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M. Connior

Arkansas State University, matthew.connior@smail.astate.edu

I. Guenther

Arkansas State University

Thomas S. Risch

Arkansas State University

Stanley E. Trauth

Arkansas State University

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Amphibian, Reptile, and Small Mammal Associates of Ozark Pocket Gopher Habitat in IZARD COUNTY, ARKANSAS

M. Connior^{1,2}, I. Guenther¹, T. Risch¹, and S. Trauth¹

¹Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, AR 72467

²Correspondence: Matthew.connior@smail.astate.edu

Abstract

We conducted a study of the amphibian, reptile, and small mammal community assemblage of Ozark pocket gopher (*Geomys bursarius ozarkensis*) habitat in north-central Arkansas. We used 2 methods to capture individuals: hand capture and drift fences. During the study, we captured and marked a total of 9 anuran, 4 salamander, 5 lizard, 3 turtle, 16 snake, and 8 small mammal species exclusive of pocket gophers. We found one hatchling three-toed box turtle (*Terrapene carolina triunguis*) and one rough earth snake (*Virginia striatula*) inside a pocket gopher burrow and mound, respectively. Additionally, we witnessed both eastern racers (*Coluber constrictor*) and eastern coachwhips (*Masticophis flagellum*) retreat into pocket gopher burrows, as well as Hurter's spadefoots (*Scaphiopus holbrookii hurterii*) burrow into pocket gopher mounds when released. Our results highlight the importance of mammalian burrows, specifically pocket gophers, to other vertebrate associates in grassland ecosystems. Both conservationists and managers need to determine the pocket gopher's impact on ecosystem health and viability, specifically in natural grasslands, before conservation and/or management strategies are employed.

Introduction

Pocket gophers are fossorial rodents that mound dirt above ground while burrowing, which can alter the temporal microhabitat significantly. Prior to the 1990s, all pocket gophers in Arkansas were classified as Baird's pocket gopher (*Geomys breviceps*; Sealander and Heidt 1990). However, a second species, Ozark pocket gopher (*G. bursarius ozarkensis*), was described through further DNA testing and additional ectoparasite examination (Elrod et al. 1996, 2000). The Ozark pocket gopher is endemic to IZARD COUNTY, ARKANSAS (Elrod et al. 2000, Kershner 2004), and is currently a "species of greatest conservation need" in the Arkansas Wildlife Action Plan (Anderson 2006). Thus, the Ozark pocket gophers' impact on the ecology of their habitat community should be determined

before making future management/ conservation decisions. Previous studies have shown that pocket gopher habitats are high in species richness and provide abundant cover for associates (Howard and Childs 1959, Vaughan 1961, Wilks 1963).

As part of a larger study, we conducted an inventory of Ozark pocket gopher associates (i.e., amphibians, reptiles, and small mammals) found both on the surface and in the burrows. Our primary objective was to determine the amphibians, reptiles, and small mammals that use pocket gopher habitat.

Methods and Materials

Our study area consisted of 2 study sites (Site 1, Site 2) located on private property in IZARD COUNTY, ARKANSAS. Both study sites were ~ 4 ha open, grassy cattle pastures bordered by small creeks, roads, and woodland.

We collected specimens along drift fences and by hand. Drift fences were placed at the periphery of the pastures, as we used drift fences to assess possible pocket gopher dispersal. We ran 2 drift fences per site at 2 sites for a total of 101 trap nights per site during 3 March to 2 July 2007 to capture species that co-exist with pocket gophers. The drift fences measured 33 m in length and had an 18.9 l bucket pitfall trap at each end with an additional 18.9 l bucket on either side of the drift fence every ca. 8 m (8 buckets per fence). We also placed a funnel trap 12 m from the end of the drift fence on either side. The funnel traps (90 x 30 x 30 cm) were made of 0.62-cm wire mesh hardware cloth and had double entrances.

We placed 2 additional drift fences at Site 2 from 2 January to 4 April 2008. These drift fences were similar to those described above, except, they lacked funnel traps. The funnel traps were not installed due to cold temperatures that would cause mortality to captured individuals.

We captured additional vertebrate species by hand at both sites by searching by sight and excavation of burrows during pocket gopher trap placement. Our hand capture collection technique was opportunistic where no specific transects or efforts were employed.

Typically, hand captures were limited to reptiles due to their ectothermy and basking behavior.

