

# Bat Habitat Use Across the Gradient of Urbanization in a Single Season

## INTRODUCTION

- Bat species respond to urbanization in varying ways, and can be categorized as urban avoiders, urban adapters, or urban exploiters based on where their relative density, or relative abundance, is highest along a gradient of urban intensity.
- Bats in each category can have corresponding traits.
- For example, urban avoiders such as canyon bats (Fig. 1), are small-bodied bats with slow, short-distance flight and a low call frequency, useful when foraging within dense vegetation.

Fig 1. Canyon bat roosting in a tree



Fig 2. Mexican free-tailed bat in flight



- In contrast, urban exploiters such as Mexican free-tailed bats (Fig. 2) are large-bodied bats with fast, long-distance flight, and a high frequency call, useful for open-space foraging of aerial prey.
- These traits can make bats more or less susceptible to disturbances, such as urbanization.
- However, urban areas can provide resources to bats such as water, food, and man-made roosts. In some regions, such as arid regions, urban areas may offer more preferable conditions than the surrounding wildland, resulting in higher use than expected.
- Little is known about bat distribution in arid urban environments.

## RESEARCH OBJECTIVES

The overall objective of our study is to understand the effect of urbanization on bat distribution across the gradient of urbanization in a single season and in an arid region. Specifically, we will:

- Evaluate the distribution of bat species within the urban avoider, urban adapter, urban exploiter framework
- Evaluate the relative abundance of Arizona bat species

We predict that across a gradient of urbanization, relative abundance will decrease for urban avoider bats, increase for urban exploiter bats, and peak at moderate levels of urbanization for urban adapter bats.

## METHODS

- Bats were sorted into categories based on morphological traits and results of other scientific research (Table 1).

Table 1. Predicted categories of 4 Arizona bat species.

Code	Scientific Name	Common Name	Category
PAHE	<i>Parastrellus hesperus</i>	Canyon bat	Urban Avoider
TABR	<i>Tadarida brasiliensis</i>	Mexican free-tailed bat	Urban Exploiter
MYCA	<i>Myotis californicus</i>	California myotis	Urban Avoider
MYYU	<i>Myotis yumanensis</i>	Yuma myotis	Urban Adapter

- We collected data with a stationary acoustic bat monitor and microphone (Fig. 3) for 5 consecutive nights at 50 sampling locations across the Phoenix metropolitan area (Fig. 4).

Fig 3. Wildlife Acoustics' SM4BAT-FS acoustic monitor and SMM-U2 microphone used to record bat echolocation calls.

