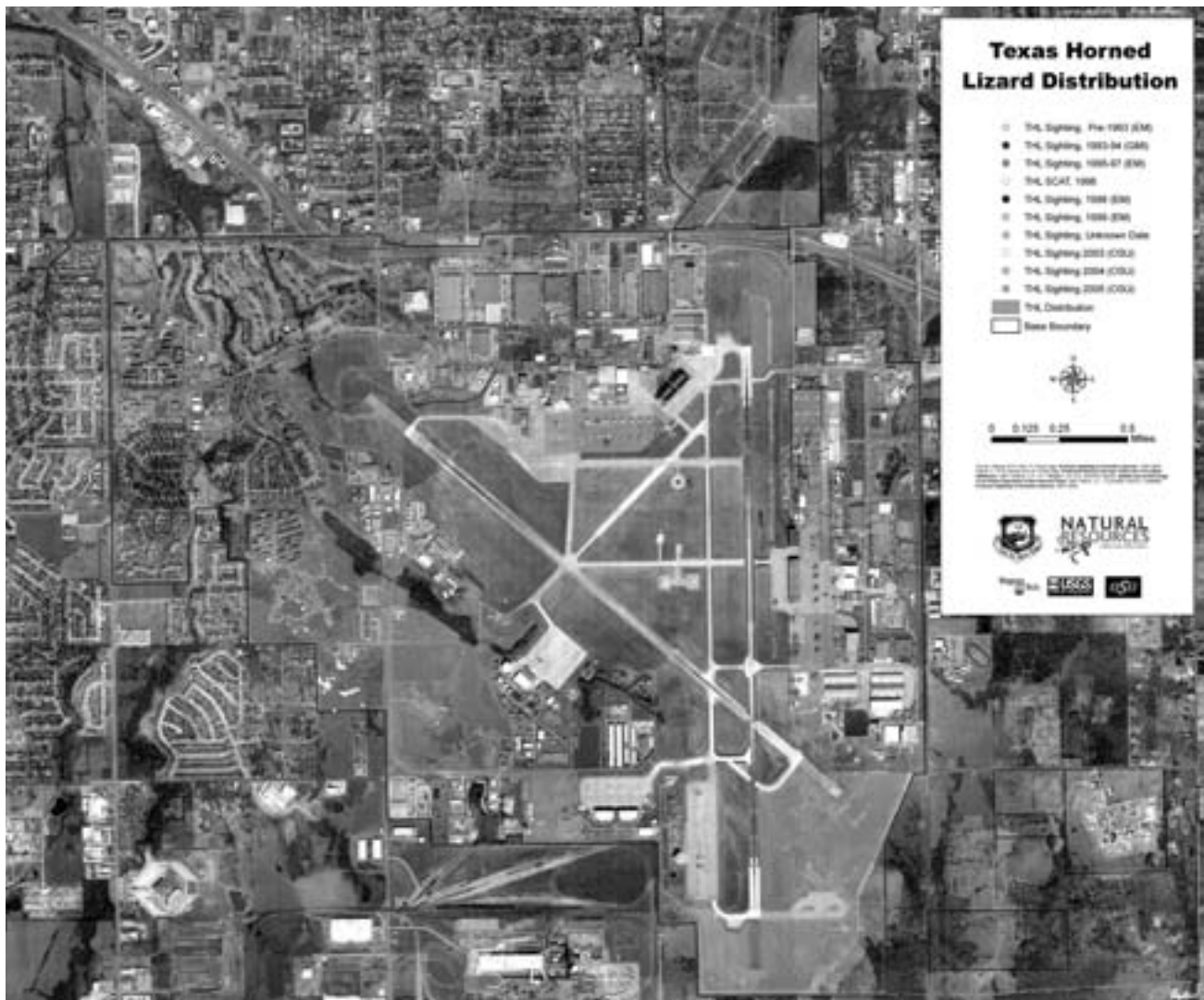
Capture locations and other documented historical sighting locations were used to construct a distribution layer for lizards. This was accomplished with the buffer tool in ArcMap, creating 360-m (maximum home range length) buffers around

all lizard locations, and then eliminating known unfavorable habitat. Knowing distribution and potential habitat areas for the lizards allows for consideration in planning of base development, as well as the ability to prescribe mitigation when conflicts arise. Populations of Texas Horned Lizards often have a localized distribution, and thus can survive in protected areas within an urban environment (Endriss 2006). For example, populations of horned lizards often are found in small city parks and vacant lots (Carpenter et al. 1993, Donaldson et al. 1994, Stark 2000). Military bases often find themselves with islands of relatively undisturbed habitat as urban development encroaches upon them. Apparently, on Tinker, all the right natural resources, including habitat and prey, are available to sustain a viable population of Texas Horned Lizards.

Learning more about horned lizards and other sensitive species is important, and knowledge garnered is vital to proper management of these species, especially in highly dynamic environments such as an industrialized military installation. This unfolding of Texas Horned Lizards life history and ecology at Tinker AFB may be key to understanding the lizard in other



Spraying herbicide on turf to restore the area to native grass.



Texas Horned Lizard distribution on Tinker AFB showing historical and recent survey locations. Isolated sightings within potentially favorable habitat have occurred outside the main study area.



The white middorsal line of the Texas Horned Lizard is cryptic, providing excellent camouflage in a native grass environment where the stripe mimics dead plant stems.

environments. We hope that this knowledge will foster informed management and decision-making regarding the species across its range. Such management in return would promote more robust and stable populations. This would lessen the potential for federal or state listing as threatened or endangered species, thereby precluding potential land use and other restrictions on the military and private landowners. In this scenario, both humans and nature win.

Acknowledgements

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Educational signs alert humans to lizards on the base.