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RESEARCH NOTE

WOLF SPIDERS VARY PATCH RESIDENCE TIME IN THE PRESENCE OF CHEMICAL CUES FROM PREY (ARANEAE, LYCOSIDAE)

Foraging efficiency of 'sit-and-wait' predators is an important influence on animal fitness (Stephens & Krebs 1986). It is suggested that the decision of how long to stay in a foraging patch before moving to another (patch residence time) will affect energy intake rates and may contribute to fitness (Morse & Fritz 1982).

Many studies have sought to identify the proximal cues spiders use to determine both the choice of foraging patches (Kronk & Riechert 1979; Cady 1984; Morse & Fritz 1982; Riechert 1985; Riechert & Gillespie 1986; Morse 1993; Pasquet et al. 1994) and the duration of time spent in a patch (Turnbull 1964; Janetos 1982; Greenstone 1983). Both environmental factors such as temperature (Riechert 1985), humidity (Cady 1984), and vegetation structure (Morse & Fritz 1982; Lesar & Unzicker 1978) as well as factors that relate to prey abundance (Turnbull 1964; Riechert 1976; Gillespie 1981), hunger (Turnbull 1964; Wise 1975), and perceptual cues (Lizotte & Rovner 1988; Morse 1993; Persons & Uetz in press) have been shown to affect patch choice and/or residence time.

Chemical cues, although well-known to be important components of courtship communication for many species of wolf spiders (Kaston 1936; Hegdekar & Dondale 1969; Tietjen 1979; Rovner 1991), have never been demonstrated to be an important component of foraging decisions with respect to patch residence time. The presence of chemosensory hairs on the male pedipalps has been mapped and related to microhabitat preferences of spiders (Tietjen & Rovner 1980). Some experiments have demonstrated that male *Schizocosa saltatrix* (Hentz 1844) and *S. ocreata* (Hentz 1844) may be capable of responding to airborne pheromones (Tietjen 1979). Whether or not spiders use chemical cues within a foraging context is not known. The data presented here examine whether adult female *S. ocreata* use the substratum-borne chemical cues of prey to modify the duration of time spent in a foraging patch.

Twenty immature female *S. ocreata* wolf spiders were caught in September of 1994 at the Cincinnati Nature Center, Clermont County, Ohio. Each spider was housed in its own container, provided water *ad libitum*, and fed three one-week old crickets every four days to standardize hunger level for testing. Spiders were allowed to mature while being maintained on a plaster of Paris substratum at room temperature (23–25 °C) and stable humidity with a 12:12 L:D photoperiod.

Two differently treated substrata were compared for effects on patch residence time; each substratum consisted of a sheet of copy paper 20 cm in diameter. For the experimental treatment, 100 one-week old crickets were allowed to walk on the paper for a 30 min interval. For the control treatment, a clean sheet of paper was used.

The test apparatus consisted of two containers made of white foam-core board. Each container housed two round chambers (Fig. 1). One chamber served as a neutral chamber into which the spider was introduced, and the other chamber contained either the control paper or the substratum that crickets walked upon. Each spider was tested under both treatments in random order.

An experimental trial consisted of a single spider introduced into the neutral (no test substratum) chamber under a clear plastic vial.

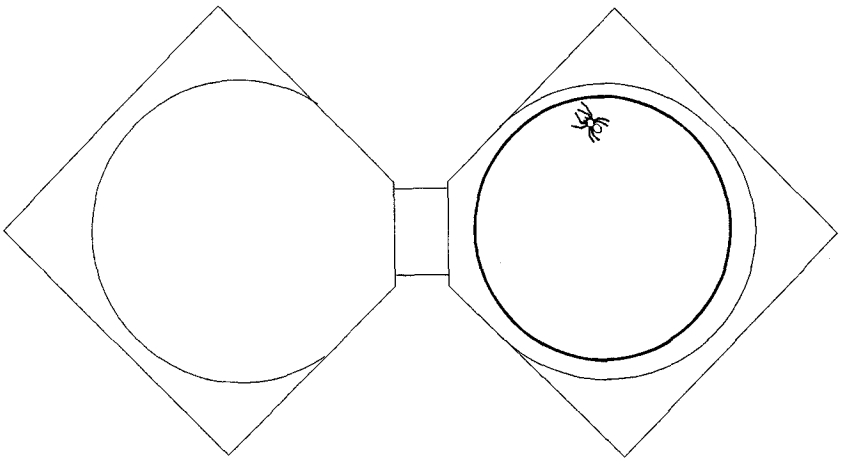

Figure 1.—The artificial foraging environment used for spider testing. Each apparatus consists of two chambers: a neutral chamber and a chemical stimulus chamber. The stimulus chamber contains a circular disk that is either permeated with prey-produced chemical stimuli or serves as a control disk without such stimuli. Spiders are placed in the 'neutral' chamber prior to each experiment (spider shown in stimulus chamber) and allowed to move freely between the two chambers after a five minute acclimation period.