We identified all captured individuals to species or subspecies. We marked small mammals with ear tags using the same procedures as Fokidis et al. (2006) and the herpetofauna, exclusive of turtles, by either toe-clipping or scale-clipping (Nietfeld et al. 1996). We marked turtles by notching carapace scutes (Cagle 1939). We implanted passive integrated transponder (PIT) tags into snakes that were large enough to mark. We deposited voucher specimens of all amphibians and reptiles captured in drift fences and most of the hand captures in the Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ; see Table 2). We deposited all small mammal specimens collected (i.e., trap mortality) in the Arkansas State University Museum of Zoology Mammalogy Collection (ASUMZ).

Results

Vertebrate Captures in Habitat

We captured 13 amphibian, 25 reptile, and 8 small mammal species or subspecies in Ozark pocket gopher habitat during field seasons in 2007 and 2008. Two subspecies of *Coluber constrictor* were captured, *C. c. priapus* and *C. c. flaviventris*. Drift fences accounted for the majority of the species/subspecies collected in 2007 (Table 1). One additional species, tiger salamander (*Ambystoma tigrinum*), was captured in the drift fences in 2008 (n = 2 females; 6 February). Of the 18 families represented, 8 were amphibians (3 urodela; 5 anuran), 7 were reptiles (2 testudines; 5 squamates), and 3 were small mammals (2 insectivores; 1 rodent) (Table 2).

Table 1. Amphibian, reptile, and small mammals captured in drift fences in 2007 and 2008 at two Ozark pocket gopher habitat sites.

Scientific Name	Common Name	Site 1 (2007) No. Captured	Site 2 (2007) No. Captured	Site 2 (2008) No. Captured
Amphibians				
<i>Acris crepitans blanchardi</i>	Blanchard's Cricket Frog	1	4	0
<i>Ambystoma opacum</i>	Marbled Salamander	0	2	0
<i>Ambystoma tigrinum tigrinum</i>	Tiger Salamander	0	0	2
<i>Bufo americanus charlesmithi</i>	Dwarf American Toad	65	8	2
<i>Bufo fowleri</i>	Fowler's Toad	1	0	0
<i>Eurycea lucifuga</i>	Cave Salamander	1	0	0
<i>Gastrophryne carolinensis</i>	Eastern Narrowmouth Toad	3	4	0
<i>Notophthalmus viridescens louisianensis</i>	Central Newt	1	1	1
<i>Pseudacris crucifer crucifer</i>	Northern Spring Peeper	0	1	0
<i>Rana catesbeiana</i>	American Bullfrog	18	1	0
<i>Rana palustris</i>	Pickering Frog	17	43	5
<i>Rana spenocephala</i>	Southern Leopard Frog	10	7	0
<i>Scaphiopus holbrookii hurterii</i>	Hurter's Spadefoot	18	11	1
Reptiles				
<i>Cemophora coccinea copei</i>	Northern Scarlet Snake	3	1	0
<i>Aspidoscelis sexlineata viridis</i>	Prairie Racerunner	30	5	0
<i>Coluber constrictor priapus</i>	Southern Black Racer	1	3	0
<i>Coluber constrictor flaviventris</i>	Eastern Yellowbelly Racer	0	1	0
<i>Eumeces anthracinus pluvialis</i>	Southern Coal Skink	2	3	1
<i>Eumeces fasciatus</i>	Five-lined Skink	3	3	0
<i>Heterodon platirhinos</i>	Eastern Hognose Snake	1	1	0
<i>Lampropeltis calligaster calligaster</i>	Prairie Kingsnake	1	0	0
<i>Sceloporus undulatus hyacinthinus</i>	Northern Fence Lizard	19	16	5

Amphibian, Reptile, & Small Mammal Associates of Ozark Pocket Gopher Habitat in Izard County, Arkansas

