

## Use of an active ant nest as a hibernaculum by small snake species

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### INTRODUCTION

Use of ant or termite nests (active and inactive) as nest sites by a variety of vertebrate species is well-documented (Riley et al. 1985; Scherba 1965), as are a number of snake genera with chemical and/or morphological specializations that facilitate ant-snake commensalisms (Holm 2008). Less studied is the use of (in particular) ant nests as hibernacula by non-specialist snakes, and the most frequently cited of these involve inactive ant nests (Carpenter 1953; Lang 1971) or ones with very few ants present (Criddle 1937). When ants have been noted as present, they have been identified (sometimes tenuously, Criddle 1937) as of the genus *Formica*, widespread in North America. Cervone (1983:p140) noted an association between *Virginia valeriae pulchra*, closely related to Kansas *V. v. elegans*, and the ant *Formica exsectoides*. These snakes (plus juvenile *Diadophis* and one adult *Thamnophis brachystoma*) hibernated in abandoned mounds. "near the water table." Cervone (1983:p34) also wrote that "one does not find *V. v. pulchra* under the same rock with specimens of *Formica exsectoides* but it may share its habitat with other species of ants."

Ant mounds offer potential hibernacula both for small snake species and also for juveniles of many species, though this potential may be offset by aggression of ants in active nests and the concomitant risk of death for snakes, especially juveniles (Larsen and Hare 1992). Despite this risk, such hibernacula may be especially important for snake species not adapted (as is *Carphophis* for example) for burrowing in habitats where soils are dense, or rocky, and difficult for snakes to excavate. Thermal characteristics of ant nests appear

only to offer snakes access to survivable temperatures below frost line, rather than temperatures notably warmer than surrounding soils (Scherba 1962).

*Formica* nests are roughly flask-shaped, and may extend to more than 140cm below the surface (Noble and Clausen 1936; Criddle 1937; Scherba 1962). General characteristics of *Formica* nests are summarized in Table1.

### STUDY AREA

My study area is about 12 hectares in Jefferson County Kansas that is roughly centered on the coordinates N39.04625 W-95.21038; elevation varies from 1057-1066 ft. It is part of a 65 hectare tract recently acquired by KBS from a private owner whose family owned the land since the 1940s. It was used as cropland and pasture, then seeded in Conservation Reserve Program (CRP) grass during the early 1980s and has been maintained as CRP since. Predominant species are Big Bluestem (*Andropogon gerardii*), Indian Grass (*Sorghastrum nutans*) and other tallgrass prairie species. The tract is bordered to the north by woodland, some of which has been shown on county land use maps as woodland since 1860.

In 2006 as part of an ongoing community study of *Virginia valeriae*, transects of paired (tin-wood) shelters (Parmelee and Fitch 1995) were established through this tract. From September-November 2006 and March-November 2007 170 shelters were checked several times weekly for a total of 12,600 shelter-samples. This frequency continued March-May 2008, after which sampling effort was reduced. All snake species except



Figure 1. Minimal pre-dormancy brooding by *Formica subsericea* workers, September 2008.

*Diadophis punctatus* and *Agkistrodon contortrix* were captured, processed (snout-vent length, tail length, mass, etc), marked with a unique scale clip, and released within minutes at point of capture.

#### OBSERVATIONS

Early in 2006, one of these 85 paired shelters (tin at N39.04783 W-95.20941) was observed to by chance have been placed upon an active nest of the ant *Formica subsericea* a common species (Trager pers comm; Fisher pers. comm.; Hedlund 2008). Voucher specimens of the ants are deposited in the KBS/KSR Reference Collection, Number 8005-1. No above-ground mound was seen when transects were established. Ants were very active beneath the relatively warm tin from late spring through summer 2006. By October 2006, it was apparent that this set of shelters and a set

placed 10m south also were highly productive capture sites for several small species of snakes such as *Virginia valeriae*, *Diadophis punctatus*, *Carphophis vermis*, and *Storeria dekayi*.

It was noted that in March 2007, these small snake species often were collected beneath the ant nest shelter while ants were very active; snakes frequently had ants moving across them, and ants were not aggressive towards snakes. *Virginia*, *Carphophis* and *Storeria* generally had dispersed from this shelter set by early April, after which ants were brooding larvae, and later pupae, in large number just beneath the tin. *Diadophis* continued to be found beneath this tin in greatly reduced number, usually well-distant from the ants. By mid-September 2007, ants largely had begun their dormancy and their activity was greatly reduced. *Virginia*, *Carphophis*, *Diadophis* and *Storeria* again were noted using the shelter, and often



Figure 2. Adult *Virginia valeriae* escaping into *Formica subsericea* tunnel, October 2008.

sought to escape capture by moving into the nest tunnels. Snakes also were captured partly emergent from tunnels.

In early through mid-March 2008, the recaptures of marked snakes (Fall 2007) of the genera *Storeria* and *Virginia* from this ant nest shelter (often newly emergent from tunnels) strongly suggested that the snakes had overwintered in the nest. By mid-March, ants again were active and in association with snakes. Thereafter, the 2007 pattern of activity noted above repeated, and in October 2008 juvenile *Thamnophis sirtalis* also were observed to escape into the ant tunnels when the shelter was raised.

