



Behavioral plasticity in the western black widow, *Latrodectus hesperus*, across a continuum of urbanization

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Introduction

- Individuals that change their behavior, displaying context-specific behavioral optima, demonstrate ‘adaptive plasticity.’^[2]
 - Ex: Showing high levels of activity in the presence of prey and low levels of activity in the presence of a predator.
- Individuals whose behaviors are repeatable within a context and correlated across contexts show a ‘behavioral syndrome.’^[3]
 - Ex: Showing consistent (repeatable), high levels of activity in both the presence of prey and predators.
- Plasticity and behavioral syndromes often vary across populations as a result of differing selection pressures.^[1]
- We tested the Black Widow spider, a local urban pest, for plasticity, behavioral syndromes, and urban/desert population differences by quantifying behavioral variation across contexts.
- We hypothesized that urban widow populations thrive in human habitations because they are able to exhibit high levels of behavioral plasticity.
- In contrast, we proposed that desert widow populations are characterized by context-general behavioral syndromes rather than plasticity.

Methods

- Adult females were collected from urban Phoenix and Sonoran Desert sites (10 from each).
- Spiders constructed web in 57x38x33cm tubs (Fig. 1) for one week before beginning repeated anti-predator, foraging, and mating trials.
 - Prior to each trial, spiders were ‘disturbed’ by prodding of the abdomen with a wooden dowel until they retreated to the refuge.
 - Anti-predator trials: Following disturbance, spiders were left to return to their web.
 - Foraging trials: Following disturbance, a cricket (tethered to the tub to prevent wandering) was placed on the web of each spider.
 - Mating trials: Following disturbance, a potential mate was placed on the web of each spider.
- Trials lasted 3 hours. Spiders were checked at regular intervals for changes in posture, activity, and web location.
- Here we analyze percentage of female activity and percentage of male activity dependent variables in order to test for repeatability, across-context correlations, and population differences.

Results

- Urban/desert differences were found in only one of eight dependent variables. Urban males courted urban females significantly more than desert females ($F_{1,18}=4.782$, $p<0.042$, Fig. 2).
 - Due to this general lack of population differences, all females ($n=20$) were pooled for remaining analyses.
- On average, spiders behaved differently in anti-predator, foraging, and mating trials. For example, females were less active in anti-predator trials than they were in foraging or mating trials (Fig. 3).
- Individuals showed great behavioral consistency (repeatability) within replicate anti-predator trials ($F_{19,95}=2.539$, $P<0.002$).
 - Repeatability was much weaker for activity in foraging ($F_{19,57}=0.875$, $P>0.612$) and mating trials ($F_{19,57}=0.883$, $P>0.604$).
- No correlations were found across behavioral contexts, showing no evidence of behavioral syndromes in this species.
- Body condition was found to be correlated with mating behavior (Fig. 4) but not with anti-predator or foraging behaviors.

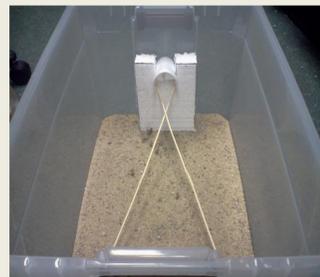


Figure 1. An aerial view of laboratory environments.

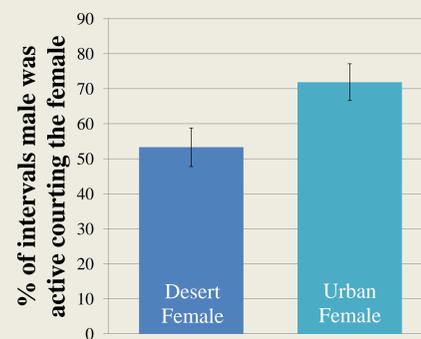


Figure 2. Males (descended from urban parents) spend more time courting urban females than desert females.

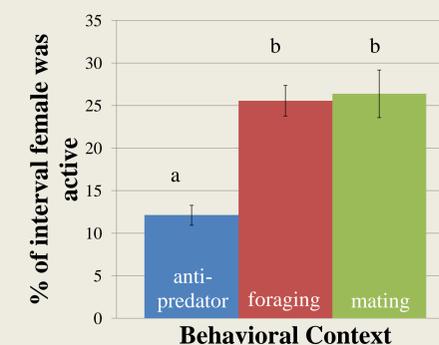


Figure 3. Average differences across behavioral contexts. Data are presented back-transformed.

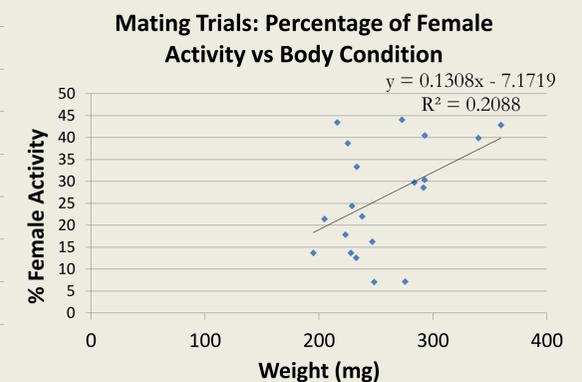


Figure 4. Female mating behavior was positively correlated with body condition.

Discussion

- Urban males courted urban females significantly more than desert females.
 - As urban and desert females showed no significant differences in behavior, the ability of urban males to distinguish females from different populations may depend on differences in chemical cues presented by females.
- Differences in average responses across contexts (Fig. 3) are consistent with adaptive plasticity.
 - Thus, Black Widows show context-specific plasticity. However, we found no urban/desert differences in plasticity, indicating the Black Widow’s behavioral plasticity is not the result of recent local adaptation to disturbed, urban environments.
- We found that spider activity was positively correlated with body condition in mating trials, but not in foraging or anti-predator trials.
 - This implies that the effects of condition are only seen in contexts where increased activity levels are beneficial. High activity in anti-predator and foraging contexts may result in death or the loss of prey, whereas activity may be a sign of receptivity to males.

Literature Cited

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