After a five min acclimation period, the vial was removed and the spider was allowed to enter and exit the single treatment chamber freely for a 30 min time period. Each trial was videotaped from above and duration and number of chamber visits was determined by videotape analysis. A new paper disk was used for each 30 min trial to reduce any effect produced by draglines of previous spiders introduced to the chambers.

The final visit into a treatment chamber was omitted if the spider was in the chamber when the trial time had expired. All 20 spiders visited each treatment chamber at least three times and were used in the analysis.

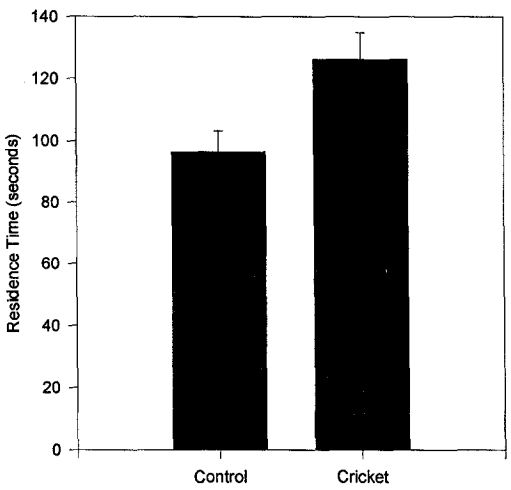

Figure 2.—Mean patch residence times (±SE) by cricket chemical cue stimulus. (n = 20).

Before analysis, patch residence time was natural log (ln) transformed to conform to ANOVA assumptions of normality. A fully crossed mixed model two-way ANOVA was used to analyze the variation in duration of patch visits. Patch residence time was tested using individual spider (random effect) and substratum-cue (fixed effect) as factors. F-values were adjusted using the appropriate mean squares ratio for a mixed model design.

Spiders spent significantly longer periods of time on substrata that crickets had walked on previously (mean = 126.2 sec; SE = 8.59) over substrata that lacked prey chemical cues (adjusted $F_{1, 19} = 13.31$; $0.001 < P < 0.005$) (mean = 96.4 sec; SE = 6.86) (Fig. 2). There were significant differences between individual spiders with respect to patch residence time ($F_{19, 302} = 6.29$; $P < 0.001$), but no significant interaction between individual spiders and substratum type ($F_{19, 302} = 1.29$; $P > 0.05$).

These wolf spiders have the ability to perceive chemicals left by prey. Although the video recording did not allow for close study of the precise behavioral responses to the chemical cues, it was apparent that the high

turning rates typically observed by male spiders chemo-exploring in the presence of female pheromones was lacking. The primary observable difference was in the proportion of time the spider was stationary under the two treatments.

It is unclear what chemicals the spiders are using as a cue or what chemosensory organs are involved. Studies by Harris & Mill (1977) have found that dictynid spiders have curved, blunt-tipped chemosensory hairs that are capable of perceiving various halide salts and acids but have little response to amino acids, urea or some sugars. Stimuli from fly and beetle extracts also failed to elicit a response. Similar chemosensory hairs have been identified and mapped on the palps of several species of wolf spider (Tietjen & Rovner 1980; Kronestedt 1979; Foelix & Chu-Wang 1973). These studies suggest that the pedipalps may be a possible site for perceiving chemical cues, although they may be quite specific in their responses. These experiments have focused primarily on male chemosensory organs with less emphasis of female chemosensory hairs. This study suggests that female wolf spiders may use chemical cues as a source of information while foraging in addition to visual and vibratory information from prey (Lizotte & Rovner 1988; Persons & Uetz in press).

Caution is indicated in the interpretation of these data, as the mean difference between time spent on the chemical cues substratum versus the control was not large. This, combined with the high numbers of crickets used for the experimental treatment, raises questions about to what degree spiders use chemical cues in a natural setting. It is known that spiders use chemical cues in the rejection of unpalatable prey (Givens 1978; Vasconcellos-Neto & Lewinsohn 1984), but research presented here suggests that chemical information may provide a valuable source of information for making patch residence time decisions as well.

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