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Reptiles and Amphibians Associated with Texas Pocket Gopher (*Geomys personatus*) Burrow Systems Across the Texas Sand Sheet

Pocket gophers (Rodentia: Geomyidae) are herbivorous solitary rodents that are highly modified morphologically for their fossorial lifestyle, enabling them to dig elaborate subterranean burrow systems (Stein 2000; Hafner et al. 2003; Merrit 2010). These burrow systems create unique environments for other organisms to invade and use, potentially leading to long-term interactions (Hafner et al. 2000, 2003). There have been multiple reported cases of associations between pocket gophers and invertebrates (e.g., Hubbell and Goff 1940; Blume and Summerlin 1988; Cameron 2000; Kovarik et al. 2008; Tisheckin and Cline 2008) as well as vertebrates, specifically mammals and herpetofauna (Table 1). Notably, many of the studies on the vertebrate associates of pocket gophers are restricted to a small number of pocket gopher species and geographic localities (Table 1). Here we present documented associations between the Texas Pocket Gopher (*Geomys personatus*) and other taxa, specifically herpetofauna.

Geomys personatus is endemic to the native coastal prairies and deep, sandy soils found throughout northeastern Tamualipas, Mexico, and much of southern Texas (Williams 1982; Schmidly and Bradley 2016). The burrow systems of these pocket gophers are prominent features of the natural habitats of the Texas Sand Sheet (the Coastal Sand Plains of the Southern Texas Plains ecoregion) and are comprised of several chambers and tunnels extending up to 30 m in length, and may be as much as 3 m deep (Williams 1982; Fig. 1). During efforts to capture *G. personatus*, nine species of herpetofauna were observed utilizing pocket gopher burrow systems. To our knowledge, these observations represent the first documented association of these species with *G. personatus* burrow systems. Here, we document our findings, add to the current literature of pocket gopher associates, and discuss the potential mechanisms driving these associations.

Methods

Fieldwork occurred on three East Foundation stewardship properties distributed across the Texas Sand Sheet: San Antonio Viejo Ranch (SAV) in southern Jim Hogg county and northern Starr county (60,033 ha), El Sauz Ranch (ES) in Kenedy and Willacy counties (10,984 ha), and Santa Rosa Ranch (SR) in Kenedy County (7544 ha; Fig. 2). These properties are situated across several Texas ecoregions: the Gulf Prairie and Marshes, and the Southern Texas Plains (which includes the South Texas Brush County and the South Texas Sand Sheet). These ecoregions contain ideal habitats with deep sandy soils for *G. personatus* (Schmidly and Bradley 2016). Fieldwork involved daily efforts to capture pocket gophers year-round and opportunistically from June 2013 to June 2015, with trips ranging from three to 20 days, averaging five days per field trip. Active pocket gopher burrow systems were located by surveying properties by foot; active systems were identified as those with mounds consisting of dark, damp soil and noticeable plugs. Using a shovel, fresh mounds at the surface of burrow systems were uncovered and holes were dug in the ground until tunnels into the burrow system were exposed. During this excavation period (i.e., the process of digging into a mound and below the surface of the ground to detect burrow openings), we opportunistically encountered reptiles and amphibians associated with pocket gopher mounds and burrow systems. All encounters were recorded and, when necessary, herpetofauna specimens were captured by hand and a dichotomous key (Dixon 2013) was used to verify species.

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Results

Geomys personatus burrow systems were found in open habitats with sandy soils across all East Foundation properties; we did not estimate pocket gopher density, but noted that these small mammals were quite abundant across all three properties with appropriate soil types. We focused our pocket gopher collecting efforts by excavating active burrow systems (i.e., occupied by a pocket gopher as indicated by the presence of at least one mound with fresh, damp, soil). Opportunistically, we also examined older mounds lacking the presence of fresh, damp soil, which may or may not represent burrow systems that were abandoned (these instances are specified below). Over a period of three years, we observed 125 unique individual amphibians and reptiles representing nine species within and surrounding pocket gopher burrows across the East Foundation properties (Table 2). Herpetofauna utilized pocket gopher burrow systems differently and were observed within at least one of five general zones of burrow systems (Fig. 1). Each observation was of one individual herpetofauna species, unless otherwise noted.

