

2007

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Recommended Citation

Stanley, Johnathan W. and Trauth, Stanley E. (2007) "Distribution of the Queen Snake (*Regina septemvittata*) in Arkansas," *Journal of the Arkansas Academy of Science*: Vol. 61, Article 17.

Available at: <https://scholarworks.uark.edu/jaas/vol61/iss1/17>

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Journal of the Arkansas Academy of Science, Vol. 61 [2007], Art. 17
Distribution of the Queen Snake (*Regina septemvittata*) in Arkansas

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Abstract.—We documented the distribution of the queen snake, *Regina septemvittata*, in northern Arkansas during the 2005 and 2006 activity seasons. Arkansas currently contains the only known disjunct population of this species west of the Mississippi River. Field work was conducted throughout the Boston Mountains of the Ozark Plateau to verify the presence of queen snakes from historic localities as well as to identify new localities containing these snakes. Seventeen individuals were found in the Mulberry River of Franklin and Johnson counties and the Illinois Bayou watershed of Pope County. Of these 17 snakes, 5 were kept as voucher specimens in the Arkansas State University Museum of Zoology herpetological collection, 11 were marked (elastomer dyes, PIT tags, and scale clippings) and released, and 1 evaded capture. None of the marked individuals were recaptured. Our findings suggest that queen snake populations have not increased in number or range since the last published study on the species in Arkansas in 1991.

Key words:—queen snake, *Regina septemvittata*, Arkansas, Boston Mountains, Ozark Plateau, Mulberry River, Illinois Bayou watershed, Arkansas State University Museum of Zoology, populations.

Introduction

The queen snake (*Regina septemvittata*) is a medium-sized semi-aquatic snake that feeds primarily on crayfish. It ranges throughout much of eastern North America as far north as southeastern Pennsylvania, western New York, and southwestern Ontario westward to Wisconsin and southward to northern Georgia, Alabama, and Mississippi (Conant and Collins 1998, Ernst 2002). A disjunct population of queen snakes occurs in the Interior Highlands of Arkansas (Trauth et al. 2004) and Missouri (Johnson 1987) that is separated from the main body of the species' range by over 400 km. Smith (1999) and Ernst

(2002) have summarized the literature dealing with the biology of the queen snake.

Queen snakes are known from isolated records in a few major streams that flow southward out of the Boston Mountains of the Ozark Plateau (Trauth 1991, see Fig. 1). The first specimens of *R. septemvittata* collected in Arkansas were taken from the Hot Springs area of Garland County in the 1890's (Hurter and Strecker 1909), but no specimens have been reported from that area since the 1920's (Conant 1960). Conant (1960) searched for museum specimens and found records for only 7 specimens from Arkansas and 3 from Missouri. No additional specimens have been reported from Missouri since 1927 (Johnson 1987).

