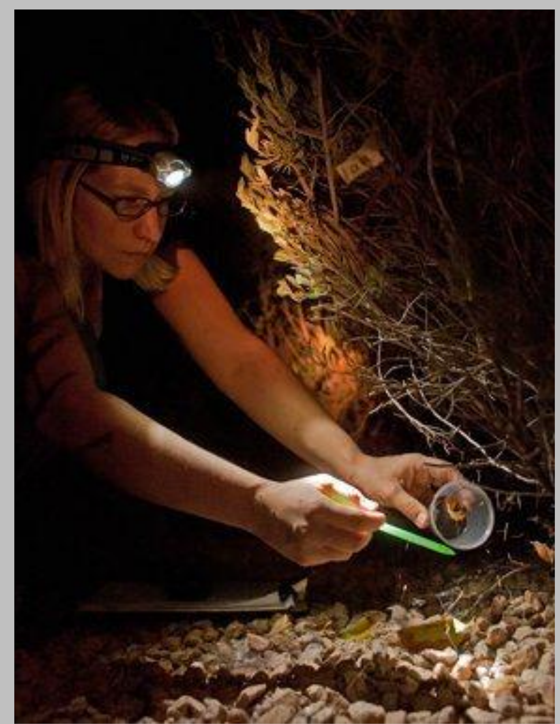

Black widows in an urban desert: population variation in an urban pest across metropolitan Phoenix

Patricia Trubl [1], Theresa Gburek[1], Lindsay Miles[1] & J. Chadwick Johnson [2]

[1] School of Life Sciences, Arizona State University and [2] Division of Mathematical & Natural Sciences, Arizona State University at the West Campus.

INTRODUCTION

•One focus of urban ecology is on the effects of urban disturbance on biodiversity. For example, urbanization often leads to reduced species diversity but high abundances for a few urban specialists[1].

•Past work has emphasized the importance of reduced temporal variation (lack of seasonality) in affecting urban ecosystems. This lack of seasonality could stem from 1) increased urban temperatures arising from an urban heat island effect[2], and/or 2) water supplementation heightening productivity (e.g. prey availability) throughout the year[3]. Thus, reduced temporal variation may have the effect of homogenizing urban habitat.

•In contrast, spatial variation may have the opposite effect of differentiating urban habitats to the extent that urban disturbance varies across the landscape leading to fragments of distinct urban habitat. For instance, work on urban birds has shown that the size of land fragmentation across urban habitat affects both avian abundance and diversity[4].

•Here we examine the urban population dynamics of the Western black widow spider (*Latrodectus hesperus*). Black widows are both a common pest that thrives in disturbed, urban habitat throughout the Phoenix metropolitan area and a species of medical importance due to the toxicity of their venom to humans.

•Specifically, we test the prediction that urban widow populations exhibit minimal temporal variation, but are characterized by high degrees of spatial variation. In other words, we predict that among-population variation greatly exceeds within-population variation.

METHODS

•Ten black widow sub-populations (sites) across the greater Phoenix metropolitan area were monitored during the peak of their breeding season (June-August) (Fig. 1).

•Sites were censused biweekly for population density (males and females). Webs were located visually and, if need be, we confirmed that the web was occupied by dangling live prey in the web until the web's occupant emerged.

•Ten female widows per site were randomly chosen and monitored weekly. We tracked each focal female's mass, foraging behavior and web volume.

•Missing females were replaced with another randomly chosen female. Data were included only if females were present for 3 consecutive weeks.

•Females were collected at the end of the season for nutrient analysis (see Discussion).