Among amphibians, we observed *Spea bombifrons* (Plains Spadefoot) within the loose topsoil of pocket gopher mounds (Zone B, Fig. 1) no more than approximately 33 cm below the surface during summer months of 2013 and 2014 (Table 2). We also observed *Anaxyrus speciosus* (Texas Toad) 5–8 cm below ground level within the humid tunnels of pocket gopher burrow systems (Zone E, Fig. 1; Table 2). Most encounters (N = 7) of *A. speciosus* occurred in mounds close to water sources (tanks) during the late spring and summer; other encounters occurred in the days following rains during late spring field seasons.

Five lizard species were observed: *Aspidoscelis gularis* (Common Spotted Whiptail), *Aspidoscelis sexlineata* (Six-lined Racerunner), *Holbrookia propinqua* (Keeled Earless Lizard),

TABLE 1. Vertebrate (birds, mammals, and reptiles and amphibians) burrow system associates of pocket gophers (Rodentia: Geomyidae). Mammal associates are listed taxonomically following Schmidly and Bradley (2016). All mammal and herpetofauna scientific names have been updated to reflect current taxonomy. Pocket gopher species, geographic locality (state), and reference for the association are indicated, if known. Pocket gopher species include (a) Baird's Pocket Gopher (*Geomys breviceps*), (b) Plains Pocket Gopher (*Geomys bursarius*), (c) Northern Pocket Gopher (*Thomomys talpoides*), (d) Valley Pocket Gopher (*Thomomys bottae*), (e) Digger Pine Pocket Gopher (*Thomomys bottae mewa*), (f) Attwater's Pocket Gopher (*Geomys attwateri*) and (g) Ozark Pocket Gopher (*Geomys bursarius ozarkensis*).

