Bat Habitat Use Along the Gradient of Urbanization in the Phoenix Metropolitan Area

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Central Arizona-Phoenix Long-Term Ecological Research
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INTRODUCTION

- Bat species respond to urbanization in varying ways, and can be categorized as urban avoiders, urban adapters, or urban exploiters. Bats in each category can have corresponding traits.

- For example, western long-eared myotis bats (Fig. 1) are considered urban avoiders. They are small bats with slow, maneuverable, and sometimes hoovering, flight and a low call frequency, useful when foraging within dense vegetation.

Fig 1. Long-eared myotis roosting in a tree

Fig 2. Mexican free-tailed bat in flight

- In contrast, Mexican free-tailed bats (Fig. 2) are urban exploiters. They are large bats with fast, long-distance flight, and a high frequency call, useful for open-space foraging of aerial insects.

- The way species distribute across a gradient of urbanization shapes the composition of the bat community.

- Little is known about bat habitat use in arid urban environments.

STUDY AREA

- This study will be conducted in the arid urban environment of Phoenix, Arizona, across a gradient of urbanization (Fig 3).
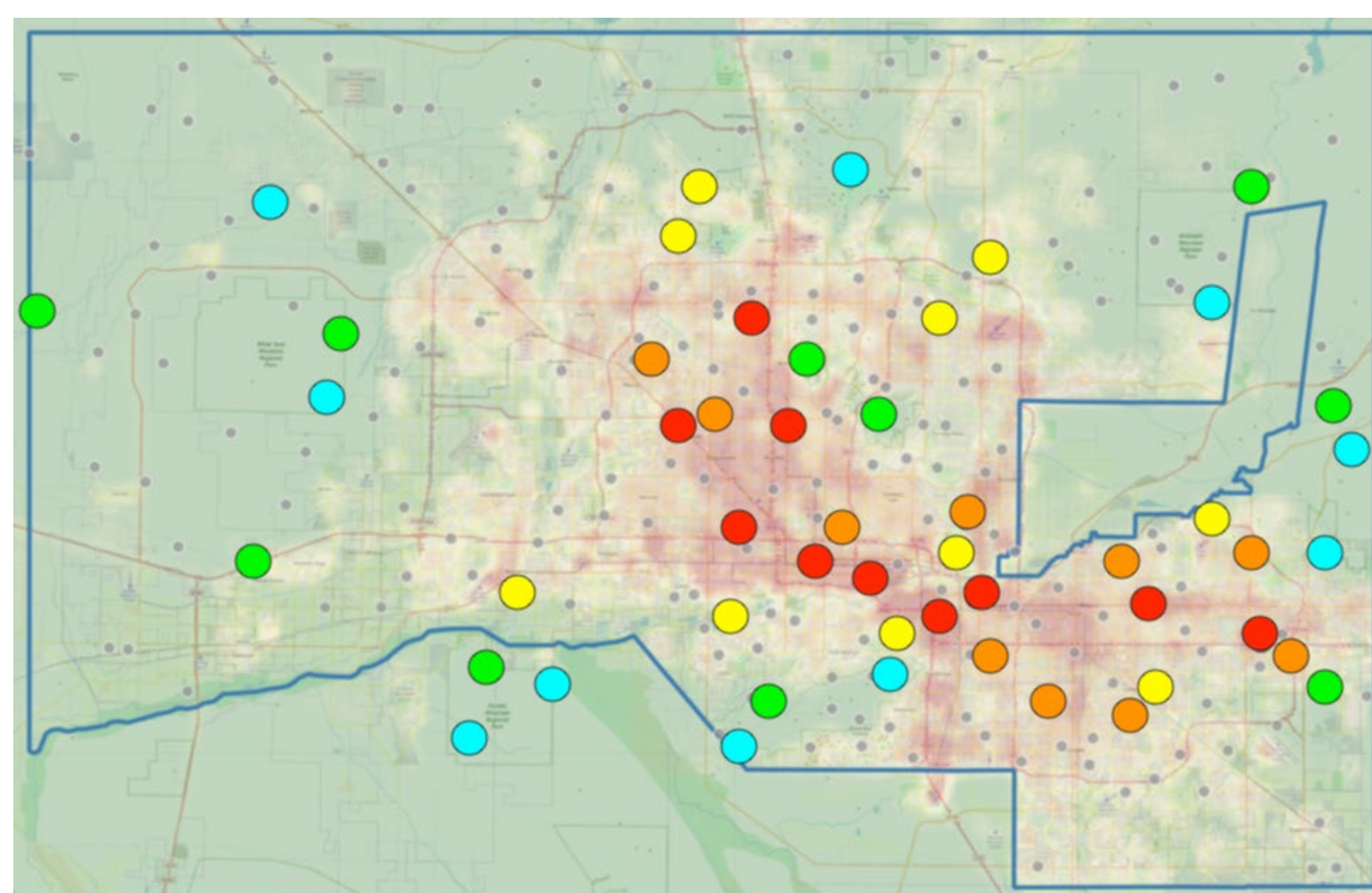

Fig 3. Fifty sampling locations along a gradient of urban intensity across the Phoenix metropolitan area within the CAP LTER boundary. Points are color-coded by percent urbanization. Blue=Strata 1 (0%), Green=Strata 2 (.1-17%), Yellow= Strata 3 (18-35%), Orange=Strata 4 (36-53%), and Red=Strata 5 (54-81%). Gray points indicate CAP sites that we did not get permission for or did not meet requirements.

