

Diet of the Louisiana Pine Snake (*Pituophis ruthveni*)

The Louisiana Pine Snake (*Pituophis ruthveni*) is a large-bodied constrictor endemic to western Louisiana and eastern Texas (Sweet and Parker 1991). Surveys suggest that the species has declined in recent decades and is now restricted to isolated habitat patches (Reichling 1995; Rudolph et al. 2006). *Pituophis ruthveni* is listed as a Candidate Species under the Endangered Species Act by the U. S. Fish and Wildlife Service (USFWS 2011), and as a threatened species by the Texas Parks and Wildlife Department (TPWD 2011).

Ongoing fieldwork indicates that *P. ruthveni* is associated with sandy, well-drained soils with a well-developed herbaceous flora (Himes et al. 2006; Rudolph and Burgdorf 1997). Within this habitat, *P. ruthveni* is known to use the burrows of Baird's Pocket Gopher (*Geomys breviceps*) for foraging, escape from predators and fire, and hibernation (Ealy et al. 2004; Himes et al. 2006; Rudolph and Burgdorf 1997; Rudolph et al. 1998, 2002). Pocket gophers of the genus *Geomys* feed primarily on subterranean portions of herbaceous plants (Behrend and Tester 1988; Myers and Vaughn 1964). Habitat alteration, especially successional changes due to alteration of fire regimes resulting in increases in woody vegetation and declines in herbaceous vegetation, degrades habitat for *G. breviceps* with potential negative consequences for *P. ruthveni* populations. Within the range of *P. ruthveni* suitable habitat for *G. breviceps* is maintained by frequent fire that reduces competition from woody vegetation and stimulates the development of herbaceous vegetation, the primary food source for pocket gophers (Rudolph and Burgdorf 1997).

Rudolph et al. (2002) previously reported on 22 prey records of *P. ruthveni*. Small mammals were prominent in the diet (18 of 22 records) and *G. breviceps* comprised 10 of the 22 records. Based on habitat use and the close association with pocket gopher burrows, Rudolph and Burgdorf (1997) hypothesized that the decline of *P. ruthveni* in recent decades is due to habitat loss, landscape fragmentation, vehicle related mortality, and in remaining forested habitat to the alteration of fire regimes due to fire suppression. Less frequent fire return intervals allow the succession of woody vegetation to occur resulting in competitive decline of the herbaceous vegetation and ultimately of pocket gopher populations. The limited data on prey composition previously available support this hypothesis (Rudolph et al. 2002). We now report additional prey records for this rare and declining species.

Methods.—We have obtained additional prey records from fecal samples of 27 wild caught snakes obtained since 2002. Snakes were from throughout the current range of the species. These snakes were held in captivity for short periods of time during the course of other research activities. Snakes ranged from 112 to 141 cm snout–vent length (SVL). The 19 snakes sampled in Rudolph and Burgdorf (2002) also fell within this size range. Identifiable

prey remains (hair, teeth, claws) were extracted from fecal samples and compared to a reference collection obtained from local species, fecal samples from captive snakes fed a known prey item, and published descriptions of mammalian hair and teeth. Prey biomass was estimated using median weights of species from Davis and Schmidly (1994). Masses for *Peromyscus* spp. and *Reithrodontomys* spp., which were not specifically identified, were estimated using values for each of the potential species present in the study area. All unidentified mammals were mouse-sized species. The value for *Peromyscus* sp., the largest mouse-sized taxon, was used for unidentified mammals. Mass of turtle eggs (presumed to be *Trachemys scripta*) was from Tucker et al. (1998).

Results.—A total of 31 additional prey records, primarily small mammals, were obtained from these 27 snakes (Table 1). Consistent with the previous report, *G. breviceps* was the most frequent prey item (18 of 31). An estimate of % biomass represented for the 53 total prey records known to date suggests that *G. breviceps* (28 of 53, 53%) comprises 75.4% of the estimated total prey biomass represented in the currently available prey sample for *P. ruthveni*. Overall, the preponderance of small mammals in the diet (47 of 53, 89%) is consistent with diets across the genus (Rodríguez-Robles 2002; Sweet and Parker 1991). The 53 prey records from a total of 46 snakes collected throughout the current range of the species provides a reliable estimate of the overall diet of *P. ruthveni*.

