2004

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Recommended Citation

Johnson, L. D., Smith, G. R., & Rettig, J. E. (2004). Summer activity of small snakes in four habitats in northwestern Missouri. Bulletin of the Maryland Herpetological Society, 40(1), 47-52.

Summer Activity of Small Snakes in Four Habitats in Northwestern Missouri

Linda D. Johnson, Geoffrey R. Smith, and Jessica E. Rettig

As land use patterns continue to change due to an increase in urbanization and suburbanization (see Dale et al., 2000), it is becoming more important to understand the influence of habitat structure and type on the ecology of plants and animals so that appropriate and effective conservation or management efforts can be proposed and implemented. One component of the biota that may be particularly affected by the change in land use patterns is the herpetofauna. Several studies have found that changes in the structure of a habitat, either through fire or logging, can substantially alter the amphibians and reptiles found in an area (e.g., McLeod and Gates, 1998).

We conducted a field study to assess the levels of activity of two small species of snakes, the ringneck snake *(Diadophis punctatus)* and the worm snake *(Carphophis vermis)*, in four habitat types in northwestern Missouri. Our goal was to determine which habitats had the most snake activity and whether vegetation structure influenced the activity levels.

Methods.

We surveyed snake activity in four habitat types on a single 31 hectare plot in northeastern Ray County, Missouri. The four habitats had different histories and were at different stages of succession. Site A consisted of an open prairie, site B was a selectively logged woods, site C was primarily old growth forest, and site D was a secondary growth forest. We assessed vegetation structure using three 2.5 m radius quadrats in each habitat, counting the number of saplings and large trees in each quadrat, and estimating percent ground cover in a 1 m^2 sub-area.

In each habitat we used a 25 x 25 meter trapping area. We placed 13 coverboards (see Grant et al., 1992) in an evenly spaced checkerboard pattern in each of the four habitats. We checked coverboards at approximately three day intervals during the months of late May, June and July 1998. The coverboards used were 0.5 m X 1 m rectangular pieces of 1/2 inch plywood, to which we attached a section of nylon rope. For each check we recorded if there had been rain in the previous 24 hours, and also recorded maximum and minimum temperatures in the habitat using a max-min thermometer placed in a representative location in the sampling grid. A mean temperature was obtained by averaging maximum and minimum temperatures for a particular period.

Results.

Comparison of Sites. The amount of ground cover tended to be highest in site D, followed by sites A and C, and site B had the lowest amount of ground cover (Table 1; Kruskal-Wallis Test: df=3,H_{ties}=7.41,P_{ties}=0.06). The number of saplings did not differ among sites (Table 1; Kruskal-Wallis Test: df=3,J_{ties}=4.49, P_{ties}=0.21). Site A lacked large trees, and sites B,C and D had similar numbers of large trees, but the differences among sites only approached significance at an *cx*-value of 0.05 (Table 1; Kruskal-Wallis Test: df=3,J_{ties}=6.95,P_{ties}0.07).

Ringneck Snakes. Site B had by far the highest level of activity, followed by Sites A and C (Table 2; Kruskal-Wallis Test: df=3,H_{ties}=30.41,P_{ties}<0.0001). No ringnecks were found in site D. Activity levels peaked in mid to late June, particularly in site B (Fig. 1A).

Rainfall in the 24 h prior to sampling had no effect on activity (Mann-Whitney Test: P>0.10 for all four sites). Activity level was not affected by the maximum temperature (P>0.33 for all sites), minimum temperature (P>0.49 for all sites), nor mean temperature (P>0.59 for all sites).

Worm Snakes. Site B had the highest levels of activity followed by sites A and C (Table 2; Kruskal-Wallis Test: df=3,H_{ties}=11.29,P_{ties}=0.010). As for ringneck snakes, no worm snakes were found in site D. Activity levels were consistenly low through-

Table 1. Mean amount of ground cover, number of saplings, and number of larger trees in 2.5 m radius quatrats for four sites in different habitat types in northwestern Missouri (descriptions of sites in text). Means are given ±1 SE. In each case the sample size is 3.

