Scramble for Eggs: Does sexual selection affect mobility and light environment usage in sexually dimorphic jumping spiders?

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Introduction

In many species, when sexually receptive females are scarce, males engage in scramble competition; males compete with other males to find receptive females, and faster males tend to have better reproductive success.[1]

This phenomenon has been observed across diverse taxa yet is not well studied in jumping spiders such as those in the genus *Habronattus* (Fig 1). Once a *Habronattus* male finds a receptive female, he performs a complex, colorful courtship display that allows the female to determine his suitability as a mate, the colors of which are visible only in high-light environments due to limitations of their color vision.[2] **How has sexual selection acted upon movement patterns and light environment usage in this group of jumping spiders?**

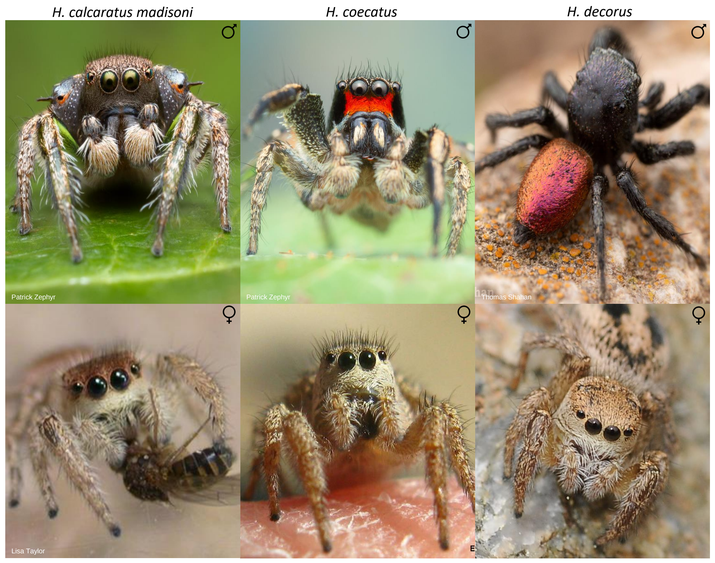

Figure 1*: Top left, male *H. calcaratus madisoni*, top middle, male *H. coecatus,* top right, male *H. decorus*, bottom left, female *H. calcaratus madisoni*, bottom middle, female *H. coecatus*, bottom right, female *H. decorus

Hypothesis

We hypothesize that male *Habronattus* jumping spiders are under sexual selection for increased movement and increased usage of high light environments .

Methods

We quantified the location and activity of three species of *Habronattus* spiders (n=54) in their natural habitat at the Edge of Appalachia Preserve, Ohio, during fifteen-minute observations. To record total distance moved during each trial, flags were planted (Fig 2) at the spider's starting, ending, and pivot positions. Spider position under sun or shade was also recorded. Results were analyzed using the Scheirer Ray Hare Test.[3]

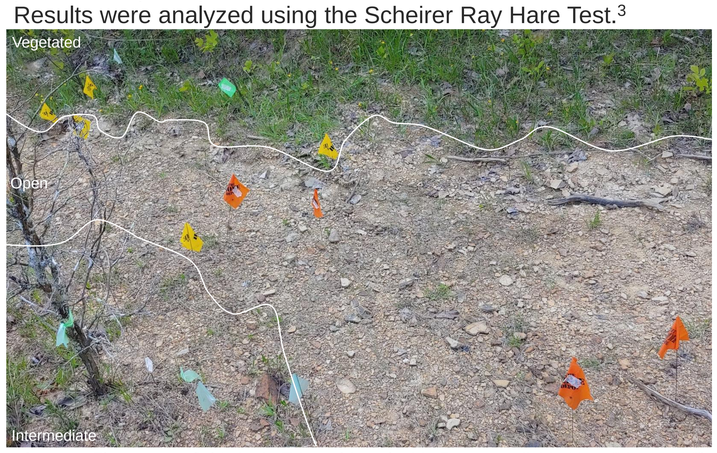

***Figure 2*: Flags at our field site in Edge of Appalachia Preserve divided into "Vegetated" habitat (top), "Open" habitat (middle), and "Intermediate" habitat (bottom left)**