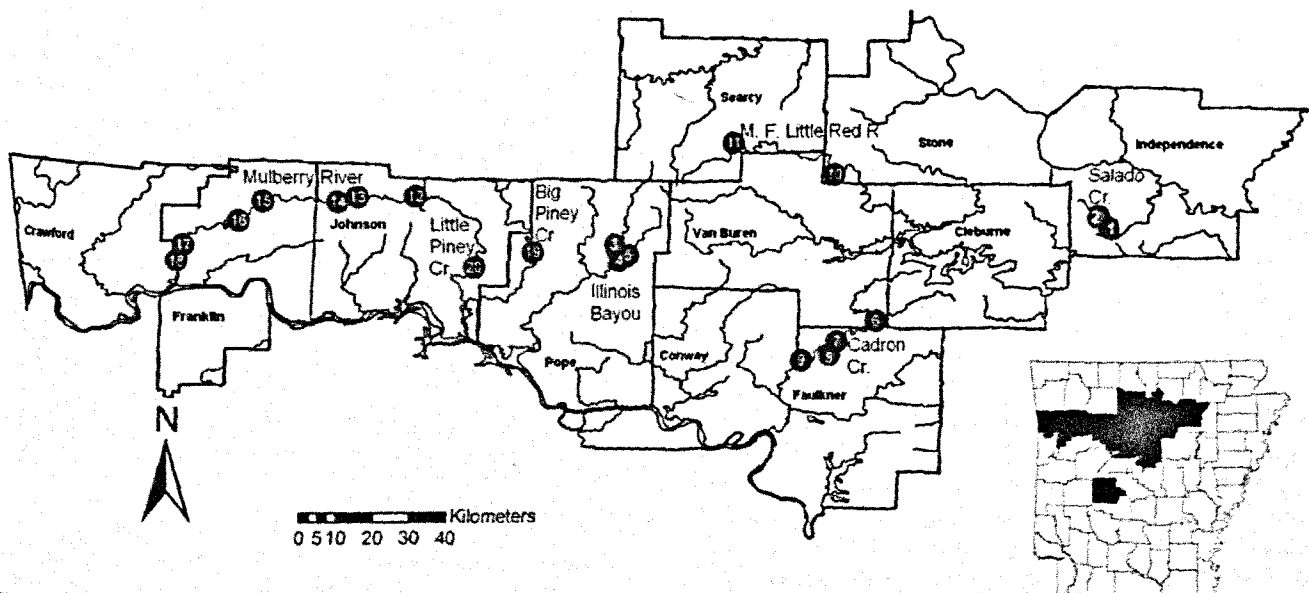


Fig. 1. Map of searched locations during the present study. Inset shows the selected counties in relation to the entire state of Arkansas as well as Garland County, the site of the original location of queen snakes within the state.

The 7 Arkansas museum specimens reported by Conant (1960) include the original collections from Garland County as well as specimens from the Mulberry River area of Franklin County and the Illinois Bayou area of Pope County. An additional museum specimen from Franklin County reported by Dowling (1957) is no longer extant (Conant 1960). Weatherby (1974) collected 21 specimens from the Mulberry River in Johnson County. Plummer (1980) reported new county records for Arkansas: Cadron Creek in Faulkner County and Salado Creek in Independence County, the latter constituted a significant range extension to the east within the state. A distribution survey of the queen snake in Arkansas during the summer of 1990 yielded only 4 specimens, and all were from the Mulberry River in Johnson, Franklin, and Crawford counties (Trauth 1991). Trauth (1998) failed to find queen snakes in the Buffalo National River, which lies primarily along the northern border of the Boston Mountains. Trauth et al. (2004) illustrated documented localities for the queen snake in Arkansas, including an additional occurrence in Van Buren County, though future searches failed to locate additional individuals, and no vouchers were taken from that locality.

This study was undertaken to assess the current distribution of queen snakes in Arkansas by searching reaches of all streams containing historic locality records for this species. Also, an attempt was made to identify new populations of queen snakes in selected streams.

Materials and Methods

Fieldwork was conducted from May through October 2005 and 2006. Primary study sites included the Mulberry River (Franklin and Johnson counties), Illinois Bayou (Pope County), Cadron Creek (Faulkner County), and Salado Creek (Independence County). Additional sites included Little Piney Creek (Johnson County), Big Piney Creek (Pope County), and the Middle Fork of Little Red River (Searcy and Stone counties, see Fig. 1). Collection techniques consisted of ground searching by flipping rocks within and along the edges of streams following the technique of Branson and Baker (1974). In addition, baited and unbaited minnow traps were utilized; traps were set in the evening and collected the next morning. Some traps were baited with fish steaks or sardines, whereas others were not baited. Traps were not set out in areas accessed often by humans because of the risk of traps being stolen or when rain was a possibility because rising water would drown snakes inside. All captured snakes were measured in length (SVL and total length) and massed, and several were photographed. Only vouchered snakes were sexed due to the small body size of those released and the risk of manipulative injury. One voucher specimen per watershed per county was retained and deposited in the Arkansas State University Museum of Zoology (ASUMZ). Tissue samples were taken and stored in 95% ethanol. Liver tissue and tail clips were taken from vouchered specimens, and scale or tail clips were taken from all but one of the released

animals. All released individuals were either permanently tagged with Biomark PIT (passive integrative transponders) tags or were marked with visual implant elastomer dyes (VIE) by placing a unique number of dots in a row under the skin on the left ventral side. Marked snakes were then released at or near the site of capture. Global Positioning System (GPS) coordinates were taken for all sampled localities using decimal degrees in WGS 1984, and herpetofaunal habitat associates were recorded at each site.

Results

Seventeen queen snakes were found at 4 sites (Table 1; Fig. 1 and 2). Two snakes were found at Illinois Bayou (site 3) during the 2005 season; 1 snake was retained as a voucher and the other was PIT tagged and released. Three snakes were found at Illinois Bayou (site 4) during 2005; 1 was kept as a voucher and the other 2 were PIT tagged and released. Nine individuals were found in 2006 in the Mulberry River (site 13). One of the 9 eluded capture, 2 were PIT tagged and released, 5 were VIE marked and released, and 1 was kept as a voucher. Three snakes were found in 2006 in the Mulberry River (site 17). Two of these snakes were kept as vouchers, as 1 died prior to being released. The third snake was PIT tagged and released.