Vertebrate Associate	Geographic Locality	Reference (Pocket gopher species)
Birds		
Burrowing Owl (*Athene cunicularia*)	Colorado	Vaughan 1961
Mammals		
Least Shrew (*Cryptotis parva*)	Arkansas	Connior et al. 2014[a]
Eastern Mole (*Scalopus aquaticus*)	Colorado	Vaughan 1961[b]
		Scheffer 1945[c]
Striped Skunk (*Mephitis mephitis*)	Colorado	Vaughan 1961
Long-tailed Weasel (*Mustela frenata*)	Colorado	Vaughan 1961[b, c]
	Nevada	Hall 1946[d]
Mountain Vole (*Microtus montanus*)	Colorado	Vaughan 1961[c]
Prairie Vole (*Microtus ochrogaster*)	Colorado	Vaughan 1961[b, c]
Northern Grasshopper Mouse (*Onychomys leucogaster*)	Colorado	Vaughan 1961
North American Deer Mouse (*Peromyscus maniculatus*)	Arkansas	Connior et al. 2011[a]
	California	Howard & Childs 1959[e]
	Colorado	Vaughan 1961
Heermann's Kangaroo Rat (*Dipodomys heermanni*)	California	Howard & Childs 1959[e]
Ord's Kangaroo Rat (*Dipodomys ordii*)	Colorado	Vaughan 1961[b]
Hispid Pocket Mouse (*Chaetodipus hispidus*)	Texas	Wilks 1963[f]
San Joaquin Pocket Mouse (*Perognathus inornatus*)	California	Howard & Childs 1959[e]
Golden-mantled Ground Squirrel (*Callospermophillus lateralus*)	Colorado	Vaughan 1961[c, d]
Richardson's Ground Squirrel (*Urocitellus richardsoni*)	Colorado	Vaughan 1961[c]
Spotted Ground Squirrel (*Xerospermophilus spilosoma*)	Colorado	Vaughan 1961[b]
Thirteen-lined Ground Squirrel (*Ictidomys tridecimlineatus*)	Colorado	Vaughan 1961[b, c]
Desert Cottontail (*Sylvilagus audubonii*)	Colorado	Vaughan 1961
Amphibians and Reptiles		
Hurter's Spadefoot (*Scaphiopus hurterii*)	Arkansas	Connior et al. 2008[g]
	Texas	Wilks 1963[f]
Couch's Spadefoot (*Scaphiopus couchii*)	Texas	Wilks 1963[f]
Undetermined Spadefoot (*Scaphiopus* sp.)	Colorado	Vaughan 1961[b]
Great Plains Toad (*Anaxyrus cognatus*)	Colorado	Vaughan 1961
Texas Toad (*Anaxyrus speciosus*)	Texas	Wilks 1963[f]
Gulf Coast Toad (*Incilius nebulifer*)	Texas	Wilks 1963[f]
California Tiger Salamander (*Ambystoma californiense*)	California	Howard & Childs 1959[e]
Barred Tiger Salamander (*Ambystoma mavortium*)	Colorado	Vaughan 1961[b]
Northern Map Turtle (*Graptemys geographica*)	Arkansas	Connior et al. 2008[g]
Three-toed Box Turtle (*Terrapene carolina triunguis*)	Arkansas	Connior et al. 2008[g]
Ornate Box Turtle (*Terrapene ornata*)	Colorado	Vaughan 1961[b]
Lesser Earless Lizard (*Holbrookia maculata*)	Colorado	Vaughan 1961
Six-lined Racerunner (*Aspidoscelis sexlineatus*)	Arkansas	Connior & Chordas 2012[a]
	Colorado	Vaughan 1961
Western Whiptail (*Aspidoscelis tigris*)	California	Howard & Childs 1959[e]
Glossy Snake (*Arizona elegans*)	Texas	Wilks 1963[f]
Black Racer (*Coluber constrictor*)	Arkansas	Connior et al. 2008[g]
Prairie Rattlesnake (*Crotalus viridis*)	Colorado	Vaughan 1961[b]
Eastern Hognose Snake (*Heterodon platyrhinos*)	Texas	Wilks 1963[f]
Prairie Kingsnake (*Lampropeltis calligaster*)	Louisiana	Connior 2013[a]
Coachwhip (*Masticophis flagellum*)	Arkansas	Connior et al. 2008[g]
Gopher Snake (*Pituophis catenifer*)	California	Howard & Childs 1959[e]
	Colorado	Vaughan 1961[b]
	Nebraska	Morse 1927[b]
Louisiana Pine Snake (*Pituophis ruthveni*)	Louisiana	Rudolph & Burgdorf 1997[a]
	Louisiana	Rudolph et al. 1998[a]
	Texas	Ealy et al. 2004[a]
	Texas	Rudolph & Burgdorf 1997[a]
	Texas	Rudolph et al. 1998[a]
	Texas	Rudolph et al. 2007[a]
Rough Earth Snake (*Haldea striatula*)	Arkansas	Connior et al. 2008[g]

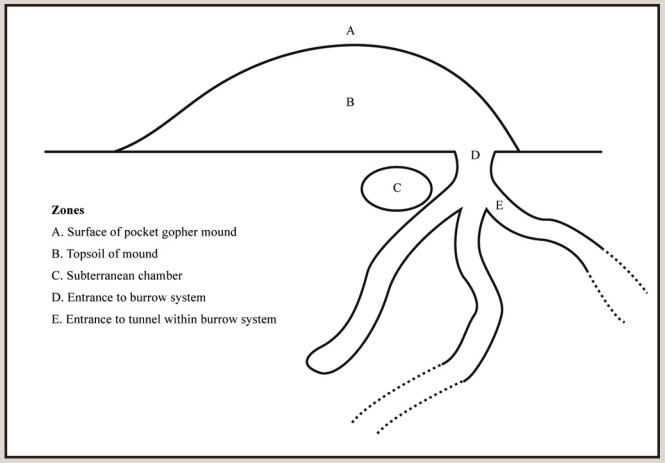

FIG. 1. Diagram of *Geomys personatus* burrow systems depicting "zones" within the system in which herpetofauna were observed.

