A population genetic approach to investigate effects of urbanization and habitat fragmentation on the Western black widow spider, Latrodectus hesperus



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ABSTRACT

Urbanization causes a sudden and drastic change to the landscape, fragmenting habitats, leading to a disruption in dispersal, potentially impacting gene flow of the organisms living in these new urban habitats. Due to the variable effects caused by urbanization, it is important to understand the genetic variation if we wish to understand why some organisms thrive in urban environments and become pest species. We test the hypothesis that urbanization and habitat fragmentation restricts gene flow in urban black widow populations and therefore may cause urban populations to exhibit patterns of genetic diversity consistent with fragmentation, isolation, and recent colonization relative to desert black widow populations. Preliminary results indicate urban populations may not only be recently derived but that isolation has been established for some time given the significant divergence between them and surrounding desert samples.

BACKGROUND

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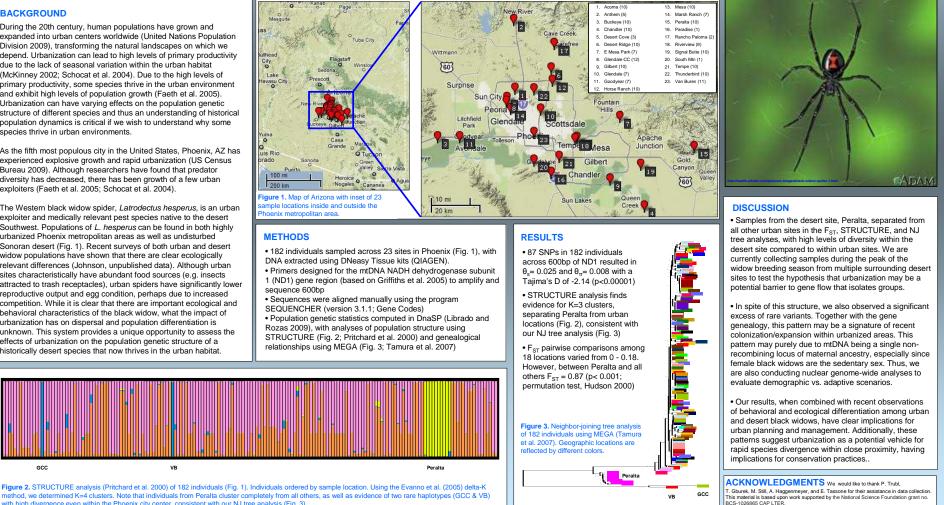
During the 20th century, human populations have grown and expanded into urban centers worldwide (United Nations Population Division 2009), transforming the natural landscapes on which we depend. Urbanization can lead to high levels of primary productivity due to the lack of seasonal variation within the urban habitat (McKinney 2002; Schocat et al. 2004). Due to the high levels of primary productivity, some species thrive in the urban environment and exhibit high levels of population growth (Faeth et al. 2005). Urbanization can have varying effects on the population genetic structure of different species and thus an understanding of historical population dynamics is critical if we wish to understand why some species thrive in urban environments.

As the fifth most populous city in the United States, Phoenix, AZ has experienced explosive growth and rapid urbanization (US Census Bureau 2009). Although researchers have found that predator diversity has decreased, there has been growth of a few urban exploiters (Faeth et al. 2005; Schocat et al. 2004).

The Western black widow spider, Latrodectus hesperus, is an urban exploiter and medically relevant pest species native to the desert Southwest, Populations of L. hesperus can be found in both highly urbanized Phoenix metropolitan areas as well as undisturbed Sonoran desert (Fig. 1). Recent surveys of both urban and desert widow populations have shown that there are clear ecologically relevant differences (Johnson, unpublished data). Although urban sites characteristically have abundant food sources (e.g. insects attracted to trash receptacles), urban spiders have significantly lower reproductive output and egg condition, perhaps due to increased competition. While it is clear that there are important ecological and behavioral characteristics of the black widow, what the impact of urbanization has on dispersal and population differentiation is unknown. This system provides a unique opportunity to assess the effects of urbanization on the population genetic structure of a historically desert species that now thrives in the urban habitat.

VB

with high divergence even within the Phoenix city center, consistent with our NJ tree analysis (Fig. 3).



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