The average size of the captured snakes ($n = 16$) was small (Table 1, Branson and Baker 1974, Ernst 2002, Trauth et al. 2004). Mean SVL was 28.3 cm (range = 19.0 to 45.8 cm; SE = 1.9). Total length averaged 36.3 cm (range = 24.4 to 57.9 cm; SE = 2.4). Mean mass was 15.2 g (range = 3.8 to 48.5 g; SE = 3.1). Sex ratios were not recorded due to the small size of the snakes and fear of injury during sexing. However, of the 5 vouchered snakes, 3 were female and 2 were male.

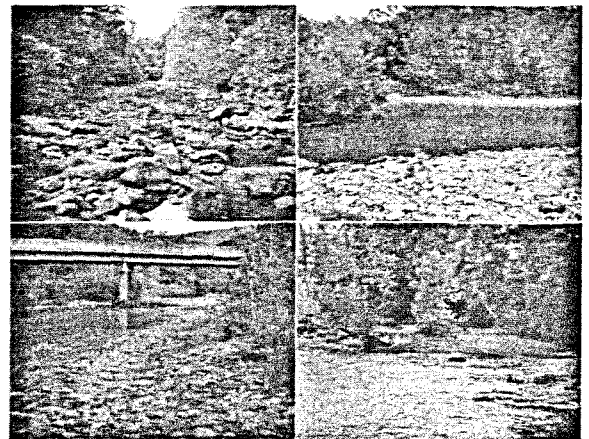


Fig. 2. Queen snake capture locations during the present study. Clockwise beginning in the top left: site 3, Middle Fork of Illinois Bayou; site 4, confluence of the Middle and East forks of Illinois Bayou; site 17, Mulberry River in Franklin County; site 13, Mulberry River in Johnson County.

Habitats at each capture site (Fig. 2) consisted of flat or rounded rocks (≤ 1 m diameter) along the shore of the stream and flowing water. Water depth was noticeably lower during the hottest part of summer and varied between capture sites (range ca. 30 to 100 cm). Crayfish appeared abundant at each site and indicate a ready food source. Fifteen herpetofaunal habitat associates were recorded. They included 4 snake species, 2 turtle species, 4 lizard species, 3 anuran species, and 2 salamander species (Table 2).

Discussion

Interestingly, the largest snake captured (SVL = 45.8 cm; total length = 57.9 cm; mass = 48.5 g) was found to be immature upon dissection due to a lack of sperm in the ductus deferens. Also interesting is that the 5 smallest snakes were all captured within 100 m on the same day, possibly indicating that they were neonates. This is consistent with the size of neonates given by Raney and Roecker (1947). The fact that only immature snakes were found may indicate that our search methods were biased. However, those methods were effective in other areas (Raney and Roecker 1947, Wood 1949, Branson and Baker 1974).

Ernst and Barbour (1989) stated that queen snakes require clean unpolluted streams. Also, they noted that water pollution and possibly acid rain have reduced crayfish populations in many parts of the range of queen snakes and have eliminated the snake from these areas. Many cattle and poultry farms are located adjacent to the target streams of this study, and these operations could adversely affect queen snake populations due to nutrient runoff into the streams (Homyack and Giuliano 2002, Jones-Lepp et al. 2004).

Queen snakes are known to breed in spring and fall (Branson and Baker 1974), but little is known about reproduction in Arkansas or how pollution may affect reproduction. Queen snakes are thought to give birth in August or September in Arkansas (Trauth 1991). The size of the queen snakes found in October 2006 supports this timing of parturition.

Also, we observed numerous water-related recreational activities, especially along the Mulberry River. Some of these activities, such as kayaking, may not substantially disturb queen snake habitat. However, in other activities pick-up trucks and ATVs were driven into the streams, causing greater habitat disturbance. The vehicles could crush snakes beneath rocks and reduce stream bed habitat suitable for crayfish, the queen snake's dominant food source.

We found several queen snakes during the months of May and early June. During the summer months, however, queen snake activity was not detected by our search methods. This trend is consistent with that reported by Wood (1949). Branson and Baker (1974) state that queen snakes are not active at night, nor do they usually bask on overhanging branches. During the present study, minnow traps were unsuccessful at capturing queen snakes at night, and none was observed on

any overhanging branch. The recent drought in Arkansas may have caused queen snakes to be less active due to reduced water in streams. In October 2006, 6 individuals were located in 1 day. The higher number that day may have been due to a recent clutch birth, as these were the smallest animals found during the study.