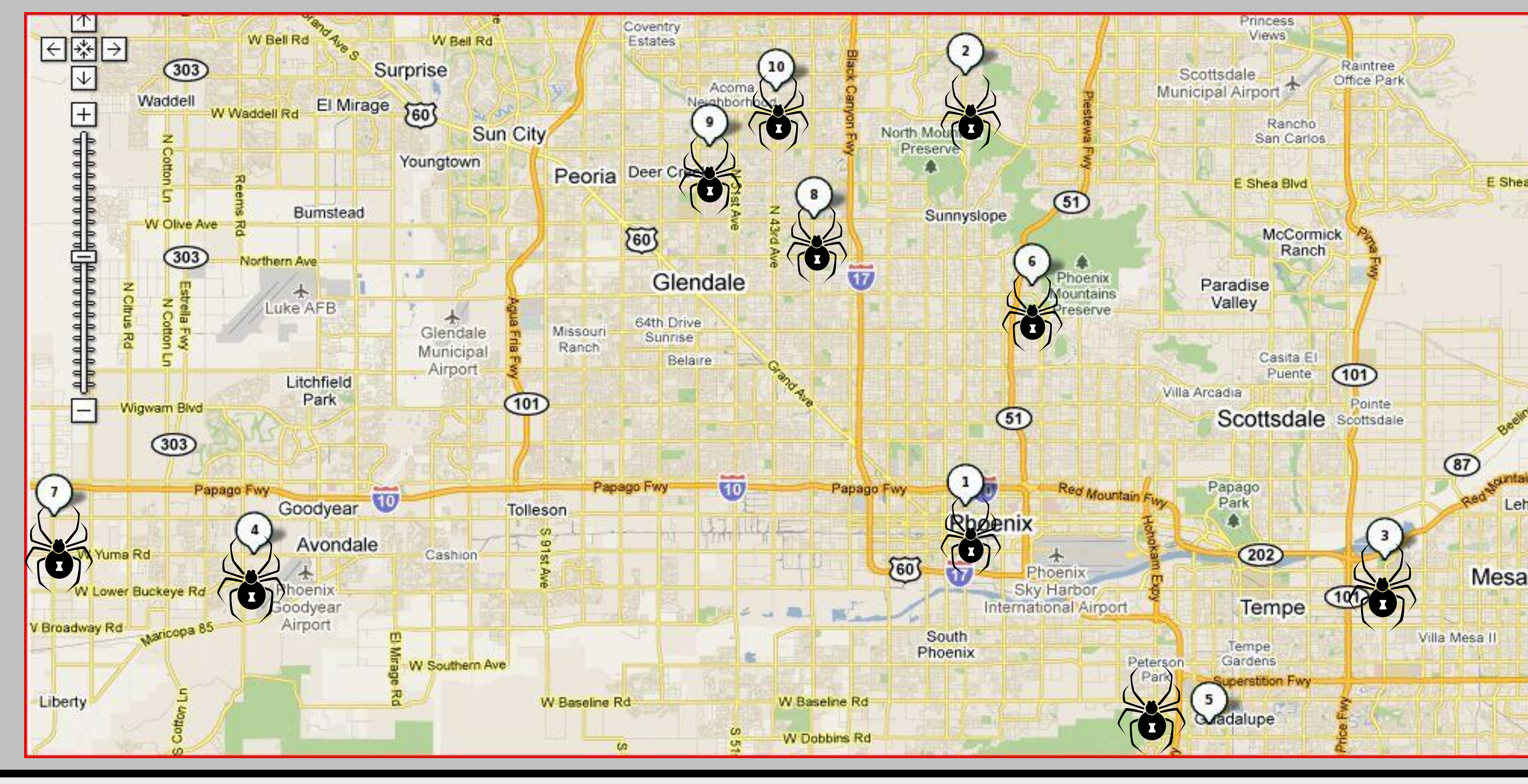

Fig. 1 Location of each sub-population monitored during the breeding season (June-August) 2010.

RESULTS

As predicted, repeated measures analysis showed no effect of seasonality on population density ($F_{4,8}$= 2.42, p=0.13), female mass ($F_{2,200}$= 0.6, p= 0.62) or web volume ($F_{2,201}$= 0.55, p=0.59). Thus we averaged each measure across the season to look for differences among sites. Our 10 sites proved to be highly variable in terms of female mass (Fig. 2), web volume (Fig. 3), and population density (Fig. 4). The proportion of time females were found in the foraging posture did not vary among sites ($F_{1,9}$= 1.36, p=0.21). Female mass and web volume did not influence one another ($F_{1,9}$= 0.41, p=0.54). Nor did population density influence female mass ($F_{1,9}$=1.48, p=0.23) or web volume ($F_{1,9}$=1.27, p=0.29).