Results

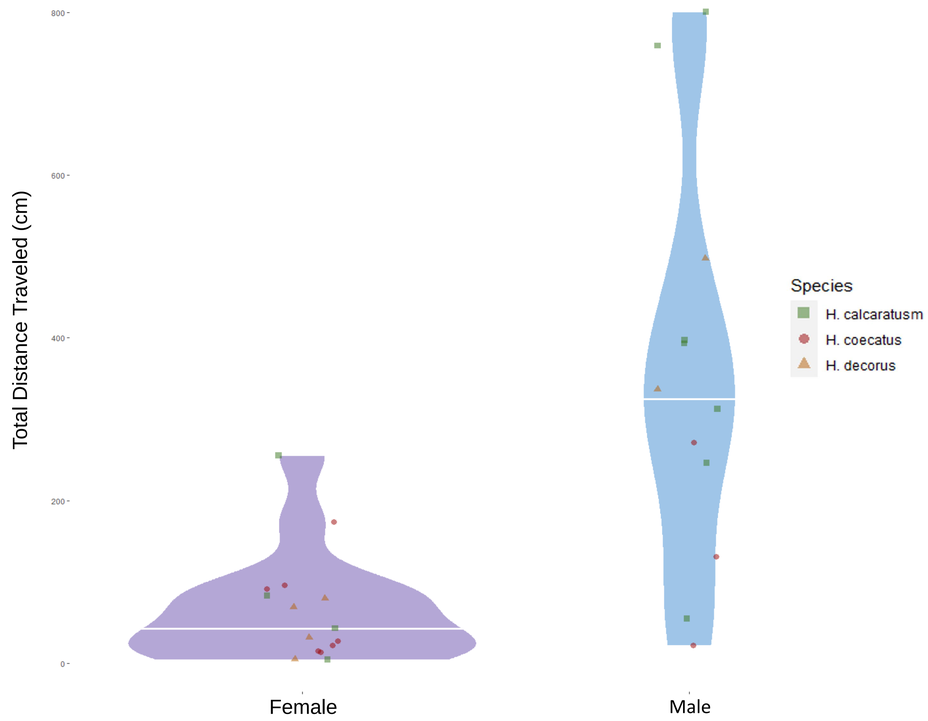

***Figure 3:* Males travel significantly more than Females.** A Kruskall Wallis test using the Scheirer Ray Hare extension was performed to analyze the effect of Species and Sex on Total Distance Traveled. There was not a statistically significant interaction between the Species and Sex (DF = 2, H = 1.54, p = 0.461). Simple main effects analysis showed that Sex has a statistically significant effect on Total Distance Traveled (DF = 1, H = 11.7, p < 0.001) while Species did not (DF = 2, H = 0.934, p = 0.627).