Site	Proportion Ground Cover	Number of Saplings	Number of Large Trees
A	0.78 ± 0.05	2.5 ± 1.5	0
B	0.62 ± 0.06	2.3 ± 0.9	3.0 ± 1.2
C	0.73 ± 0.08	0	4.0 ± 1.7
D	0.93 ± 0.03	2.0 ± 1.0	4.7 ± 0.9

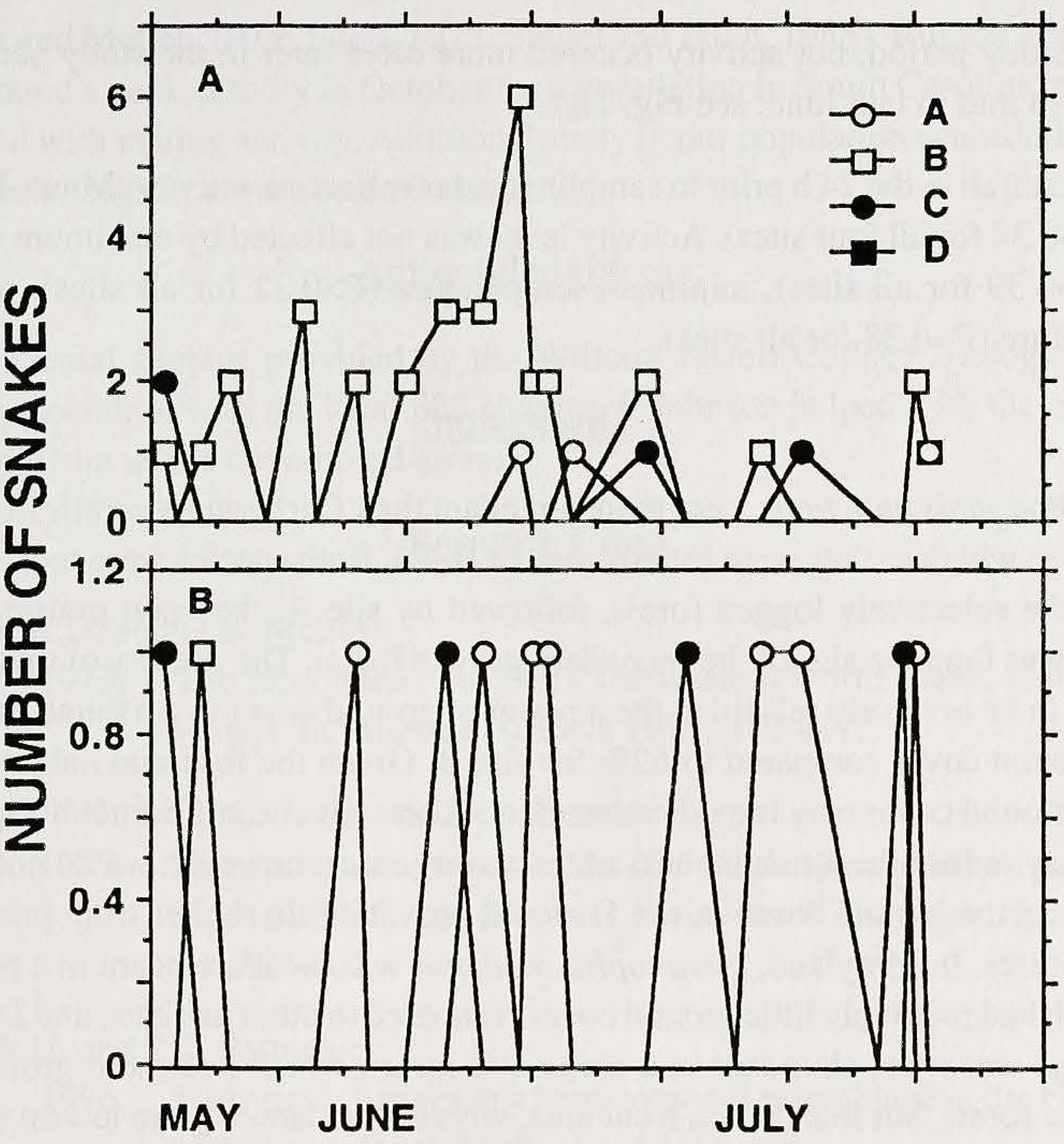

Figure 1. Activity of two species of small snakes *Diadophis punctatus* (A) and *Carphophis vermis* (B) in four habitats in northwestern Missouri as determined by coverboards (see text for description of habitat types).