Table 1 continued

Scientific Name	Common Name	Site 1 No. Captured	Site 2 (2007) No. Captured	Site 2 (2008) No. Captured
Reptiles (continued)				
<i>Scincella lateralis</i>	Ground Skink	3	9	2
<i>Tantilla gracilis</i>	Flathead Snake	8	3	0
<i>Terrapene carolina triunguis</i>	Three-toed Box Turtle	3	1	0
<i>Thamnophis sirtalis sirtalis</i>	Eastern Garter Snake	0	1	0
<i>Virginia striatula</i>	Rough Earth Snake	1	0	0
Mammals				
<i>Blarina carolinensis</i>	Southern Short-tailed Shrew	0	4	0
<i>Cryptotis parva</i>	Least Shrew	10	89	8
<i>Microtus pinetorum</i>	Woodland Vole	21	41	9
<i>Mus musculus</i>	House Mouse	0	1	0
<i>Ochrotomys nuttalli</i>	Golden Mouse	0	2	0
<i>Peromyscus maniculatus</i>	Deer Mouse	19	14	0
<i>Reithrodontomys fulvescens</i>	Fulvous Harvest Mouse	14	14	0
<i>Scalopus aquaticus</i>	Eastern Mole	0	1	0

An additional 11 amphibian and reptile species were captured by hand. Box turtles and large snakes made up the majority of hand captures. We captured eastern racers (*Coluber constrictor*) and three-toed box turtles (*Terrapene carolina triunguis*) frequently (n = 14, 16, respectively). Eastern coachwhips (*Masticophis flagellum flagellum*) and prairie kingsnakes (*Lampropeltis calligaster calligaster*) were fairly common based on visual observations.

During this study, we documented 5 new county records. Four of those records were herpetofauna: eastern yellowbelly racer, *Coluber constrictor flaviventris* (Connior et al. 2007a); great plains rat snake, *Elaphe guttata emoryi* (Connior et al. 2007b); hurter's spadefoot, *Scaphiopus holbrookii hurterii* (Connior et al. 2007c); three-toed box turtle, *Terrapene carolina triunguis* (Connior et al. 2007d). Captures of Southern short-tailed shrew, *Blarina carolinensis*, also represented a new county record (see below).

Blarina carolinensis

Izard Co.--Found in a cattle pasture on private property off Co. Rd. 3, 4 km E of St. Hwy 9. UTM 15N 0597627E, 3987505N. 4 individuals. 20 March 2007 (1 individual; ASUMZ 28413); 25 April 2007 (1 individual; ASUMZ 28414); 26 April 2007 (2 individuals; ASUMZ 28415, ASUMZ 28416).

Vertebrate Observations in Burrows and Mounds

One of us (MBC) captured a juvenile three-toed box turtle inside a pocket gopher burrow while setting a live trap. Additionally, one of us (MBC) captured a rough earth snake (*Virginia striatula*) in a pocket gopher mound. Two of us (MBC, IG) witnessed both eastern racers and eastern coachwhips retreat into pocket gopher burrows and common map turtles (*Graptemys geographica*) digging nests in the soft dirt of pocket gopher mounds. After release of captured Hurter's spadefoots, they would commonly retreat by digging into pocket gopher mounds.

Discussion

Pocket gophers are ecosystem engineers, which not only provide habitat for other vertebrates but also impact the distribution of soil and nutrients (Reichman and Seabloom 2002, Reichman 2007). Other subterranean rodents, such as prairie dogs, have great impacts on the ecosystem and vertebrate fauna that elevate them to keystone species (Kotliar et al. 1999, 2006). Keystone species are species whose effect on the ecosystem is exceptionally larger than expected relative to its abundance (Power et al. 1996). Gopher tortoises (*Gopherus polyphemus*) have numerous vertebrate associates in their burrows as well (Lips 1991, Witz et al. 1991). Madison (1997) found that

M. Connior, I. Guenther, T. Risch, and S. Trauth

Table 2. Complete list of all amphibian, reptile, and small mammal species captured in Ozark pocket gopher habitat in Izard County, Arkansas.