We were unable to establish the existence of any large populations. However, since most of the queen snakes found were juveniles, it is obvious that they are breeding, though it is not certain if the rate of reproduction is sufficient to sustain the population long into the future. Weatherby (1974) stated inbreeding and differences in the environment may be responsible for the lack of genetic variation in Arkansas populations versus eastern populations. If inbreeding is occurring then this is of concern because it will reduce genetic variation and likely result in lower fitness, reduced resistance to disease, and reduced ability to deal with environmental changes (Lacy 1997, Hedrick and Kalinowski 2000).

Others have found queen snakes to be more common in suitable habitat with abundant crayfish (Branson and Baker 1974, Ernst 2003, Raney and Roecker 1947, Wood 1949). Wood (1949) reported 125 specimens within a 100 m stretch of stream in Ohio with as many as 24 collected beneath a single rock. The lack of large populations of queen snakes in Arkansas, even in the presence of abundant crayfish, coupled with the drastic decline of queen snakes in Garland County (Hurter and Strecker 1909, Conant 1960), may indicate a vulnerable species in the state.

ACKNOWLEDGMENTS.—We thank the Arkansas Game and Fish Commission for funding and for scientific collection permits for this study. We thank Phillip Stewart, Charles McDowell, Bobby Neal, Jacob Sawyer, and members of the Arkansas Herpetological Society for their assistance in the field at various times. We also thank Joy Trauth and two anonymous reviewers for making comments on the manuscript.

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Table 1. Queen snakes (n = 17) observed from 4 sites during the present study. Measurements were taken for each captured snake, and those not vouchered were marked and released. Sex was not recorded for released individuals due to their small size, and tissue samples were misplaced for two of the specimens.

Site #	Date	SVL (cm)	TL (cm)	Mass (g)	Sex	ASUMZ/PIT/VIE	Tissue Sample
3	1-Jun-05	33.6	42.7	17.0	Female	ASUMZ 29319	-
3	1-Jun-05	32.2	43.4	37.0	-	PIT 985120028262162	scale clip
4	2-Jun-05	24.6	31.8	12.0	-	PIT 985120027797821	none
4	2-Jun-05	43.9	55.1	27.0	-	PIT 985120022814375	scale clip
4	2-Jun-05	27.0	32.6	11.0	Female	ASUMZ 29320	-
13	15-May-06	27.4	34.8	10.8	-	PIT 985120027803683	tail clip
13	15-May-06	26.2	33.8	8.7	-	PIT 985120027985378	tail clip
13	16-May-06	26.6	34.1	10.7	Male	ASUMZ 30127	tail clip/liver
13	14-Oct-06	19.7	25.7	4.5	-	VIE mark; 1 spot	tail clip
13	14-Oct-06	19.0	24.4	3.8	-	VIE mark; 2 spots	tail clip
13	14-Oct-06	20.9	27.3	5.5	-	VIE mark; 3 spots	tail clip
13	14-Oct-06	24.0	30.5	8.5	-	VIE mark; 4 spots	tail clip
13	14-Oct-06	22.8	29.3	6.8	-	VIE mark; 5 spots	tail clip
13	14-Oct-06	N/A	N/A	N/A	N/A	not captured	N/A
17	23-May-06	45.8	57.9	48.5	Male	ASUMZ 30128	tail clip/liver
17	23-May-06	31.3	39.7	18.0	-	PIT 985120027816456	tail clip
17	23-May-06	28.1	37.0	13.5	Female	ASUMZ 30129	tail clip/liver

Table 2. Herpetofaunal species observed utilizing the same sites as queen snakes during the study. Not all individuals were identified to the species level, but all were identified at least to the genus level.

Site # (Stream)	Reptiles (number observed)	Amphibians (number observed)
3 (Illinois Bayou)	<i>Nerodia sipedon</i> (1)	<i>Acris crepitans</i> (20+) <i>Rana</i> sp. (10+)
4 (Illinois Bayou)	<i>Coluber constrictor</i> (1) <i>Nerodia sipedon</i> (1) <i>Sceloporus undulatus</i> (2)	<i>Acris crepitans</i> (20+) <i>Rana</i> sp. (10+)
13 (Mulberry River)	<i>Nerodia sipedon</i> (4) <i>Sceloporus undulatus</i> (10+)	<i>Rana catesbeiana</i> (2) <i>Rana clamitans</i> (1) <i>Eurycea multiplicata</i> (3)
17 (Mulberry River)	<i>Nerodia erythrogaster</i> (1) <i>Nerodia sipedon</i> (5) <i>Apalone spinifera</i> (1)	<i>Acris crepitans</i> (10+)