Cannibalism versus social tolerance in an urban pest: what makes black widows kill each other?

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Introduction

•The unique placement of the Herberger Young Scholars Academy (HYSA) on ASU's West campus allowed for this unique research collaboration.

•Our goals were two-fold:

- First, we challenged HYSA students to practice the scientific method by asking and answering their own research question.
- Second, we wanted to better understand why some urban pest species thrive in human-disturbed habitats.

•The black widow spider (*Latrodectus hesperus*) occurs across Phoenix in dense urban infestations.

•Cannibalism is common in spiders. Understanding what makes black widows socially tolerant versus cannibalistic could help us understand why widow infestations form.

•Here we hypothesized that if **size differences** shape social contests, then cannibalism should be greater in asymmetrically-sized pairs.

•In contrast, if web ownership **(residency)** drives aggressive interactions, then residents should win contests regardless of size.

Methods

•Spiders were lab-reared offspring of females collected from urban habitat.

•Twenty "resident" spiders were allowed to build individual webs in 57x38x33 cm. tubs, and 20 "intruder" spiders were housed individually in 10x10x12 cm.boxes.

•Ten residents and ten intruders were assigned to the "high food" treatment and were given 3 crickets per week. Spiders designated to the "low food" treatment were starved during this 3 week period. Five days before we introduced intruders into the webs of residents, all spiders were fed 1 small cricket to standardize time since last feeding.

•Following the introduction of intruders we checked spiders every 12 hours and scored each spider's position, the distance between spiders, and whether cannibalism had occurred.

Results

•High-food spiders weighed significantly more than low-food spiders (resident and intruders both $p<0.0001$; see Fig. 1). In contrast, resident and intruder spiders showed little weight difference (high food and low food both $p>0.05$).

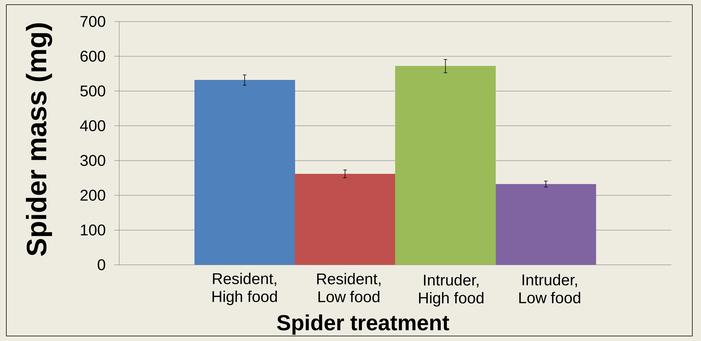

Fig. 1 Average body mass of females in the four treatments.

Cannibalistic Pairing	Winner	Loser
Resident High food Intruder High food	Resident High food	Intruder High food
Resident High food Intruder High food	Intruder High food	Resident High food
Resident High food Intruder Low food	Resident High food	Intruder Low food
Resident Low food Intruder High food	Intruder High food	Resident Low food
Resident Low food Intruder Low food	Resident Low food	Intruder Low food
Resident Low food Intruder Low food	Resident Low food	Intruder Low food

Table 1 Cannibalistic winners were most often high food (4/6) residents (4/6). Low-food intruders never cannibalized.

•Cannibalism occurred in 30% of pairings (6/20). Four of these 6 cannibalisms occurred between same-sized pairings and residents won ¾ of these contests. High food spiders won all contests against low-food spiders (see Table 1).

•Web ownership between contestants, as defined by the spider that held a position closest to the web refuge, was dominated by high-food spiders, regardless of residency. Strikingly, in asymmetrically-sized pairings, high-food spiders owned the web 99% of the time regardless of residency (see Fig. 2).

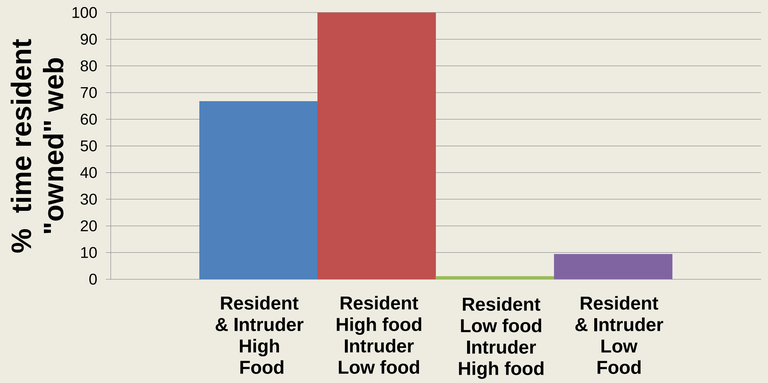

Fig. 2 Web ownership was dominated by high-food spiders

Discussion

•HYSA students had an extraordinary opportunity to complete a research project in collaboration with an ASU researcher and gather data that are relevant to the urban black widow's explosive population growth.

•Our data suggest that size asymmetry does not promote cannibalism in black widows. Instead, our cannibalism data suggest that large size and residency are both advantageous, as low-food intruders never cannibalized another spider.

•Our web ownership data indicate that size is profoundly more important than residency in determining the outcome of social contests—high-food spiders almost always outcompeted low-food spiders regardless of which spider started the trial as the resident.

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