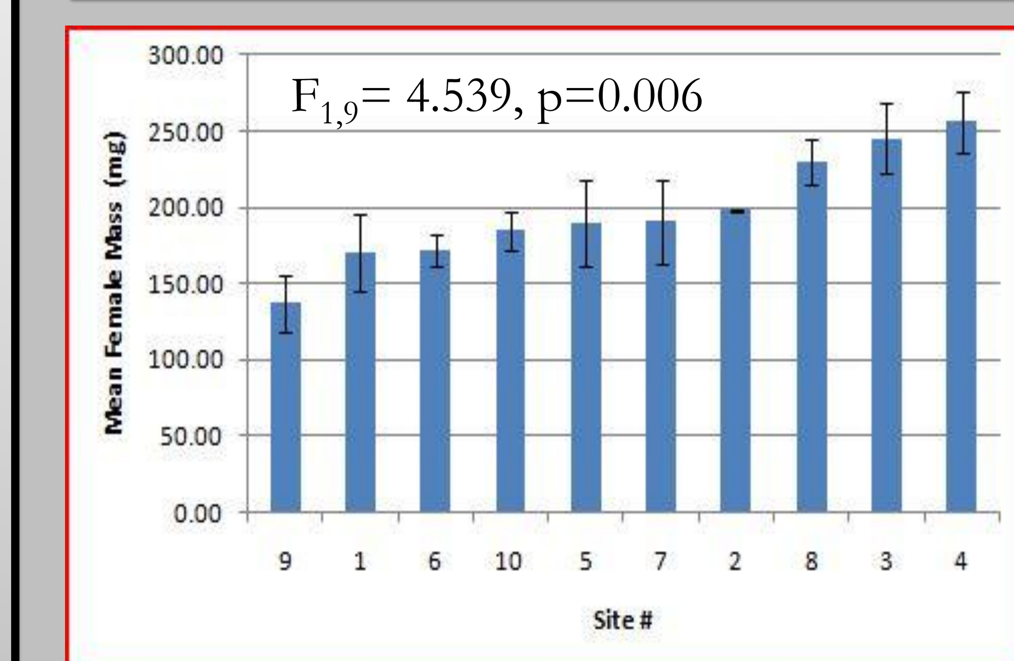

Fig. 2 Female mass varies significantly by site (N=6-17 females/site).