Table 2. Activity level for ringneck and worm snakes; and maximum, minimum, and mean temperatures for four sites in different habitat types in northwestern Missouri (descriptions of sites in the text). Means are given ± 1 SE. Number after site designation gives N.

	Ringneck	Worm		Temperature (C)	
Site	Snakes	Snakes	Max	Min	Mean
A (24)	0.21 ± 0.10	0.12 ± 0.03	40.4 ± 1.3	17.1 ± 0.8	28.8 ± 0.9
B (25)	1.32 ± 0.29	0.29 ± 0.10	29.7 ± 1.0	17.6 ± 0.7	23.6 ± 0.7
C (24)	0.17 ± 0.10	0.04 ± 0.04	31.2 ± 0.9	16.4 ± 0.9	23.8 ± 0.8
D (23)	0	0	30.6 ± 1.0	16.8 ± 0.9	23.7 ± 0.9

out the study period, but activity occured more often later in the study period (i.e., starting in mid to late June; see Fig. 1B).

Rainfall in the 24 h prior to sampling had no effect on activity (Mann-Whitenet Test: P>0.34 for all four sites). Activity level was not affected by maximum temperature (P>0.39 for all sites), minimum temperature (P>0.22 for all sites), nor mean temperature (P>0.38 for all sites).

Discussion.

Diadophis punctatus were more abundant than *Carphophis vermis* in the three habitats in which snakes were found (sites A, B, D). Both species were most active in site B, the selectively logged forest, followed by site A, the open prairie. Neither species was found in site D, the secondary growth forest. The activity of these snakes appears to be inversely related to the amount of ground cover in a habitat. Site D had 93% ground cover compared to 62% for site B. Given the fossorial nature of these snakes ground cover may impede movement. Alternatively, large amounts of ground cover may reduce the attractiveness of the coverboards; however, we do not feel this is likely as the ground cover in site D would provide little shelter from predators or temperatures. In Maryland, *Carphophis amoenus* was most abundant in a pine habitat which had relatively little ground cover compared to other habitats, and *Diadophis punctatus* was most abundant in a hardwood forest, which had more ground cover than pine forest, but less than in a cut area, where abundances were lowest (McLeod and Gates, 1998). Busby and Parmelee (1996) found that capture rates of *D. punctatus* were highest in river-bottom habitat, and lowest in an upland woodland. *Diadophis punctatus* in Michigan occur primarily in more open areas that tend to be sunny (Blanchard et al., 1979). Fitch (1975) reported that *D. punctatus* are often found in edge habitats, and need damp soil with abundant cover objects.

For both species (but most obviously for *D. punctatus*), activity levels peaked in mid to late June (see Fig. 1). In Kansas, Clark (1970) found peak observation rates of *C. vermis* in May, June, and July. Activity levels in both species were unaffected by temperature and rainfall. In contrast, Dalrymple et al. (1991), while finding a peak in activity in July for a population of *Diadophis punctatus* in Florida, found a correlation in activity level with rainfall. Fitch (1975) suggested that air temeprature may set a range in which *D. punctatus* is active, causing a decline in activity in the summer. For our population, the peak in activity in mid to late June, is likely due to an increase in movement associated with reproduction. While we have no direct evidence for this, studies on the reproductive bilogy of these two species in the region suggest that this is the time when females are laying their eggs (see Clark, 1970;

Aldridge and Metter, 1973; Fitch, 1975; Seigel and Fitch, 1985). Russell and Hanlin (1999) found a peak activity in October for a population in South Carolina, probably associated with mating activity. Additional study in our population is needed to see if such a peak exists in northwestern Missouri.

Acknowledgments.

Financial support provided by the William Jewell College Biology Department in association with the local ßßß chapter. J. Johnson helped with the construction and lay out of the coverboard arrays.

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Received: 9 September 2003
Accepted: 3 October 2003