Living on the edge: sensitivity of arthropods to development and climate along an urban-wildland interface in the Sonoran Desert

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INTRODUCTION

- Urbanization can alter biological communities by eliminating them through habitat loss or replacing native species with exotics.
- Effective management of protected areas depends on detailed knowledge of biota, particularly bioindicators.
- Ground-dwelling arthropods are a diverse group of organisms that are critical to ecological processes such as nutrient cycling (Fig 1).
- Arthropods are sensitive to rapid environmental change, such as urbanization, and are considered bioindicators.
- Arthropods in arid regions face high environmental stresses through lack of water and high temperatures, and urbanization can compound these problems.

Fig 1. Blister beetles (*Lytta magister*) [left] and green lynx spider (*Peucetia viridans*) [right]

OBJECTIVES AND PREDICTIONS

- Our goal was to investigate arthropod community dynamics in an urban-wildland interface in an arid region.
- We hypothesized that sites near the urban edge would have lower arthropod richness and different arthropod compositions compared to the interior sites.
- We hypothesized that temperature and precipitation would be strong drivers of arthropod community dynamics and arthropod communities near the urban edge would differ seasonally.
- Specifically, we predicted that the most stressful seasons would present the largest effect to arthropod communities on the urban edge.

METHODS

- We examined the arthropod communities at five locations across the McDowell Sonoran Preserve in Scottsdale, Arizona, USA (Fig 2).
- Sites were established for long-term monitoring as part of the Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) program, using the CAP LTER arthropod monitoring protocol.

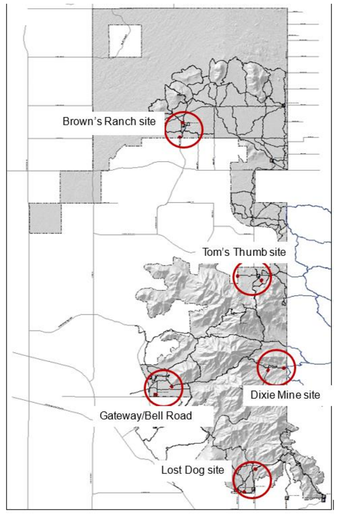

Fig 2. Map of study area, Scottsdale's McDowell Sonoran Preserve.

- Edge sites were within 100m of urban development, while interior sites were >0.5km away from the Preserve boundary.
- We sampled four interior-edge site pairs and one interior-interior site pair, for a total of 10 sites.
- At each of the sites, we placed 10 pitfall traps at 5-m intervals along a transect.
- Sampling occurred across seasons from 2012-2020.
- After collections, arthropods were sent to ASU to be identified to the lowest practical taxa (LPT).

RESULTS

- In total, we captured and identified 25,477 arthropod individuals belonging to 287 LPT over eight years.
- Dominant taxa included ants and mites (Fig 3).

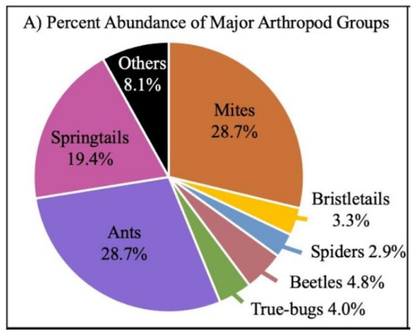

Fig 3. Percent abundance of major arthropod groups recorded in the Preserve.

RESULTS CONT.

- Although results for evenness were mixed among site pairs, we found that two site pairs had higher arthropod richness in the Preserve interior (Fig 4a).
- Importantly, we found that some differences were only apparent seasonally; for example edge sites had more fire ants than interior sites during the summer (Fig 4b).

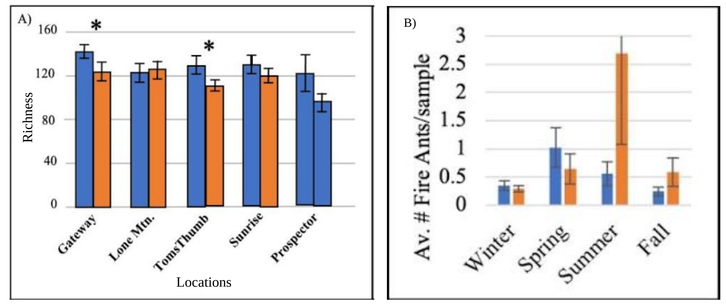

Fig 4. a) Arthropod richness across 8 sites and a) average number of fire ants per sample across 4 seasons. Blue = interior, orange = exterior.

- We also found that temperature and precipitation were strong predictors of arthropod composition. For example, temperature had a positive relationship to ant abundance.

DISCUSSION

- Overall, we found no consistent effect of the urban edge on arthropod communities. Instead the effects were site, season, and taxon specific.
- We found ant increases during summer on the urban edge were largely driven by a single non-native and invasive species, fire ants (Fig 5).
- We also found support of our hypothesis that climate would be a strong driver of arthropods.
- This research is important for understanding the dynamics of arthropod communities in arid regions and for developing conservation strategies that may mitigate the negative impacts of urbanization on ecosystems.

Fig 5. Red imported fire ants (*Solenopsis invicta*)

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