Artificial Light at Night Effects on Black Widow Spider Behavior

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Introduction

- Artificial Lights at Night (ALAN) is the change in light levels due to human-made light sources.[1]
- ALAN is rapidly increasing across the world, and has been connected to physiological and behavioral changes in animals.[2]
  - For example, beach-dwelling isopods exposed to ALAN temporarily lost their circadian rhythm of activity.[1]
- Almost two thirds of invertebrates are nocturnal and are more subtly impacted by lights, such as insects losing population size by continually congregating at lights.[3]
- Orb weaver spiders reared under ALAN had increased juvenile development, but resulted in higher daily mortality rate[2]
- Sonoran-native black widow spiders (*Latrodectus hesperus)* are nocturnal predators that are thriving in urban Phoenix.
- We hypothesize that ALAN affects voracity, webbuilding, activity, and anti-predator behaviors in desert and urban black widows by disheveling their circadian rhythm. .

Methods

- 11 urban and 11 desert adult females were collected during late Spring of 2022 and housed in separate, identical tubs.
- Spiders were then split into one of two light treatments: continuous light (ALAN), or natural light cycle (NL).
  - Daytime light for both treatments was set to 3000-1000lx
  - Nighttime light for ALAN treatment was set at ~1.74x, based on the average 9pm web lux we collected.
- Spiders were reared under light treatments for 1 week before testing.
- Activity: prior to any testing, spiders are noted as active if out on web, and inactive if hiding.
- Voracity: artificial and live prey stimuli were applied ~5cm away from the spider. Each stimulus trial was done a day apart from each other.
  - Artificial prey trials occurred before and after the live cricket test. Spiders were weighed after each.
  - Assays lasted for 5 min., or until the spider threw web at the stimulus.
- Web-building: Spiders were temporarily placed in new tubs and we scored their activity every minute for the first 15 minutes, and then every 15 minutes until a trial duration of 2 hours.
- Anti-predator: Spiders were poked in the side with a toothpick until they displayed a anti-predator behavior
  - The number of pokes, and the time taken until the spider threw web, dropped, played dead, or ran more than a body length away.

Results

- Activity did not differ between light treatments (t= -1.14, p= 0.270).
- Voracity scored as latency to throw silk did not differ in 1) pre-feeding artificial prey trials (t= 1.49, p= 0.153), 2) live prey trials (t= 1.03, p= 0.316), or 3) post-feeding artificial prey trials (t= 1.43, p= 0.170).
- Voracity scored as likelihood of any attack in the 5 minute trial was 1) greater for NL spiders in the pre-feeding artificial prey trials ($\chi2$=6.39, df= 1, p=0.01), 2) marginally increased in NL spiders in post-feeding artificial prey ($\chi2$= 3.23, df= 1, p= 0.072), but not significantly different in live prey trials ($\chi2$=2.39, df= 1, p=0.122)
- ALAN and NL did not differ significantly in webbuilding trials (t=0.984, p= 0.337).
- Desert spiders did build web significantly more than urban spiders (t= -2.20, p= .0404)
- Anti-predator response did not differ between treatments (p>0.15).

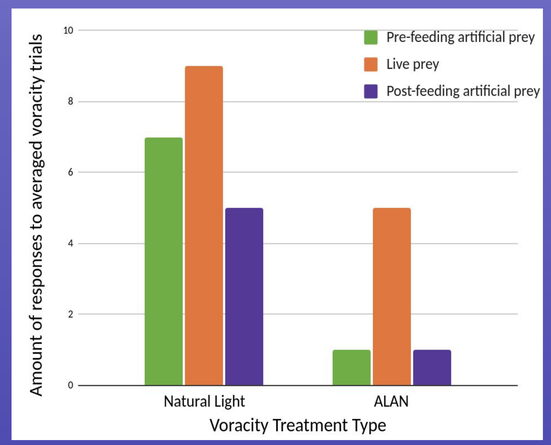

Figure 1. Amount of responses from the averaged voracity tests between ALAN and NL spiders

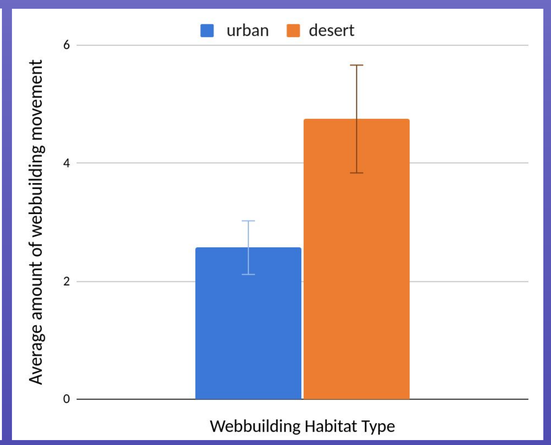

Figure 2. Average amount of webbuilding movement between urban and desert spiders

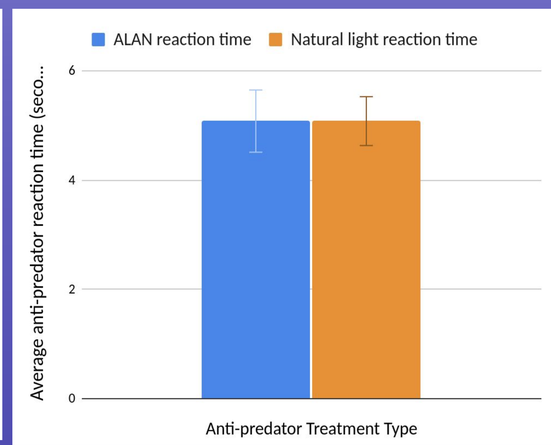

Figure 3. Average reaction time (seconds) in anti-predator trials between ALAN and NL spiders

Discussion

- ALAN had no significant effect on web-building and anti-predator behavior
  - Desert spiders did web build significantly morein these laboratory assays, suggesting intrinsic habitat differences that are not eradicated by lab rearing or light treatments.
- NL spiders attacked artificial prey more often, but not quicker, than ALAN spiders, which may imply that ALAN decreases voracity to these relatively artificial prey stimuli.
- Further research should investigate if higher lux exposures more drastically affect black widow behavior and/or physiology.
  - Similarly, the types of light sources and their wavelengths could also variably affect behavior.

Literature Cited

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