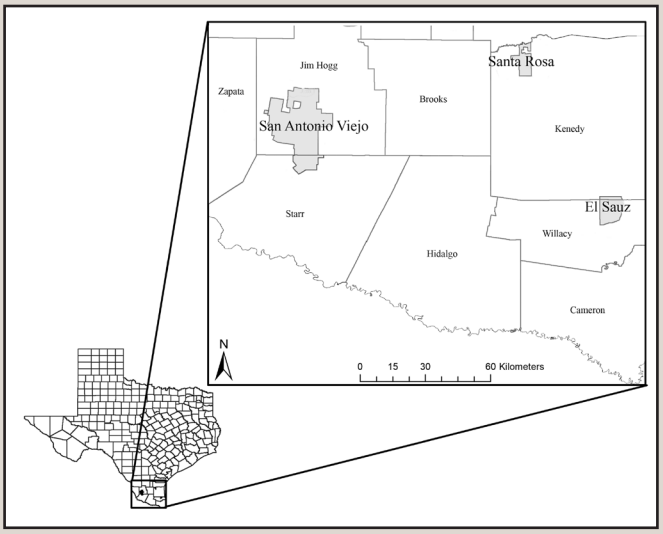

FIG. 2. Map of the East Foundation properties San Antonio Viejo Ranch (SAVR), El Sauz Ranch (ES), and Santa Rosa Ranch (SR) located in Jim Hogg, Starr, Kenedy, and Willacy counties in south Texas.

Phrynosoma cornutum (Texas Horned Lizard), and *Scincella lateralis* (Ground Skink; Table 2). *Aspidoscelis gularis* were observed within Zone E of burrow systems (Table 2, Fig. 1). *Aspidoscelis sexlineata* were found in shallow, 15–23 cm tunnels within Zone B of burrow systems (Fig. 1) during late spring field seasons. One observation was of two juvenile lizards in the same burrow system. *Holbrookia propinqua* occupied pocket gopher mounds in the same manner as *Aspidoscelis sexlineata* in summer field seasons (Table 2). *Phrynosoma cornutum* was observed during mid-summer field seasons, foraging on invertebrates while atop pocket gopher mounds (Zone A, Fig. 1; Table 2). *Scincella lateralis* was found within Zone B (Fig. 1) of older pocket gopher mounds found in an oak forest in SR (Table 2) in spring 2014.

Only one snake species, *Pituophis catenifer sayi* (Bullsnake), was observed associating with pocket gopher burrows during the summer of 2014 (Table 2). Two snakes were observed within tunnels (Zone F, Fig. 1), another was found in a shallow chamber immediately above a tunnel (Zone C, Fig. 1), and the last observation was of an individual *P. c. sayi* entering a previously opened pocket gopher burrow system.

Lastly, we observed one tortoise species, *Gopherus berlandieri* (Texas Tortoise), using pocket gopher burrows during the summer of 2014 (Table 2). One individual was observed excavating an older pocket gopher mound and the other was entering an opened pocket gopher burrow system (Zone D, Fig. 1).

DISCUSSION

The use of burrow systems by organisms other than the burrowing species is not unique to pocket gophers and has been documented for a variety of invertebrate and vertebrate taxa (e.g., Scheffer 1945; Gentry and Smith 1968; Cocroft and Hambler 1989; Witz et al. 1991; Dundee et al. 2012; Schalk 2012; Schalk and Sezano 2014). Many times, herpetofauna associate with these burrow systems for intuitive reasons: the mound and burrow environments can provide a food source or shelter from environmental conditions (i.e., help provide a stable environment for thermoregulation and water balance) or predators (e.g., Vaughan 1961; Rudolph et al. 1998, 2002; Ealy et al. 2004; Rothermel and Luhring 2005; Himes et al. 2006; Rudolph et al. 2007; Connior et al. 2008; Todd et al. 2008; Connior and Chordas 2012; Dundee et al. 2012; Schalk 2012; Connior 2013; Schalk and Sezano 2014). The associates of pocket gophers are generally well-known (Cameron 2000), with several pocket gopher reports detailing complete disregard (or at most, minimum inconvenience) of many of their herpetofauna associates (Vaughan 1961; Hickman 1977). This research is the first to report associations between *G. personatus* burrow systems and South Texas herpetofauna. Of the nine amphibian and reptile species we encountered, the majority have never been recorded in association with any pocket gopher species prior to this study (Table 2). All nine of these herpetofauna species were found in their preferred habitats, and are known residents of the South Texas Sand Sheet and the counties within which the East Foundation properties are located (Brooks 1967; Tipton et al. 2012; Dixon 2013; Hibbitts and Hibbitts 2015, 2016). Recent efforts documenting biodiversity on East Foundation properties have documented the presence of 50 herpetofauna species (Adams et al. 2016). Therefore, 18% of all known reptiles and amphibians in the study area were observed utilizing pocket gopher burrows. Since our original objective was to collect pocket gophers, our total number of hereptofauna species and individual encounters on or within burrow systems is certainly an underestimate. However, we note that tunnel opening size (approximately 10 cm horizontal diameter, 12.5 cm vertical diameter; Schmidly and Bradley 2016) of *Geomys personatus* burrows will likely limit which herpetofauna species of East Foundation properties associate with pocket gopher burrows (e.g., Luhring et al. 2016).

