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RESPONSE OF THE YELLOW SPOTTED SALAMANDER, *AMBYSTOMA MACULATUM*, TO CHEMICAL CUES OF THE EASTERN RIBBON SNAKE, *THAMNOPHIS SAURITUS*

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ABSTRACT

Our experiment examined the response of the yellow spotted salamander, *Ambystoma maculatum*, to the chemical cues of the eastern ribbon snake, *Thamnophis sauritus*. We tested the hypothesis that the yellow spotted salamander, being a lunged salamander and lacking the nasolabial slit which has been implicated in olfaction, would not spend significantly more time on either substrates containing or not containing chemical deposits of the ribbon snake. Twelve control trials gave the salamanders a choice of staying in one of two sides of an arena, both without snake cues. Twelve treatment trials gave the salamanders a choice of either a side with snake cues or without. We analyzed the amount of time the salamanders spent on each side of the arena for one hour periods. We repeated this for all twelve salamanders, for both control and experimental trials. The results showed that the salamanders did not spend significantly more time on either of the substrates containing or not containing chemical deposits of the ribbon snake ($t = 0.59$, $P = 0.561$).

Keywords: Ambystoma maculatum, *chemical cues, salamander, snake,* Thamnophis sauritus

INTRODUCTION

The ability for some animals to detect predators by means of the predator's chemical cues has been described in various studies. For salamanders, this ability has been shown in *Desmognathus monticola* in response to predatory salamanders (Roundebush 1987), and in *Plethodon doralis, Plethodon richmondi,* and *Desmognathus ochrophaeus* in response to predatory snakes (Cupp 1994). In these lungless (plethodontid) salamanders, respiration occurs through thin moist skin and the lining of the mouth. Another distinguishing feature of the plethodontids is the presence of a nasolabial groove - a small, narrow, gland-lined slit between the nostril and upper lip. This nasolabial slit may be involved in the salamander's olfaction and ability to detect chemical cues (Mason and Stevens 1980). In this experiment, we examined the responses of the lunged, yellow spotted salamander, *Ambystoma maculatum*, which does not have a nasolabial groove, to the chemical cues of a predatory eastern ribbon snake, *Thamnophis sauritus.* This snake's range overlaps with that of *Ambystoma maculatum,* especially in Pennsylvania, from where the samples for this experiment were taken, and it has been documented to prey on these

salamanders. (Bishop and Myers 2000a, b). In this study, we tested the hypothesis that *A. maculatum* would not spend significantly more time on either of the substrates containing or not containing chemical deposits of the ribbon snake.

METHODS AND MATERIALS

Using flashlights, we netted 15 salamanders at night from a small pond located off Warm Springs Road in Huntingdon, Pennsylvania. They were transported back to the lab in a bucket filled with leaves and rocks from the salamanders' natural habitat. In the lab the salamanders were kept in an artificial habitat within a large plastic tub at 8^{o} C (Fig. 1). To simulate the natural environment, the tub contained a pond with water collected from the natural habitat, surrounded by soil, leaves, rocks and other natural debris. The tub was stocked with insects, gastropods and other food organisms, and was cleaned periodically after which it was replenished with fresh dirt, food, and water.

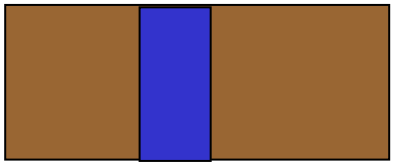

Figure 1. Artificial habitat for the experimental salamanders. Blue rectangle represents the pond and the brown area represents the dirt portion of the habitat.

Predator smell was obtained from a pet eastern ribbon snake housed in an aquarium. We cut four sheets of paper towels into long strips and placed them in the snake's habitat for 48 hours. The towel strips were kept moist with dionized water to fully absorb the scent of the snake. We collected the strips prior to each trial, and replaced them with more towel strips for the following trial. We repeated this process until the final trial.