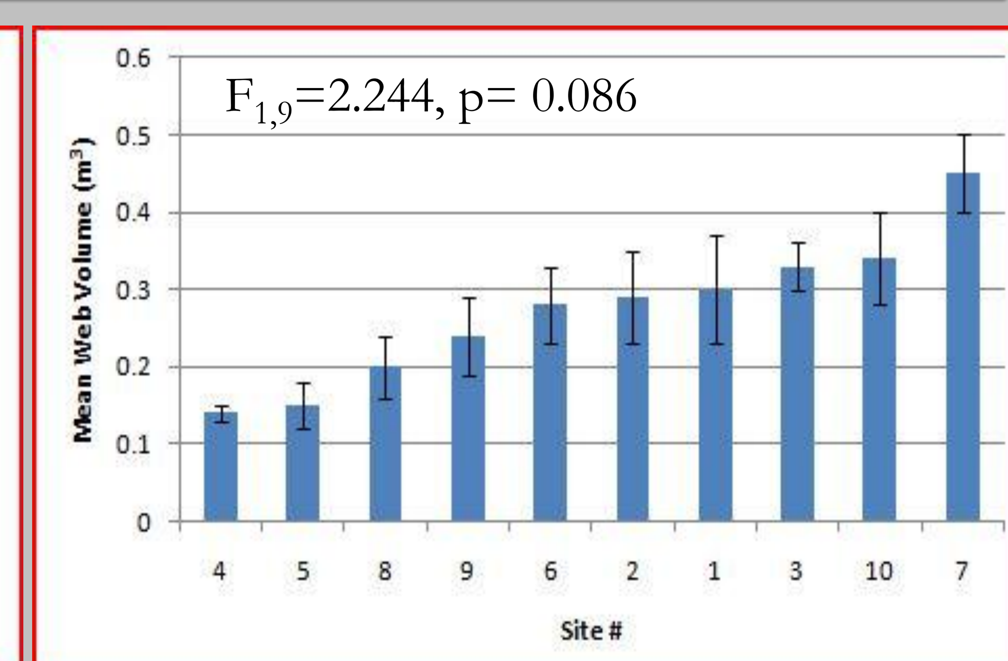

Fig. 3 Female web volume varies (NS) by site (N= 6-17 webs/site).

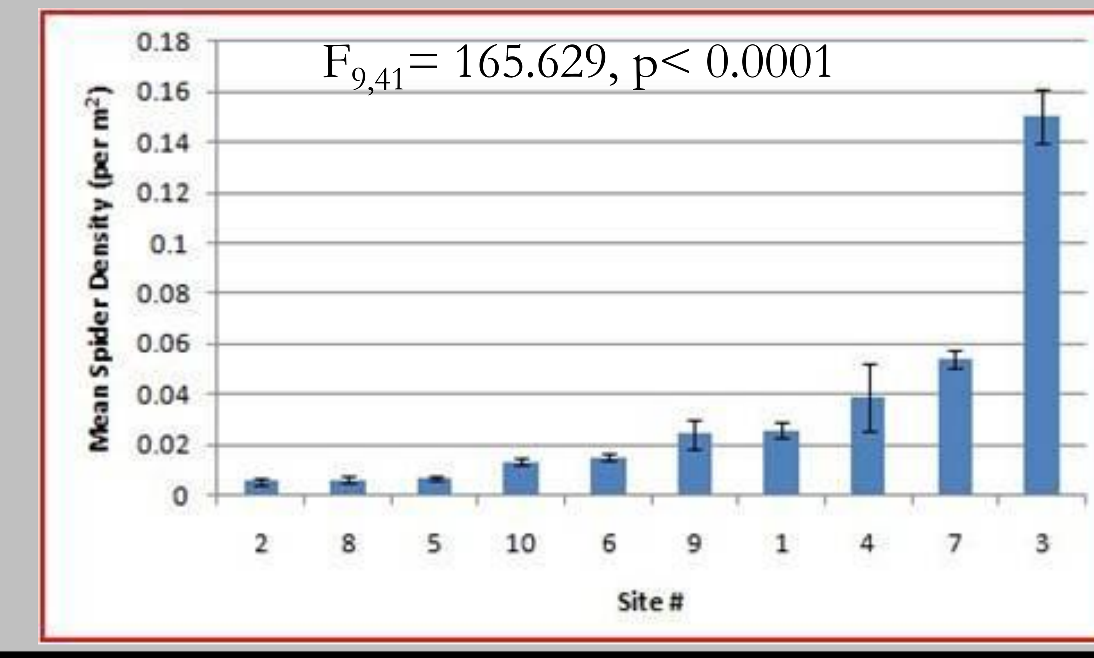

Fig. 4 Population density varies significantly by site location (N= 3-5 measures per site).

DISCUSSION

•Our data support the contention that urban black widow populations exhibit dampened temporal variation but significant spatial variation. Thus, while urban habitat can appear homogenous on the surface, in fact, urbanization can lead to habitat fragmentation on a relatively small scale. Our future efforts will be directed at understanding the biotic and abiotic variation fostering the growth of high-density urban widow infestations.

•We were surprised to find little relationship between population density, female mass and web volume. Other site characteristics (e.g. dominant web-building substrate, availability of prey and/or refuge) that were not quantified here may be better predictors of urban widow density.

•Future work will compare these urban populations to black widows inhabiting relatively undisturbed Sonoran desert habitat. In addition, widows and prey items (crickets and cockroaches) collected from the present 10 urban sites, as well as future desert sites, will be the focus of stoichiometric analyses testing the hypothesis that nutrient diversity varies across the urban – desert habitat continuum.

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