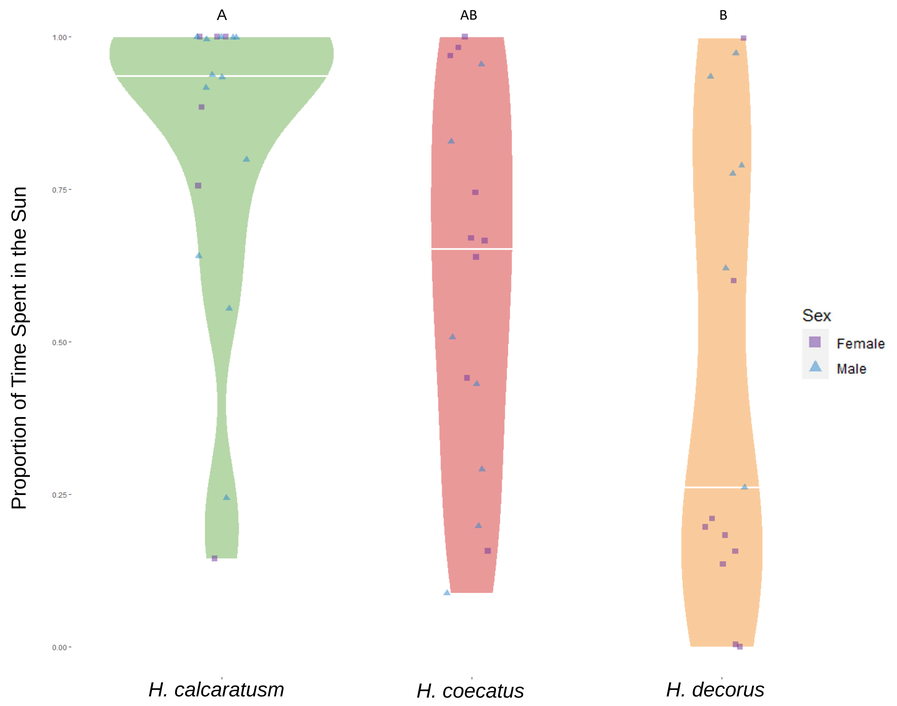

***Figure 4:* *H. calcaratus* spends significantly more time in the sun than *H. decorus*.** A Kruskall Wallis test using the Schierer Ray Hare extension was performed to analyze the effect of Species and Sex on Proportion of Time Spent in the Sun. There was not a statistically significant interaction between the Species and Sex (DF = 2, H = 5.48, p = 0.064). Simple main effects analysis showed that Species did have a statistically significant effect on proportion of time spent in sun (DF = 2, H = 9.61, p = 0.008) while Sex did not (DF = 1, H = 1.39, p = 0.237). A pairwise post-hoc Dunn Test showed that *H. calcaratusm* is significantly different than *H. decorus* (p = 0.004), but not significantly different than *H. coecatus* (p = 0.090). *H. coecatus* and *H. decorus* were also not significantly different (p = 0.900).

Discussion & Future Directions

Habronattus males travel significantly farther than *Habronattus* females. This supports our hypothesis that males are operating under scramble competition. Other studies have shown that *Habronattus* males may behaviorally mimic wasps[4] (Fig 5). Increased movement heightens the risk of predation, and the adaptation of mimicry may enable males to engage in scramble competition while alleviating the selective pressure of predation. Future studies can focus on the relationship of male movement to predation risk, and to courtship success.

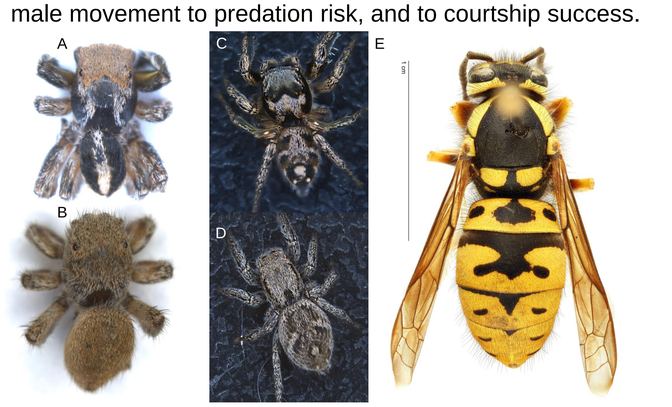

Figure 5: Dorsal views of male *H. calcaratus madisoni* (A), female *H. calcaratus madisoni* (B), male *H. coecatus* (C), female *H. coecatus* (D) and *Vespula atropilosa* (E). Females have cryptic coloration, and males have coloration that may be adapted for imperfect wasp mimicry

H. calcaratusm spends significantly more time in the sun than *H. decorus,* and neither were significantly different than *H. coecatus* (Fig 3). A simple explanation is that this is due to niche partitioning (Fig 2). Habitat usage should be a focus in future studies. Another possibility is that variation between species in their usage of color spectra during courtship drives differences in behavior (Fig 1). The visibility of different colors varies in low-light environments. Controlled courtship trials in various light environments could be a next step.

Lastly, variation in visual distinctiveness between males of sympatric species may influence male behavior (Fig 6). *Habronattus* males indiscriminately court females from other species in the genus, who are under intense pressure to select only conspecific males. Males with similar-looking sympatric species may be under pressure to court in high-light environments conducive for accurate female choice. Collecting ecological data from a system with both *H. viridipes* and *H. calcaratusm* would help to elucidate this potential finding.

Figure 6: Male *Habronattus calcaratus madisoni* courtship display (left) compared to a male *Habronattus viridipes* courtship display (right). Both species have overlapping native range. We did not encounter any *H. viridipes* during our trials.

References:

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2. Taylor, L. A., & McGraw, K. J. (2013). Male ornamental coloration improves courtship success in a jumping spider, but only in the sun. *Behavioral Ecology*, *24*(4), 955-967.
3. Sokal, R. R., Rohlf, F. J., & Rohlf, J. F. (1995). *biometry*. Macmillan.
4. Taylor, L. A., Cook, C., & McGraw, K. J. (2019). Variation in activity rates may explain sex-specific dorsal color patterns in Habronattus jumping spiders. *PloS one*, *14*(10), e0223015.

Acknowledgements

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Courtship video of *H. pyrrithrix*

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