Despite similar habitats, we did not find all nine herpetofauna species associating with pocket gophers across all East Foundation properties. For example, and as expected, we did not find *Spea bombifrons* in SR. In this case, most of our collecting efforts occurred in the winter when *S. bombifrons* are normally occupying deeper burrows, up to 460 cm below the surface (Tipton et al. 2012). Although *Aspidoscelis gularis* was only found within pocket gopher mounds on SAV during late summer field seasons, we did encounter this species on ES and SR while searching for *G. personatus* mounds during spring field seasons. Thus, this species is present at these properties but we failed to observe it in association with pocket gopher burrows. The number of independent observations of *A. gularis* (21; Table 2) indicates that

TABLE 2. Observed herpetofauna species occupying active *Geomys personatus* burrow systems on East Foundation properties from 2013 to 2015 (representing all four seasons). Properties include (a) San Antonio Viejo Ranch, (b) El Sauz Ranch, and (c) Santa Rosa Ranch (Fig. 2). Observations are ordered from most to least where an "observation" refers to every time a unique individual was observed during efforts to capture *G. personatus*. Asterisks indicate novel pocket gopher–herpetofauna associations not previously reported in the literature.

Herpetofauna species	Total observations	Observations per property
Texas Toad (*Anaxyrus speciosus*)	13	8[b], 5[c]
Plains Spadefoot (*Spea bombifrons*)*	26	10[a], 16[b]
Common Spotted Whiptail (*Aspidoscelis gularis*)*	21	21[a]
Six-lined Racerunner (*Aspidoscelis sexlineata*)	17	12[a], 5[b]
Keeled Earless Lizard (*Holbrookia propinqua*)*	17	11[a], 3[b], 3[c]
Texas Horned Lizard (*Phrynosoma cornutum*)*	17	14[a], 1[b], 2[c]
Ground Skink (*Scincella lateralis*)*	8	8[c]
Bullsnake (*Pituophis catenifer sayi*)	4	4[a]
Texas Tortoise (*Gopherus berlandieri*)*	2	2[c]
Total observations	125	

this species is a common associate of pocket gopher burrow systems. *Scincella lateralis* prefer habitats with substantial leaf litter (Brooks 1967; Dixon 2013) and SR was the only property surveyed extensively for *G. personatus* within oak forest areas. To verify if this species is associated with pocket gopher burrows in SAVR and ES, additional surveys in appropriate habitat are necessary.

Some species were observed in very low numbers at certain study sites. For example, our observations of *Phrynosoma cornutum* at ES and SR are low (Table 2). However, this species is known to seek refuge in animal burrows under mesquite near harvester ant mounds (*Pogonomyrmex barbatus*; Eifler et al. 2012). We observed many *Phrynosoma cornutum* at SAV and these data indicate that the association of this lizard with pocket gopher burrows at ES and SR, although rare, is likely not random. Although we observed only a small number of *Pituophis catenifer sayi* in association with pocket gopher burrows, this species has an extensive range throughout Texas, is present on all East Foundation properties, inhabits a wide array of habitats, is often ubiquitous within its home range (Kapfer et al. 2008), and, most importantly, is known to prey upon pocket gophers (Schmidt and Davis 1941; Dixon and Werler 2005). Therefore, these observations likely reflect true associations that may commonly occur in nature. Lastly, although we only observed two *Gopherus berlandieri* individuals associated with pocket gopher burrows, this species is known to occupy the burrows of mammals such as armadillos, badgers, and pocket gophers rather than excavating their own extensive burrows (Kazmaier et al. 2001). Therefore, the association between *Gopherus berlandieri* and *Geomys personatus* likely commonly occurs in nature and additional studies better documenting burrow system use of tortoises are warranted. A better understanding of the association between these two species may provide valuable information for conservation of the state threatened *Gopherus berlandieri*.

