



The effect of urban heat island simulated temperatures on the life history of male black widow spiders

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INTRODUCTION

- Urbanization rapidly alters physical landscapes, impacting habitat availability and species diversity.
- Urban organisms face unique challenges in these disturbed habitats, often resulting in life history changes.
- The urban heat island (UHI) is a phenomenon in which urban regions experience warmer temperatures primarily caused by the heat-trapping properties of concrete, metal, bricks, and other human activities, which poses a significant threat to urban ectotherms [1] [2].
- The Western Black Widow (*Latrodectus hesperus*) is a venomous spider species found in western regions of North America, commonly in urban areas, making it an urban pest (see photos above).
- Here we examine the effect of simulated UHI temperatures on the development, behavior, and survival of juvenile widows reared from females collected from both urban and desert populations.
- We predict that elevated UHI temperatures will speed development, increase voracity and reduce longevity.
- If urban widows are adapted to the city, they should increase voracity and development speed in response to urban population density and resource competition.

METHODS

- Eight black widow families (5 urban, 3 desert) were reared from field-collected females producing egg sacs (Fig. 1).
- Siblings were split between hot (31 °C) and cold (27 °C) incubators, with 3 males and 3 females per temp. per family.
- These temperatures are based on previous estimates of urban/desert widow microclimates [3].
- Voracity was measured as the latency to attack fruit flies.
- Development speed and longevity were measured as # days from hatching to molt and death.
- Body size was measured as the length (mm) of legs 1 and 4, and width (mm) of the cephalothorax (Fig. 2).



Fig. 1. Egg sack and mature female widow (middle) and eggs (right) collected from urban and desert female widows. Juvenile female widow mid molt (left)

RESULTS

- We found NS trends for cold temperatures to slow male development (Fig. 3), and hot temperatures decreased male longevity (Fig. 4).
 - Notably, desert males exposed to UHI elevated temperatures died almost two weeks faster than any other treatment group (Fig. 4).
- The length of leg 1 in adult males, a trait believed to be under sexual selection, was limited by UHI temperatures for urban but not desert males.
 - (Fig. 5; 1-tailed p=0.02)
- The width of the male cephalothorax, a trait believed to be under natural selection, was limited by UHI temperatures for urban but not desert males.
 - (Fig. 6; 1-tailed p= 0.01)

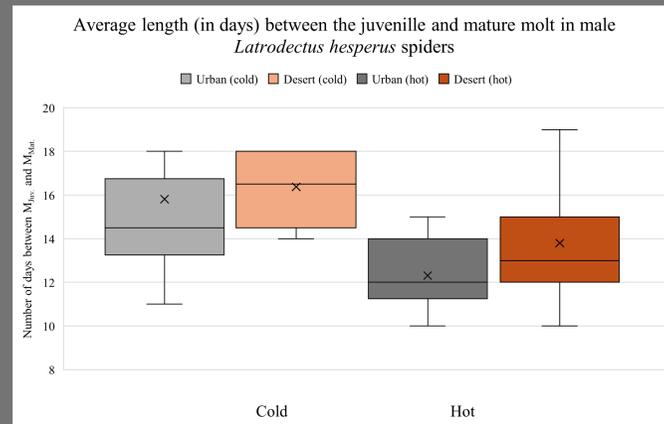


Figure 3. Effects of temperature variation on male development speed.

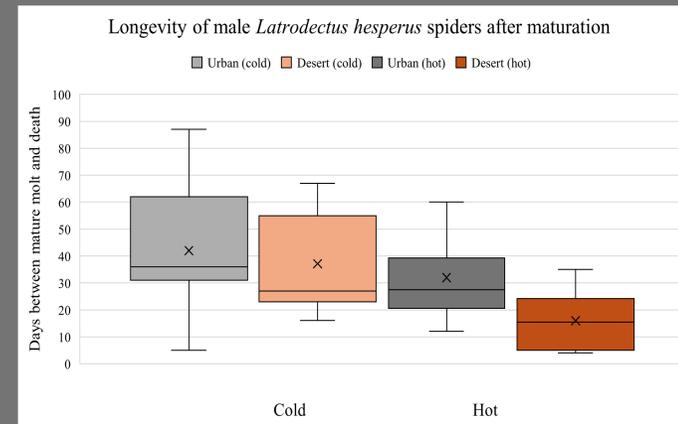


Figure 4. Effects of temperature variation on male longevity.

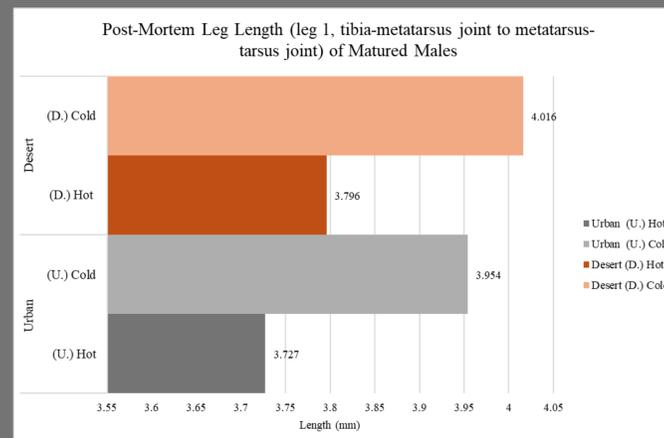


Figure 5. Effects of temperature/habitat on male leg length (leg #1)

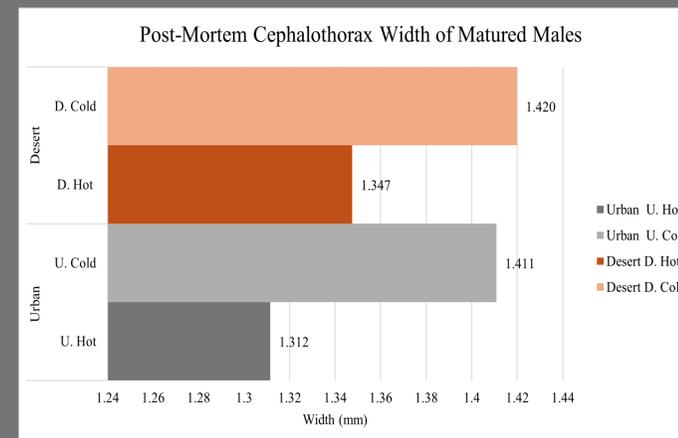


Figure 6. Effects of temperature/habitat on male cephalothorax width



Fig. 2 Leg length (left) and cephalothorax width (right) measures.

DISCUSSION

- We found urban males survived longer than desert males at the same temperature, indicating possible adaptation to UHI temperatures.
- Increased temperatures had the intuitive effect of speeding male development, but also proved to reduce lifespan, and compromise both leg length and cephalothorax width.
 - This suggests a relationship between temperature, metabolic demand, development speed, maturation, size at adulthood and mortality.
 - While desert males kept at hot conditions died the fastest, most effects of temperature were seen equally in urban and desert males.
 - In one exception to this, only urban males responded to UHI conditions by maturing at smaller leg and body sizes.
- These findings contribute to a broader understanding of how urbanization, specifically the urban-heat island effect, may influence the life history of this urban pest.

LITERATURE CITED

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