There were a total of twenty-four trials in the entire experiment. Twelve trials had snake smell present in the arena, and twelve trials, the controls, had no snake smell present in the arena. The area was a square plastic tub that was approximately 4 inches deep, 2.5 ft. long, and 18 inches wide. A 10-inch cardboard divider was placed in the tub separating the two sides (Figure 2). For trials one through twelve, the plastic tub was half unscented and half scented. For trials twelve through twenty-four, each side of the tub was unscented.

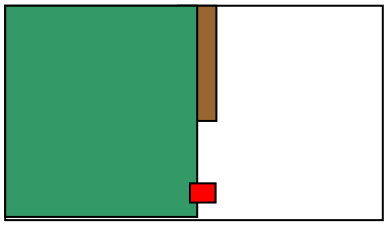

Figure 2. Experimental arena: the green side is the scented side and the white side is the unscented side. The brown portion is the divider, and the red box is where the salamander was placed at the beginning of the experiment.

Before each trial an experimental salamander was taken form its artificial habitat and warmed under a red light for 15 minutes. Then the salamander was placed exactly in the center of the arena. We allowed the salamanders to acclimate to the arena for ten minutes before beginning observations of the salamander's behavior and movement for one hour. We noted the number of times the salamander crossed into each side of the arena, and how long they stayed there. Once a trial was finished we placed the salamander in an alternate habitat from those salamanders that were not yet tested. We repeated this process until all trials were complete, for both the snake scent and controls, using twelve of the original fifteen salamanders. We randomly selected these twelve salamanders, and released three of them. After the completion of the experiment, we released the remaining salamanders. The data were analyzed using a t-test in Minitab to determine whether or not the salamanders spent a significant amount of time on either side of the arena for both the control and experimental setup. In the statistical analysis, we disregarded time spent by the salamanders in the neutral zone, as this area was only the very small space in which the salamanders were initially placed.

RESULTS

The salamanders showed no significant difference in how much time they spent on either side of the experimental arena, whether they were both unscented (controls: $t = 0.46$, $P = 0.651$) or one was scented with snake odor and the other was not (treatments: $t = 0.59$, $P = 0.561$).

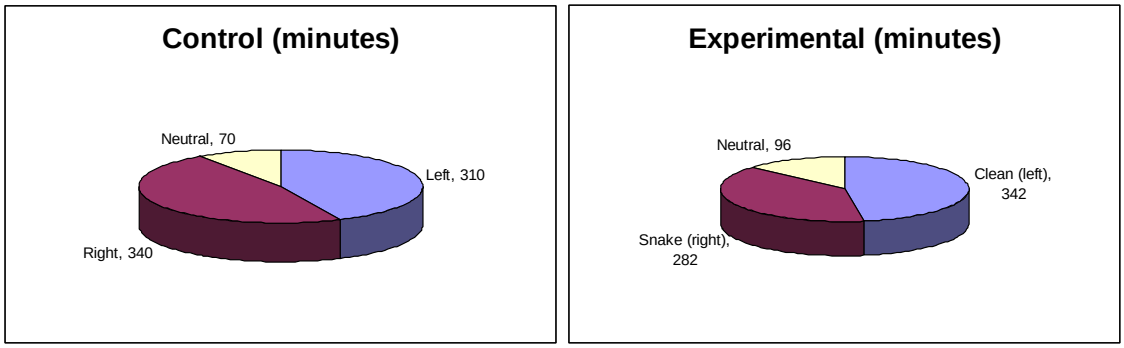

Figure 3. Amount of time salamanders spent in the different areas of the experimental arena for both controls and treatments.

DISCUSSION

We found no evidence that yellow spotted salamanders were attracted to or repelled from substrate soaked with the scent of the eastern ribbon snake. However, we have insufficient data to judge whether the lack of a nasolabial slit in the salamanders had anything to do with this lack of odor discrimination.

Future research should examine the effects of varying levels of predatory scent, scent from other predatory species, various acclimation periods, and the breeding status of the salamanders. In our study each individual salamander was exposed to the control and experimental environments only once. Further testing with a larger number of trials for each salamander may produce different results. We hope that our study may serve as a useful starting point for other similar studies.

ACKNOWLEDGEMENTS

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