Fossorial rodents such as pocket gophers act as ecological engineers by creating extensive burrow systems which alter plant community structures, create deep soils, and increase soil moisture levels (Cox et al. 1995). The burrow systems of pocket gophers create optimal habitat for not just the rodents, but also for a suite of associated taxa (Cameron 2000; Hafner et al. 2003). These observations are the first to extensively document amphibian and reptile use of *G. personatus* burrow systems in South Texas. With 18% of all East Foundation herpetofauna exhibiting this association (although this figure is likely an underestimate), this showcases the important functions *G. personatus* burrow systems play for reptiles and amphibians, and likely for other organisms as well, across the Texas Sand Sheet. Given that this study focused on opportunistic encounters with reptiles and amphibians, future work should focus specifically on herpetofauna detection within and on pocket gopher burrow systems. Doing so will result in more detailed information on pocket gopher and herpetofauna associations such as documenting association abundance, detectability of associations, seasonal differences in burrow system use, and rigorously assessing burrow use preferences. Importantly, a better understanding of burrow system use by *Gopherus berlandieri* may provide valuable insight for conservation planning of this state threatened species.

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LITERATURE CITED

ADAMS, C. S., T. J. HIBBITTS, AND T. A. CAMPBELL. 2016. New amphibian and reptile county records from the Lower rio Grande Valley in Texas, USA. Herpetol. Rev. 47:430–431.

BLUME, R. R., AND J. W. SUMMERLIN. 1988. Histeridae (Coleoptera) from pocket gopher burrows (Geomyidae) in East Central Texas. Coleopt. Bull. 42:202–204.

BROOKS, G. R. 1967. Population ecology of the ground skink, *Lygosoma laterale* (Say). Ecol. Monogr. 37:71–87.

CAMERON, G. N. 2000. Community ecology of subterranean rodents. *In* E. A. Lacey, James L. Patton, and G. N. Cameron (eds.), Life Underground: The Biology of Subterranean Rodents, pp. 227–256. University of Chicago Press, Chicago, Illinois.

COCROFT, R. B., AND K. HAMBLER. 1989. Observations on a commensal relationship of the microhylid frog *Chiasmocleis ventrimaculata* and the burrowing theraphosid spider *Xenesthis immanis* in Southeastern Peru. Biotropica 21:2–8.

CONNIOR, M. B. 2013. *Lampropeltis calligaster calligaster* (Prairie kingsnake): anthropogenic mortality. Herpetol. Rev. 44:643.

———, AND S. W. CHORDAS III. 2012. *Aspidocelis sexlineata* (six-lined racerunner): commensalism. Herpetol. Rev. 43:644.

———, I. Guenther, T. Risch, and S. Trauth. 2008. Amphibian, reptile, and small mammal associates of Ozark pocket gopher habitat in Izard County, Arkansas. J. Arkansas Acad. Sci. 62:45–51.

———, R. Tumlison, and H. W. Robison. 2011. New records and notes on the natural history of vertebrates from Arkansas. J. Ark. Acad. Sci. 65:160–165.

———, ———, ———, C. T. McAllister, and D. A. Neely. 2014. Natural history notes and records of vertebrates from Arkansas. J. Arkansas Acad. Sci. 68:140–145.

Cox, G. W., L. C. Contreras, and A. V. Milewski. 1995. Role of fossorial animals in community structure and energetics of Pacific Mediterranean ecosystems. *In* M. T. K. Arroyo, P. H. Zedler, and M. D. Fox (eds.), Ecology and Biogeography of Mediterranean Ecosystems in Chile, California, and Australia, pp. 383–398 Springer-Verlag Press, New York, New York.