OBJECTIVES

The overall objective of our study is to understand the effect of urbanization on bat habitat use across the gradient of urbanization and across seasons in an arid region. Specifically, we will:

1. Evaluate the distribution of bat species within the urban avoider, urban adapter, urban exploiter framework

2. Evaluate the diversity of the bat community

3. Investigate temporal variation in habitat use of resident bats across seasons

HYPOTHESEES AND PREDICTIONS

- We expect bats to distribute across the gradient of urbanization consistent with the urban avoider, adapter, and exploiter framework (Fig. 4).
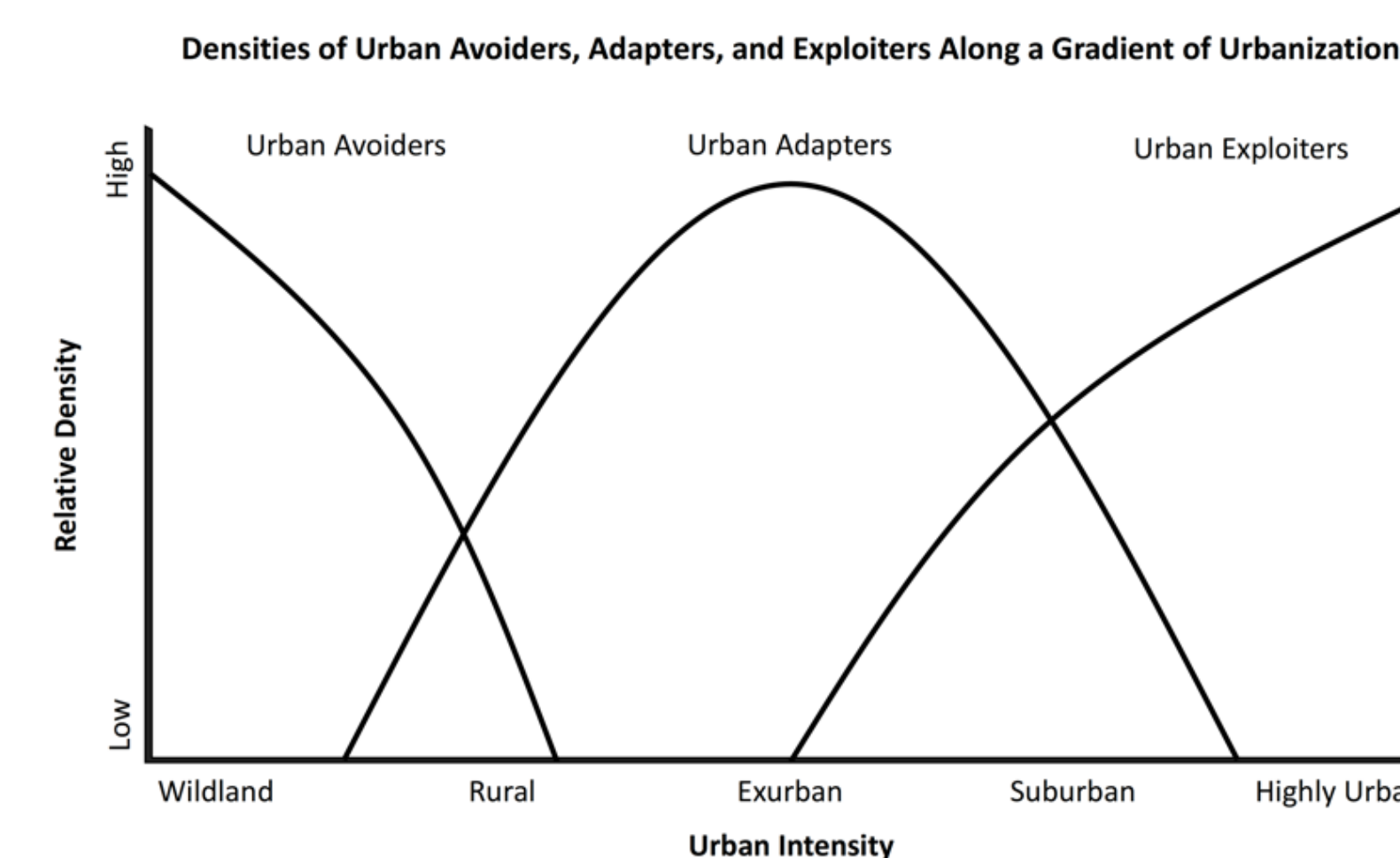

Fig 4. Conceptual diagram of urban avoider, adapter, and exploiter densities along a gradient of urbanization.

