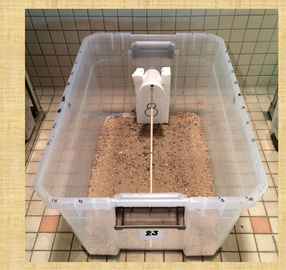
Urban vs Desert: Comparing Black Widow Boldness, Voracity and Social Tolerance

Ryan C. Clark[1] & J. Chadwick Johnson[2]

[1] School of Life Sciences, Arizona St. Univ., Tempe

[2] School of Mathematical & Natural Sciences, Arizona St. Univ., West



INTRODUCTION

- Urbanization often eliminates native species diversity, while other species (e.g. pests) thrive [1].
- It is suggested that behavior of urbanophiles could explain their success, and that these successes may well add to the loss of urban biodiversity [2].
- The Black Widow spider, *Latrodectus hesperus,* is native to the Sonoran Desert but found at a much higher density in metro Phoenix, AZ [3].
- Studies indicate that urban birds display bolder suites of correlated behaviors (behavior syndromes), possibly due to habituation [4].
- We predict that urban spiders will be bolder, exhibit enhanced aggressiveness toward prey, but be more tolerant of conspecific individuals allowing them to form dense urban infestations.

METHODS

- We sampled a total of 26 adult female black widows collected from urban (N=13) and desert habitats (N=13).
- Assays were conducted in a 72-liter plastic tub (57 × 38 × 33 cm) where focal spiders were fed 1 cricket every 7 days on reverse photoperiod (see photo).
- Conspecific intruders were reared in the lab, at the same temperature (27ºC), and fed 2 small crickets once a week, for 6 weeks prior to assay.
- **Boldness** was gauged by the distance (cm) spiders strayed from their refuge in the early dark cycle.
- **Voracity** was calculated as latency (secs) to attack artificial, standardized prey vibration.
- **Social Tolerance** of an unrelated, urban conspecific was measured once a day for 14 days and recorded as distance between individuals.

RESULTS

-Boldness displayed significant repeatability (Intraclass Correlation Coefficient ICC = 0.75, $F_{23,230} = 3.99$, $p < 0.0001$). Habitat origin had no significant effect on boldness behavior (Fig. 1; $F_{1,22} = 0.001$, $p = 0.97$).

-Voracity displayed significant repeatability (ICC = 0.79, $F_{24,48} = 4.9$, $p < 0.0001$). Habitat origin had no significant effect on voracity (Fig. 2; $F_{1,22} = 0.92$, $p = 0.35$).

-Social Tolerance displayed significant repeatability (ICC = 0.96, $F_{18,234} = 27.9$, $p < 0.0001$). Habitat origin had a marginally non-significant effect on tolerance (Fig. 3; $F_{1,20} = 3.83$, $p = 0.065$).

-Spider mass was used as a covariate in the above analyses, but never significantly predicted behavior.

-We found no significant correlations among voracity, boldness and tolerance.

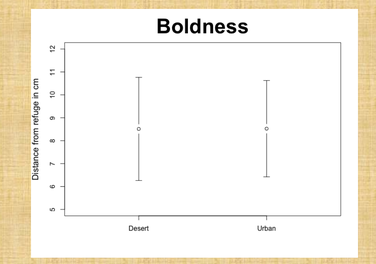


Figure 1

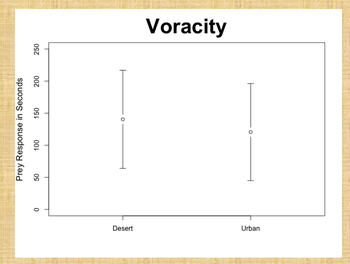


Figure 2

Figure 3

Figure 1: Distance away from back of refuge for desert and urban lineages. Points indicate the mean distance in centimeters and brackets show the standard error of the mean.

Figure 2: Response time to artificial prey stimulations for desert and urban lineages. Points indicate the mean response in seconds and brackets show the standard error of the mean.

Figure 3: Distance between individuals in the same arena for desert and urban lineages. Points indicate the mean distance in centimeters and brackets show the standard error of the mean.

DISCUSSION

- We found the black widow's behavior (regardless of habitat of origin) to be highly repeatable, and unrelated to a spider's mass.
- These data do not support the idea that urban pests thrive because of their behavioral plasticity.
- However, these three behaviors were not correlated with each other, rejecting the notion of a behavior syndrome.
- We were surprised to find no behavioral differences between urban and desert-collected spiders whatsoever.
- Notably, this was a common garden laboratory experiment, and it remains possible that urban and desert spiders show behavior differences in the field.
- Recently urban and desert black widows have proven to be highly diverged genetically [5].
- And yet those genetic differences led to no measured behavior differences.
- Future work should compare the field behavior of urban spiders, desert spiders and cross-fostered urban spiders in desert habitat and desert spiders in urban habitat.

LITERATURE CITED

1) Kark, S. et al. 2007. Journal of Biogeography, 34, 638- 651.
2) Andrade, R. et al. 2017. Journal of Arid Environments, 144, 12-20.
3) Johnson, J.C. et al. 2012. The American Midland Naturalist, 168, 333-340.
4) Evans, J. et al. 2010. Ethology, 116, 588-595.
5) Miles, L. et al., 2018. Molecular Ecology, 27, 3219-3230.

ACKNOWLEDGEMENTS

Special thanks to Christopher de Tranaltes, Colin Clay, Keaton Coker, Marko Meric, Destiny Ryan and Sarah Lindley for their assistance in spider rearing and data collection.

ASU School of Life Sciences Arizona State University

Central Arizona-Phoenix Long-Term Ecological Research CAP LTER

ASU New College of Interdisciplinary Arts and Sciences Arizona State University