Dixon, J. R. 2013. Amphibians and Reptiles of Texas: With Keys, Taxonomic Synopses, Bibliography and Distribution Maps. Third edition. Texas A&M University Press,College Station, Texas. 460 pp.

———, and J. E. Werler. 2005. Texas Snakes: A Field Guide. University of Texas Press, Austin, Texas. 384 pp.

Dundee, H. A., C. Shillington, and C. M. Yeary. 2012. Interactions between tarantulas (*Aphonopelma hentzi*) and narrow-mouthed toads (*Gastrophyrne olivacea*): support for a symbiotic relationship. Tulane Stud. Zool. Bot. 32:31–38.

Ealy, M. J., R. R. Fleet, and D. C. Rudolph. 2004. Diel activity patterns of the Louisiana pine snake (*Pituphis ruthveni*) in eastern Texas. Texas J. Sci. 56: 383–394.

Eifler, D. A., T. K. Brown, and M. A. Eifler. 2012. Habitat selection by foraging Texas horned lizards, *Phyronosoma cornutum*. Southwest. Nat. 57:39–43.

Gentry, J. B., and M. H. Smith. 1968. Food habits and burrow associates of *Peromyscus polionotus*. J. Mammal. 49:562–565.

Hafner, M. S., J. W. Demastes, D. L. Reed, and T. A. Spradling. 2003. Cophylogeny between pocket gophers and chewing lice. *In* R. D. M. Page (ed.), Tangled Trees: Phylogeny, Cospeciation, and Coevolution, pp. 195–220. University of Chicago Press, Chicago, Illinois.

———, ———, and T. A. Spradling. 2000. Coevolution and subterranean rodents. *In* E. A. Lacey, James L. Patton, and G. N. Cameron (eds.), Life Underground: the Biology of Subterranean Rodents, pp. 370–388. University of Chicago Press, Chicago, Illinois.

Hall, E. R. 1946. Mammals of Nevada. University of California Press, Berkeley, California. 710 pp.

Hibbitts, T. D., and T. J. Hibbitts. 2015. Texas Lizards: A Field Guide. University of Texas Press, Austin, Texas. 351 pp.

———, and ———. 2016. Texas Turtles and Crocodilians: A Field Guide. University of Texas Press, Austin, Texas. 276 pp.

Hickman, G. C. 1977. Geomyid interaction in burrow systems. Texas J. Sci. 29:235–243.

Himes, J. G., L. M. Hardy, D. C. Rudolph, and S. J. Burgdorf. 2006. Movement patterns and habitat selection by native and repatriated Louisiana pine snakes (*Pituophis ruthveni*): implications for conservation. Herpetol. Nat. Hist. 9:104–116.

Howard, W. E., and H. E. Childs, Jr. 1959. Ecology of pocket gophers with emphasis on *Thomomys bottae mewa*. Hilgardia 29:277–358.

Hubbell, T. H., and C. C. Goff. 1940. Florida pocket-gopher burrows and their arthropod inhabitants. Proc. Florida Acad. Sci. 4:127–166.

Kapfer, J. M., J. R. Coggins, and R. Hay. 2008. Spatial ecology and habitat selection of bullsnakes (*Pituophis catenifer sayi*) at the northern periphery of their geographic range. Copeia 2008:815–826.

Kazmaier, R. T., E. C. Hellgren, and D. R. Synatzske. 2001. Patterns of behavior in the Texas tortoise, *Gopherus berlandieri*: a multivariate ordination approach. Can. J. Zool. 79:1363–1371.

Kovarik, P., S. Chordas III, H. Robison, P. Skelley, M. B. Connior, J. Fiene, and G. Heidt. 2008. Insects inhabiting the burrows of the Ozark pocket gopher in Arkansas. J. Arkansas Acad. Sci. 62:75–78.

Luhring, T. M., G. C. Connette, and C. M. Schalk. 2016. Trap characteristics and species morphology explain size-biased sampling of two salamander species. Amphibia-Reptilia 37:79–89.