Discussion.—The abundance of *G. breviceps* in the known diet of *P. ruthveni* is consistent with the hypothesis presented by Rudolph and Burgdorf (1997). They hypothesized that changes in vegetation structure, i.e. the decline of herbaceous vegetation due to increasing fire-return intervals, resulted in declines of

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TABLE 1. Prey of *Pituophis ruthveni* as determined from field observations, analysis of fecal samples, and gastrointestinal tract contents.

Species	Rudolph et al. (2002)		This study		Total		
	Number	%	Number	%	Number	Estimated %	Biomass
<i>Geomys breviceps</i>	10	45.5	18	58.1	28	52.8	84.4
<i>Scalopus aquaticus</i>	4	18.2	3	9.7	7	13.2	6.7
<i>Sigmodon hispidus</i>	1	4.5	3	9.7	4	7.5	4.5
<i>Peromyscus</i> sp.	1	4.5	1	3.2	2	3.8	0.6
<i>Reithrodontomys</i> sp.			1	3.2	1	1.9	0.1
Unid. Mammal	2	9.1	3	4.7	5	9.4	1.5
Turtle eggs*	4	18.2	2	6.5	6	11.3	2.1
Totals	22		31		53		

*Probably *Trachemys scripta* based on egg size and habitat. A total of 20 eggs were recovered from six individual snakes.

pocket gophers and the consequent decline or extirpation of *P. ruthveni* populations.

The hypothesized dependence of *P. ruthveni* primarily on a single prey species, *G. breviceps*, may also be a factor in the reproductive biology of the species as hypothesized in Rudolph and Burgdorf (1997). *Pituophis ruthveni* has the smallest clutch size (mean = 4) and largest hatchling size (mean = 54.4 cm) in the genus (Reichling 1990). The large size at hatching may be a strategy to decrease the time required to achieve a size capable of ingesting adult pocket gophers, approximately 100 cm SVL, based on feeding trials of captive *P. ruthveni* offered live pocket gophers. Other *Pituophis* taxa with smaller hatchling sizes have a much more diverse small mammalian diet (Rodríguez-Robles 2002).

Feeding trials on captive neonates and juveniles (55–75 cm SVL) being head-started for an ongoing reintroduction effort provide additional insight on diet in this species. These captive *P. ruthveni* have refused all insect (cicadas, grasshoppers) and lizard (*Anolis carolinensis*, *Hemidactylus turcicus*) prey offered. They have readily accepted a variety of small mammals and birds, both live and dead, although most individuals refused shrews (*Blarina brevicauda*) and some reacted negatively to the presence of live shrews. Assuming animals in the field behave similarly, ectotherms, with the notable exception of turtle eggs, might not be a significant component of the diet of *P. ruthveni* of any size.

A number of snake species exhibit a dietary switch from ectotherms to endotherms that is based on snake size (Greene 1989; Rodríguez-Robles et al. 1999; Shine and Slip 1990). A major compilation of prey records for *P. catenifer*, involving over 1000 prey records (Rodríguez-Robles 2002), found that mammals were a major component of the diet of all sizes including neonates, however lizards were only consumed by snakes less than 115 cm SVL. Only one arthropod was detected in this large data set. Our data set lacked records for snakes less than 112 cm SVL.

Specialization on a single prey species is hypothesized to have major consequences relating to the overall ecology, reproductive biology, and conservation status of the Louisiana Pine Snake. In addition, the proposed scenario is the basis of a recently initiated reintroduction program for *P. ruthveni*. *Pituophis ruthveni* neonates and head-started individuals are being released in habitat that has been restored by U.S. Forest Service managers primarily through restoration of a frequent fire regime

using prescribed fire. The previously fire-suppressed reintroduction site currently has a well-developed herbaceous component with abundant pocket gophers and is presumably capable of supporting a *P. ruthveni* population.

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