- We expect species richness to either decline with increasing urbanization or peak at moderate levels of urbanization (Fig. 5).
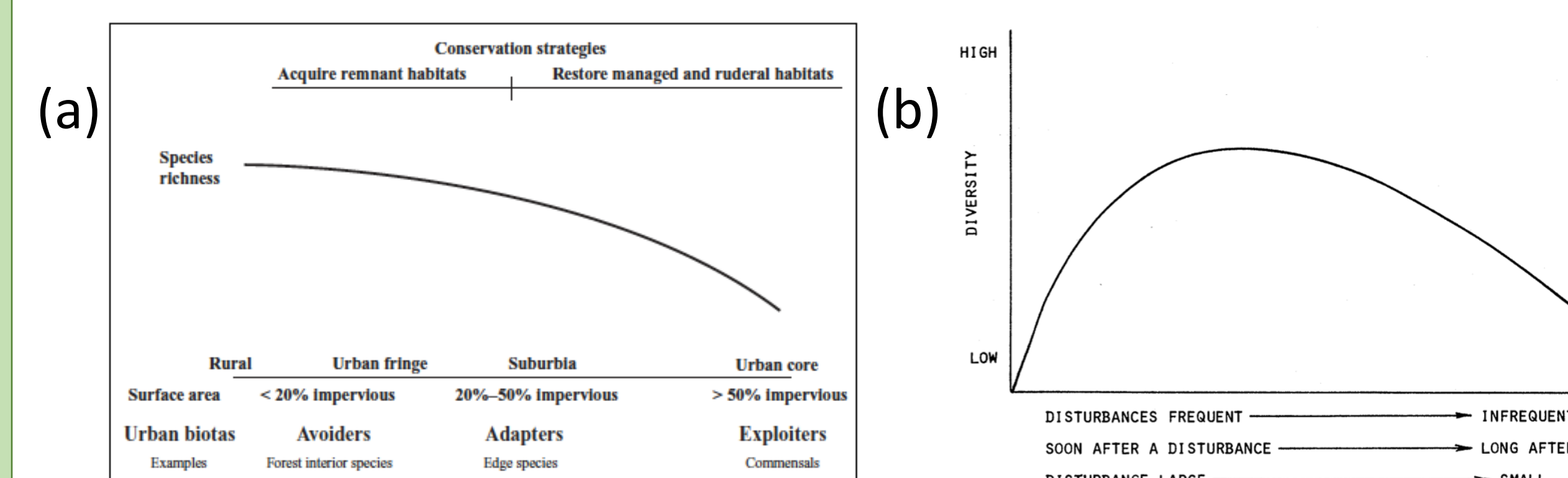

Fig 5. Possible patterns of species richness along a gradient of urbanization; (a) negative relationship between urbanization and species richness, and (b) intermediate disturbance hypothesis. (McKinney 2002, Connell 1978)

- If bats increase their use of sites with greater urbanization, it is predicted that this would occur during summer when water is limited, and/or in the winter when food and heat are limited.

- Lastly, we predict that other habitat characteristics may influence bat habitat use, such as NDVI, distance to water, vegetation type, temperature, and the moon phase.

METHODS

- We will collect data with a stationary SM4BAT-FS acoustic monitor and SMM-U2 microphone (Fig. 6) for 5 consecutive nights at 50 sampling locations, 10 in each of the 5 levels of urbanization (Strata 1-5), across the Phoenix metropolitan area (Fig. 3).

Fig 6. Acoustic monitor that records low frequency bat calls strapped to a tree trunk. The microphone is attached to a pole secured vertically overhead, with the microphone itself above the tree canopy.

- Monitors will be deployed four times in 2019 to capture each season. The seasons are as follows: Winter (Jan-Feb), Spring (Apr-May), Summer (July-Aug), and Fall (Oct-Nov).

- In order to avoid sound interference and changes in bat calls, the microphone will not be placed directly under light, powerlines, or vegetation, or within 50 m of water or pavement surfaces.

- Bat habitat use will be measured in the summer, when the majority of bat species are present in Arizona, and data will be evaluated using single-season occupancy modeling.

- Shifts in year-round resident bat habitat use will be measured across all four seasons, and that data will be evaluated using multiple-season occupancy modeling.

APPLICATIONS TO MANAGEMENT AND CONSERVATION

- Our research results will provide fundamental information about desert bat distribution and community composition.

- In addition, our results can be used to conserve bat populations in areas with expanding urbanization.

- Lastly, our research will add to the 20-year CAP LTER effort to better understand the urban sociological systems in Phoenix.

ACKNOWLEDGEMENTS