During the latter part of May 2008, when ants again had larvae just beneath the tin and snakes (when present at all) were distant from the ants, I conducted a brief trial to assess the reaction of ants to snakes. Several *Diadophis*

of varying sex and age class were sequentially released close to the brooding ants over the course of several days. Releases were done immediately after the tin was raised.

Invariably, snakes were aggressively attacked by ants, sometimes requiring investigator assistance to escape.

By late July 2008, ant brooding activity was greatly reduced, with fewer than 50 workers and an equivalent number of pupae present (Fig. 1). By late September 2008, ants again were dormant and snakes again were aggregating at this nest-shelter, freely using the tunnels as in 2007 (Figs. 2, 3). This pattern of activity is summarized in Table 2.

Unseasonably warm weather on 10 February 2009 resulted in early emergence of nine *Storeria dekayi* from this same nest (Pisani and Pittman 2009). Three of these were



Figure 3. Juvenile *Thamnophis sirtalis* escaping into *Formica subsericea* tunnel; nearby *Diadophis punctatus* preparing to do the same October 2008.

individuals marked at the nest in October 2008. Additional *S. dekayi* and *T. sirtalis* (again with several recaptures of snakes marked in 2008) were seen on 24 February and 6 March 2009.

## DISCUSSION

Only Noble and Clausen (1936) have documented use of a natural, active ant nest as a hibernaculum by small non-specialized

snakes (*Storeria*). They excavated the nest in winter and noted that ants were found below 36-inches, snakes just above. Larsen and Hare (1992) documented that immature *Thamnophis* readily utilized active, artificially established *Formica fusca* nests as hibernacula.

I did not excavate the nest reported here; doing so would have destroyed what strongly seems to be a hibernaculum for a Threatened (in

Table 1. Characteristics of *Formica subsericea* nests.

- Nests common in open, deciduous woodlands (Talbot 1961)
- Typically extend more than 4-5 feet below surface (Criddle 1937; Noble and Clausen 1936; Scherba 1962, 1965; Talbot 1961)
- Soil temperatures in the nest are not different from adjacent soil (Scherba 1962)
- Tunnels typically are ca 12mm diameter (Carpenter 1953; Noble and Clausen 1936; Pisani- present study)
- *F. subsericea* "rarely defends their nests from [other ant species] and often are enslaved by other *Formica*." (Talbot 1961)

Table 2. Chronology of interaction of *Formica subsericea* and small snakes in present study.

- Snakes and ants (no larvae or pupae) active together mid-March through mid-April; snakes typically begin to disperse 3rd week March
- Ants bring larvae to beneath tin in early May— snakes may be beneath tin, but not near ant activity.
- By 3rd week May, ants have pupae beneath tin and are very aggressive towards snakes. This pattern continues through Summer— ants have several broods.
- By late July, few ant pupae, and snakes again escape into tunnels when disturbed.
- By mid-September, no ant larvae or pupae; ants non-aggressive to snakes. y late September, ants have retreated for winter; snakes aggregating and freely using tunnels to escape capture.

Kansas) species under ongoing study. Nevertheless, the patterns reported here (summarized in Table 2) coupled with published observations cited above indicate a potential relationship of great survival value between these small (and in the case of *Virginia*, relatively uncommon) snake species and ants of the genus *Formica*. Potential benefits to snakes and ants (the latter very speculative) are summarized in Table 3. However, potential benefits to snakes may be partially offset by the risk of ant predation, especially upon juvenile snakes (Larsen and Hare 1992). An additional interesting association was noted by Bradford (1973), who observed one wild-caught male *V. striatula* in the act of consuming eggs of an unidentified species of ant, and remarked that “[a] few ants were on the snake but did not appear to have been biting him.” No capture date was given. While *V. striatula* is a species entirely distinct from *V. valeriae*, given the observations of close association between ants and *V. valeriae* it is possible that this species (especially juveniles for which data are especially lacking)

also on occasion consumes ant eggs and/or pupae.

**CONCLUSION**

Sampling difficulties make the basic biology of small, secretive snake species difficult to elucidate despite the fact that they often are far more abundant than larger species (Todd et al 2008a, b).

Whether the relationship between *Formica* ants and small snakes as discussed here is mutualism or simply seasonal nest commensalism by the snakes presently is unclear. However, a relationship plainly exists. Active ant nests probably are an overlooked, valuable hibernaculum resource for small snake species and young of certain larger species. Careful winter excavation of representative ant nests through the range of these small snakes in Kansas would do much to clarify this relationship.

Table 3. Potential benefits to snakes and ants, present study

Snakes

- Ant tunnels available without having to expend energy to dig.
- Tunnel network typically is extensive, so can accommodate many snakes.
- Tunnels extend well-below frost depth.
- Tunnels too small to admit winter predators such as shrews.

Ants

- Could scent of snakes deter other (potentially invasive) ant species?
- Any natural winter mortality of snakes may provide ants with an early food resource
- Snake urea/uric acid excretions (if any during hibernation) possibly utilized by ants as an early nutrient source?

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