Merrit, J. F. 2010. The Biology of Small Mammals. Johns Hopkins University Press, Baltimore, Maryland. 313 pp.

Morse, A. P. 1927. The way of a snake with a gopher. Copeia 164:71–72.

Rothermel, B. R., and T. M. Luhring. 2005. Burrow availability and desiccation risk of mole salamanders (*Ambystoma talpoideum*) in harvested versus unharvested forest stands. J. Herpetol. 39:619–626.

Rudolph, D. C., and S. J. Burgdorf. 1997. Timber rattlesnakes and Louisiana pine snakes of the west Gulf coastal plain: hypotheses of decline. Texas J. Sci. 49 Suppl.: 111–122.

———, ———, J. C. Tull, M. Ealy, R. N. Conner, R. R. Schaefer, and R. R. Fleet. 1998. Avoidance of fire by Louisiana pine snakes, *Pituophis melanoleucus ruthveni*. Herpetol. Rev. 29:146–148.

———, ———, R. N. Conner, C. S. Collins, D. Saenz, R. R. Schaefer, T. Trees, C. M. Duran, M. Ealy, and J. G. Himes. 2002. Prey handling and diet of Louisiana pine snakes (*Pituophis ruthveni*) and black pine snakes (*P. melanoleucus lodingi*) with comparisons to other selected colubrid taxa. Herpetol. Nat. Hist. 9:57–62.

———, R. R. Schaefer, S. J. Burgdorf, C. M. Duran, and R. N. Conner. 2007. Pine snake (*Pituophis ruthveni* and *Pituophis melanoleucus lodingi*) hibernacula. J. Herpetol. 41:560–565.

Schalk, C. M. 2012. *Physalaemus bilogonigerus*: burrow use. Herpetol Rev. 43:123–124.

———, and M. Sezano. 2014. Observations on the use of tarantula burrows by the anurans *Leptodactylus bufonius* (Leptodactylidae) and *Rhinella major* (Bufonidae) in the Dry Chaco ecoregion of Bolivia. Acta Herpetol. 9:99–102.

Scheffer, T. H. 1945. Burrow association of small mamamls. The Murrelet 26:24–26.

Schmidly, D. J., and R. D. Bradley. 2016. The Mammals of Texas. Seventh Edition. University of Texas Press, Austin, Texas. 720 pp.

Schmidt, K. P., and D. D. Davis. 1941. Fieldbook of Snakes of the United States and Canada. G. P. Putnam's Sons Publishing, New York, New York. 365 pp.

Stein, B. R. 2000. Morphology of subterranean rodents. *In* E. A. Lacey, James L. Patton, and G. N. Cameron (eds.), Life Underground: The Biology of Subterranean Rodents, pp. 19–61. University of Chicago Press, Chicago, Illinois.

Tipton, B. L., T. D. Hibbitts, T. J. Hibbitts, T. L. Hibbitts, and T. J. LaDuc. 2012. Texas Amphibians: A Field Guide. University of Texas Press, Austin, Texas. 330 pp.

Tishechkin, A. K., and A. R. Cline. 2008. The beetle (Coleoptera) fauna of pocket gopher burrows in Louisiana. Proc. Entomol. Soc. Washington 110:331–339.

Todd, B. D., B. R. Rothermel, R. N. Reed, T. M. Luhring, K. Schlatter, T. Trenkamp, and J. W. Gibbons. 2008. Habitat alteration increases invasive fire ant abundance to the detriment of amphibians and reptiles. Biol. Invasions 10:539–546.

Vaughan, T. A. 1961. Vertebrates inhabiting pocket gopher burrows in Colorado. J. Mammal. 42:171–174.

Wilks, B. J. 1963. Some aspects of the ecology and population dynamics of the pocket gopher (*Geomys bursarius*) in southern Texas. Texas J. Sci. 15:241–283.

Williams, S. L. 1982. *Geomys personatus*. Mamm. Species 170:1–5.

Witz, B. W., D. S. Wilson, and M. D. Palmer. 1991. Distribution of *Gopherus polyphemus* and its vertebrate symbionts in three burrow categories. Am. Midl. Nat. 126:152–158.