Scientific Name	Common Name	Scientific Name	Common Name
Class Amphibia	Amphibians	<i>Heterodon platyrhinos</i>	Eastern Hognose Snake
<i>Ambystoma tigrinum tigrinum</i>	Eastern Tiger Salamander ¹	<i>Lampropeltis calligaster calligaster</i>	Prairie Kingsnake
<i>Ambystoma opacum</i>	Marbled Salamander	<i>Lampropeltis getula holbrooki</i> *	Speckled Kingsnake
<i>Eurycea lucifuga</i>	Cave Salamander	<i>Masticophis flagellum flagellum</i> *	Eastern Coachwhip
<i>Notopthalmus viridescens louisianensis</i>	Central Newt	<i>Nerodia erythrogaster flavigaster</i> *	Yellowbelly Water Snake
<i>Bufo americanus charlesmithi</i>	Dwarf American Toad	<i>Nerodia sipedon pleuralis</i> *	Midland Water Snake
<i>Bufo fowleri</i>	Fowler's Toad	<i>Ophedryas aestivus</i> *	Rough Green Snake
<i>Acris crepitans blanchardi</i>	Blanchard's Cricket Frog	<i>Storeria dekayi wrightorum</i> *	Midland Brown Snake
<i>Pseudacris crucifer crucifer</i>	Northern Spring Peeper	<i>Tantilla gracilis</i>	Flathead Snake
<i>Gastrophryne carolinensis</i>	Eastern Narrowmouth Toad	<i>Thamnophis proximus proximus</i> *	Western Ribbon Snake
<i>Scaphiopus holbrookii hurterii</i>	Hurter's Spadefoot ¹	<i>Thamnophis sirtalis sirtalis</i>	Eastern Garter Snake
<i>Rana catesbeiana</i>	American Bullfrog	<i>Virginia striatula</i>	Rough Earth Snake
<i>Rana palustris</i>	Pickerel Frog	<i>Agkistrodon contortrix contortrix</i> *	Southern Copperhead
<i>Rana sphenoccephala</i>	Southern Leopard Frog	Class Mammalia	Mammals
Class Reptilia	Reptiles	<i>Blarina carolinensis</i>	Southeastern Short-tailed Shrew
<i>Chelydra serpentina serpentina</i> *	Common Snapping Turtle	<i>Cryptotis parva</i>	Least Shrew
<i>Graptemys geographica</i> *	Common Map Turtle	<i>Scalopus aquaticus</i>	Eastern Mole
<i>Terrapene carolina triunguis</i>	Three-toed Box Turtle	<i>Microtus pinetorum</i>	Woodland Vole
<i>Sceloporus undulatus hyacinthinus</i>	Northern Fence Lizard	<i>Mus musculus</i>	House Mouse
<i>Eumeces anthracinus pluvialis</i>	Southern Coal Skink	<i>Ochrotomys nuttalli</i>	Golden Mouse
<i>Eumeces fasciatus</i>	Five-lined Skink	<i>Peromyscus maniculatus</i>	Deer Mouse
<i>Scincella lateralis</i>	Ground Skink	<i>Reithrodontomys fulvescens</i>	Fulvous Harvest Mouse
<i>Cnemidophorus sexlineatus sexlineatus</i>	Six-lined Racerunner	Key:	
<i>Cemophora coccinea copei</i>	Northern Scarlet Snake	*Hand Capture	
<i>Coluber constrictor priapus</i>	Southern Black Racer	¹ Species of Concern	
<i>Coluber constrictor flaviventris</i>	Eastern Yellowbelly Racer		
<i>Elaphe guttata emoryi</i> *	Great Plains Rat Snake		

spotted salamanders (*Ambystoma maculatum*) almost exclusively used small mammal (*Blarina*; *Peromyscus*; *Microtus*) burrows for terrestrial refuge. Small mammal and gopher tortoise burrows provide refuge for numerous vertebrates throughout North America. Ozark pocket gophers provide similar refuge as the aforementioned species.

We documented 46 species or subspecies of herpetofauna and small mammals in pocket gopher habitat although only 5 species were actually captured or observed in gopher mounds or burrows. However, we suggest that the majority of species that were captured at both sites in drift fences probably utilized pocket gopher burrows in some way. Furthermore,

certain species have been captured in pocket gopher burrows or habitat in multiple studies. Vaughan (1961) recorded 22 species of vertebrates using pocket gopher burrows in Colorado; Funderburg and Lee (1968) recorded 20 herpetofauna species inhabiting pocket gopher mounds in Florida. Both studies suggested that some of the species were true burrowers and relied on this habitat for survival.

We recorded substantially lower number of drift fence captures in 2008 vs. 2007 at Site 2. Drift fences were open from January through early April in 2008 of which the majority of the time was cold. Surface activity of both herpetofauna and small mammals was minimal. We probably would have recorded similar

Amphibian, Reptile, & Small Mammal Associates of Ozark Pocket Gopher Habitat in Izard County, Arkansas

results if the drift fences remained open into the summer, since surface activity was increasing at the end of this study.

