JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE 79(3):65–66 JULY 2004

PHEROMONE DETECTION OF CONSPECIFICS BY THE FIVE-LINED SKINK, *EUMECES FASCIATUS*

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ABSTRACT—Reptiles and more specifically lizards have been shown to recognize individuals by assessing chemical cues or pheromones. We tested whether male *Eumeces fasciatus* could detect a conspecific from pheromone samples. Each male was presented in random order with a cloacal swab from itself (positive control) and a conspecific male, as well as a swab with distilled water (negative control). The number of tongue flicks was recorded for 60 seconds. Male *E. fasciatus* did not tongue flick to water. They did tongue flick to pheromone samples, but did not tongue flick more to conspecific versus self pheromone.

Communication among individuals by pheromones or odors is important in social interactions in many reptiles (Mason, 1992). Individuals can recognize conspecifics by assessing chemical cues or pheromones. Among lizards there is large morphological variation in olfactory organs, particularly the Jacobson's organ or the site of sensory epithelial tissue (Parsons, 1970). Lizards recognize pheromones by tongue flicking. The tongue carries sampled pheromones from the air or some other surface to the Jacobson's organ. The tongue and Jacobson's organ function as a chemosensory system in the autarchoglossa, a morphologically similar group of lizard families including Anguidae, Lacertidae, Scincidae, Teiidae, and Varanidae (Camp, 1923). Although the mechanistic basis of chemosensation is not well known, it is known that lizards tongue flick more to novel than familiar stimuli.

Among lizard pheromonal studies, one of the most widely studied species is the skink, *Eumeces laticeps*. In *E. laticeps*, pheromones have been shown to communicate species membership, sex and reproductive state (Cooper, 1995; Cooper and Vitt, 1986). Furthermore, male *E. laticeps* can recognize male conspecific pheromones (Cooper, 1996; Cooper and Vitt, 1984). However, whether closely related species show similar recognition is unknown.

We studied pheromone communication in the closely related skink, *Eumeces fasciatus*. We hypothesized that breeding condition adult males would be able to detect conspecifics using chemical cues because this is an important communication modality in autarchoglossan lizards, the supertaxa which *Eumeces* belongs.

MATERIALS AND METHODS

Eumeces fasciatus were collected in Montgomery County, Tennessee from April–May 2001. Laboratory trials were conducted at Austin Peay State University, Clarksville, Tennessee during the same timeframe. Skinks were maintained separately with visual barriers in glass terraria (76 cm by 29 cm by 29 cm) in a room adjusted to ambient outdoor climate and light as well as with heat lamps for 8 h per day for proper thermoregulation. Lizards were given water ad libitum and fed crickets until satiation every third day. Adult male *E. fasciatus* (n = 14) used in our pheromonal testing were identified based on previously established criteria (Fitch, 1954).

A pheromone sample was collected from each male *E. fasciatus* by wiping the cloacal region with a cotton swab. Cloacal swabs were kept frozen in individual plastic bags until the pheromone tests were conducted, usually within two days. Each male *E. fasciatus* was presented with a cloacal swab from itself (a positive control) and a conspecific male, as well as a swab with distilled water (negative control). The males were originally unfamiliar (i.e., from different source populations) and had one prior exposure before pheromone testing due to another experiment. Therefore, conspecific stimulus was not completely novel when tested. The pheromone swabs were presented in a double blind method where the experimenter presenting the swabs to the lizards knew neither the pheromone source nor the focal animal. I (Ives) would have another worker randomly select a male lizard to be tested. That worker would also randomly present me with a swab to be tested until all three swabs (self, conspecific male, and distilled water) were tested for that lizard. Thus, only the worker knew what male lizard and swab were being tested until the testing was complete. To prevent observer interference, the observer conducted the trials from behind a physical blind. The pheromone swab was presented to each lizard for 60 seconds. We recorded the number of tongue flicks a lizard made in response to a pheromone stimulus. The trials wherein a lizard tongue flicked at least once to conspecific or self pheromone (n = 40) during the pheromone tests were analyzed using Wilcoxon Signed Rank test in the JMP® Statistical Program.

RESULTS AND DISCUSSION

Negative controls indicated that lizards could detect pheromones. That is, when presented with water, lizards never moved relative to the swab nor did they ever tongue flick. In contrast, lizards did tongue flick to self pheromone swabs in 57.5% of the tests (1.0 $\pm$ 0.4 tongue flicks per pheromone test) and to con-

TABLE 1. Adult male *Eumeces fasciatus* that responded (percent) to water or pheromone exposure and the mean (± *SEM*) number of tongue flicks exhibited by each group.

	Water	Self pheromone	Conspecific pheromone
Responders (%)	0	57.5	67.5
Tongue flicks	0	1 ± 0.4	1.8 ± 1.2

specific pheromone swabs in 67.5% of the tests (1.8 ± 1.2 tongue flicks per pheromone test) (Table 1).

However, *E. fasciatus* did not tongue flick less frequently to self compared to conspecific pheromone (t = 359, n = 40, P = 0.236). Thus, our hypothesis that male *E. fasciatus* can detect conspecifics using chemical cues was not supported.

Given that *E. fasciatus* can detect a pheromonal stimulus, surprisingly, there was no differential response between self and conspecific stimuli. Although *E. fasciatus* are not generally territorial, they do occupy temporary residencies during the breeding season (Fitch and von Achen, 1977). Thus, pheromonal information about male residence might be significant to males arriving in unfamiliar areas. Pheromones may lend support to dear-enemy recognition. Males may conserve energy by only initiating conflict with unfamiliar males.

In this study, pheromone stimulus used was not completely novel. Skinks had one prior exposure to the individual from which the pheromone was derived. Thus, an alternative explanation for our results is that skinks may be able to learn and remember a pheromone source from only one encounter. Either this possibility or the lack of elevated response to conspecific pheromones are interesting possibilities and merit further study.

The related species *E. laticeps* can differentiate unfamiliar (from different source populations) stimuli (Cooper, 1996). Male *E. laticeps* tongue flick more to an unfamiliar male conspecific pheromone than their own. However, recognition of a familiar from an unfamiliar male pheromone has not been studied in any males of *Eumeces* species. This question has been studied in two species of a different lizard family, the Lacertidae (*Podarcis hispanica* [Lopez and Martin, 2002] and *Lacerta monticola* [Aragon et al., 2003]). In these studies, males were able to differentiate between pheromone sources from the same populations versus males from other populations. While it is likely the basis of this discrimination was familiarity, it also is possible there was an unmeasured genetic component to the pheromone signal (i.e., a population level difference in the pheromone composition that the lizards were detecting).

In comparison to the previous study of the related skink species, *E. laticeps,* we found that *E. fasciatus* had a lower response level to pheromone stimuli. The tongue flick rate we observed was generally lower than previous studies of other species. If chemosensation is an important modality among skinks, future studies should explore variation in chemical communication and its ecological significance. In such studies it may be useful to include low response species such as *E. fasciatus.*

ACKNOWLEDGEMENTS

We would like to acknowledge the Austin Peay State University Center of Excellence in Field Biology for providing material support. We also would like to thank M. Butler and T. Ives' classmates at the Univ. Tennessee for their comments and suggestions for this manuscript.

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