Site 1 had an overflow reservoir adjacent to a creek that remained flooded for the majority of the year. This habitat feature explains the abundance of amphibians, especially juvenile dwarf American toads and American bullfrogs captured at this site compared to Site 2 (Table 1). Pickerel frogs (*Rana palustris*) were captured more frequently at Site 2; yet, both sites have clear, cool streams, which is preferred habitat (Trauth et al. 2004). Hurter's spadefoots (*Scaphiopus holbrookii hurterii*) were also captured frequently at both sites. Both *Scaphiopus* sp. and pocket gophers prefer sandy or friable soils and are expected to share the same geographic distribution (Wasserman 1958). Hurter's spadefoots are a "species of greatest conservation need" in Arkansas (Anderson 2006). The common occurrence of spadefoots in pocket gopher habitat may reflect their utilization of mounds and burrows of pocket gophers. In Texas, the only record of a *Scaphiopus holbrookii* (eastern spadefoot) in the Welder Wildlife Refuge was collected inside a pocket gopher burrow (Wilks 1963).

Tiger salamanders are also a "species of greatest conservation need" and are apparently absent from most of Arkansas except the northern one-third of the state (Trauth et al. 2004, Anderson 2006). They have been found in pocket gopher burrows in Arizona (Calef 1954), California (Howard and Childs 1959), and Colorado (Vaughan 1961). A similar species, California tiger salamander (*Ambystoma californiense*), have also been reported from pocket gopher burrows (Pittman 2005). Due to their fossorial behavior, areas with sandy or friable soils offer optimal habitat for this species (Petranka 1998). Thus, pocket gopher habitat may provide habitat that tiger salamanders can occupy easily due to the abundant loose, sandy soil. Vaughan (1961) stated that the occurrence of tiger salamanders in Colorado is determined by the presence of burrows. We suspect that the females we captured were moving to breeding sites since reproductively active females have been previously recorded during this time of the year (Trauth et al. 1990).

Although the three-toed box turtle is a new county record, they have been documented in surrounding counties (Trauth et al. 2004). Box turtles have been known to hibernate or seek refuge in mammal burrows (Vaughan 1961, Degenhardt et al. 1996, Nieuwolt 1996). Additionally, the mounds may supply box turtles along with other reptiles a place to bask.

Large snakes are commonly found in pocket gopher habitat probably due to the abundance of prey, including pocket gophers. The most common large

snake we encountered was the black racer; several of which were observed both entering and exiting pocket gopher burrows. Although most racers probably do not prey on pocket gophers, larger individuals potentially could. Similar sized prey to the pocket gopher, such as weasels, rabbits, and large rodents, has been reported in the diet of racers (Fitch 1963). Another large snake species that was fairly common at the study sites was the eastern coachwhip. These snakes on occasion would retreat into pocket gopher burrows when alarmed. Johnson et al. (2007) documented eastern coachwhips using small mammal burrows as refugia; therefore, they may use pocket gopher burrows when available. Other large snakes have been recorded occupying pocket gopher burrows, such as *Pituophis* sp. (Vaughan 1961, Ealy et al. 2004, Himes et al. 2006, Rudolph et al. 2007). Eastern coachwhips are large enough that they could potentially prey on pocket gophers. Prairie kingsnakes occupy the same habitat as pocket gophers and their most common prey items are small mammals (Fitch 1999). Connior et al. (In Press) presented the first record of the prairie kingsnake preying on the Ozark pocket gopher. The ecological relationship between large snakes, such as coachwhips and kingsnakes, and Ozark pocket gophers is not known. However, pocket gophers may act as a prey item and provide them with refugia in their burrows. Further investigation of this relationship needs to be determined.

Conclusions

The role that Ozark pocket gophers play in the ecosystem of Izard County cannot be determined at this time. Although we did not have a reference site for comparison (i.e., habitat with pocket gophers vs. habitat lacking pocket gophers), this preliminary study suggested that burrow associates utilize pocket gopher burrows and mounds. The number and extent to which associate species rely on the pocket gophers needs to be determined through both experimental and long term studies. If the Ozark pocket gophers effect on the ecosystem is disproportionately large relative to its abundance then it may in fact be a keystone species (Power et al. 1996).

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Amphibian, Reptile, & Small Mammal Associates of Ozark Pocket Gopher Habitat in Izard County, Arkansas

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