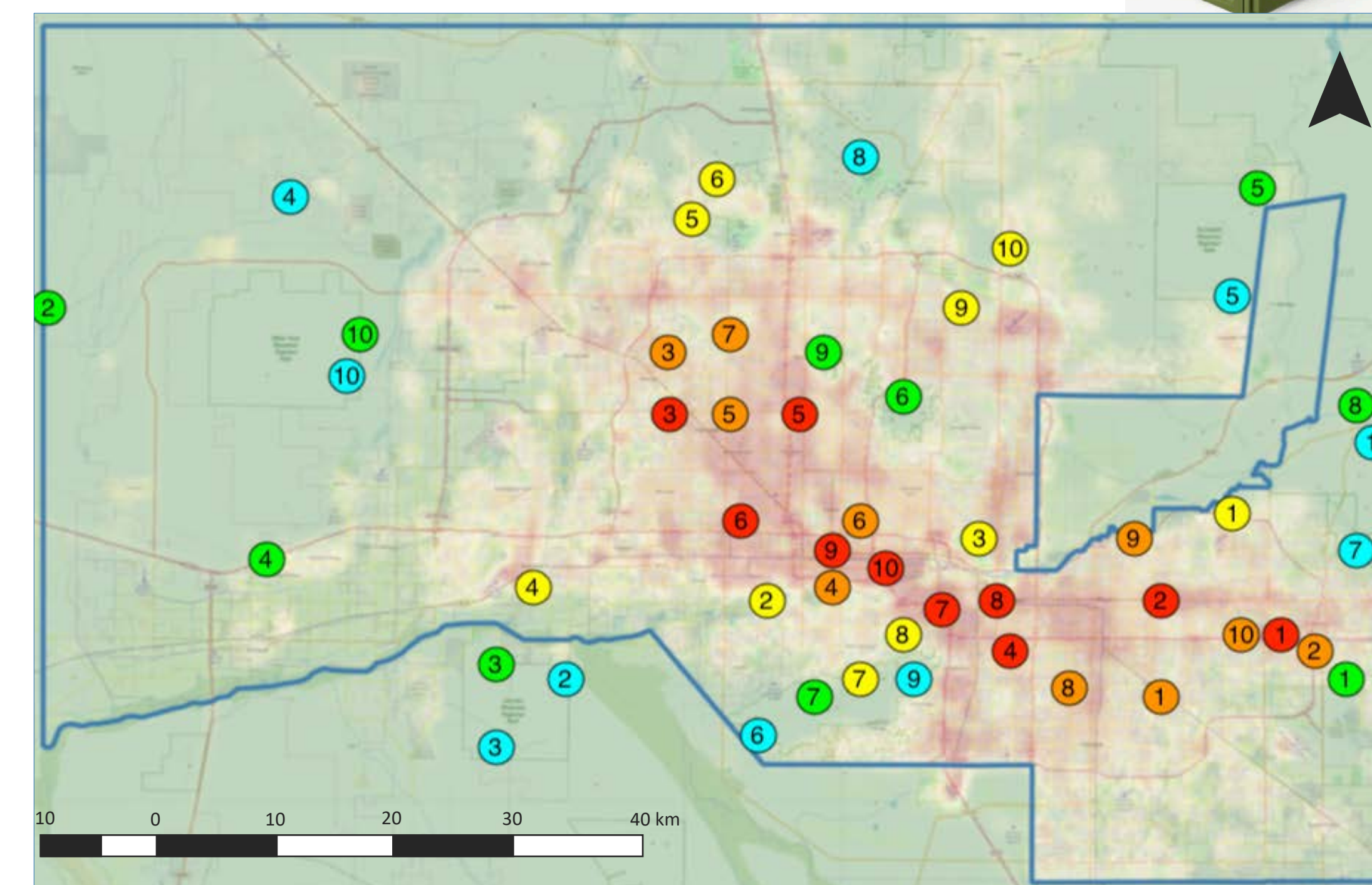


Fig 4. Fifty sampling locations along a gradient of urban intensity across the Phoenix metropolitan area within the CAP LTER boundary. Points are color-coded by percent urbanization, from wildland areas (blue) to highly urban areas (red).

- Monitors were deployed in all four seasons of 2019. Data for this poster is from the summer season, July and August of 2019.
- 8-9 monitors were deployed for a week at a time, rotating until all 50 sites were sampled.
- Relative abundance of bats was evaluated using single-species, single-season Royle-Nichols occupancy modeling.
- Optimal scale of urbanization chosen using AIC model selection.

## RESULTS

- A total of 16 species were detected. The relative abundance of 4 bats were evaluated (Table 1).
- The relative abundance of PAHE (Table 1) was highest in wildland areas (Fig. 5). In contrast, the relative abundance of TABR (Table 1) was highest in highly urban areas (Fig. 6).
- The relative abundance of MYCA and MYYU (Table 1) were highest in moderately urban areas (Fig. 7 & Fig. 8).

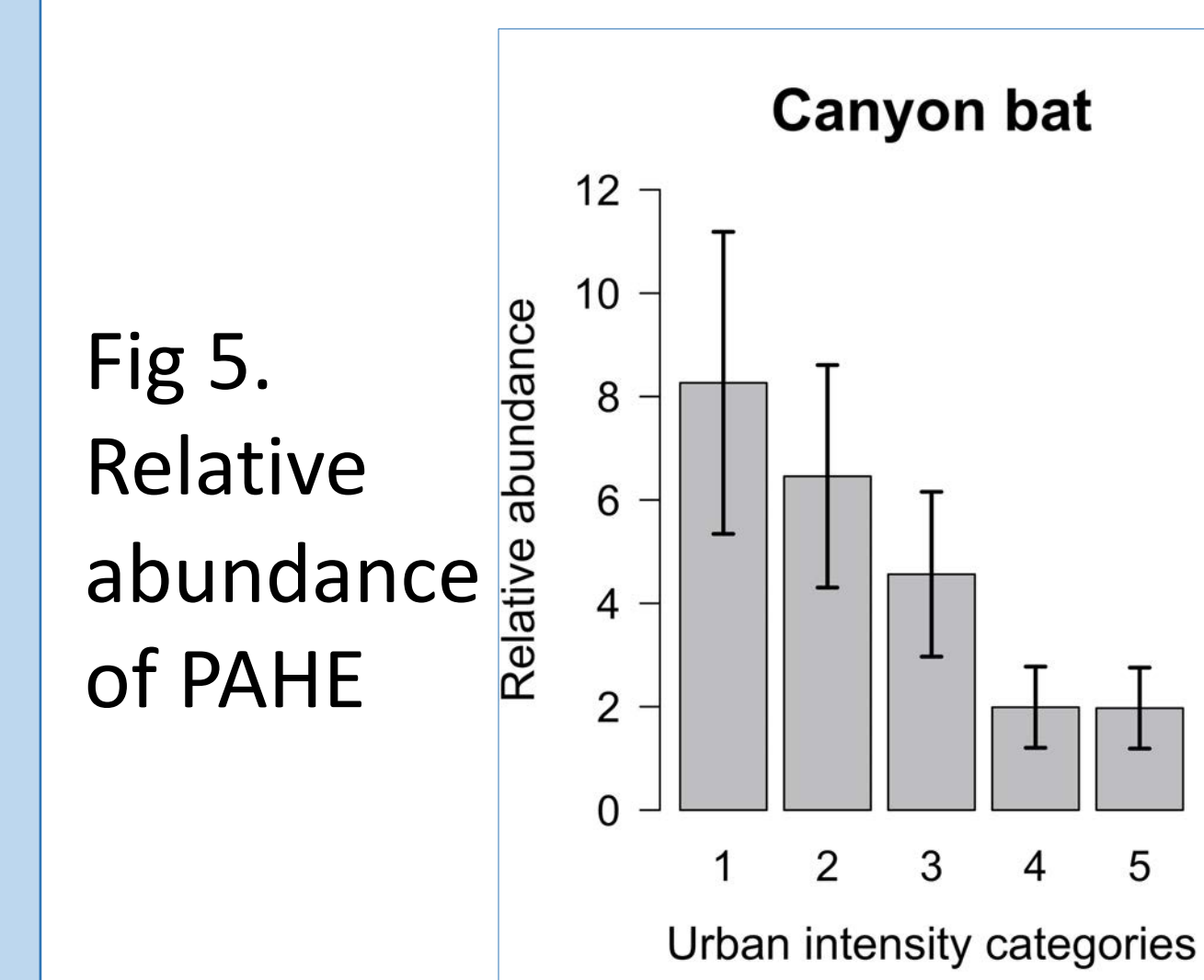


Fig 5. Relative abundance of PAHE

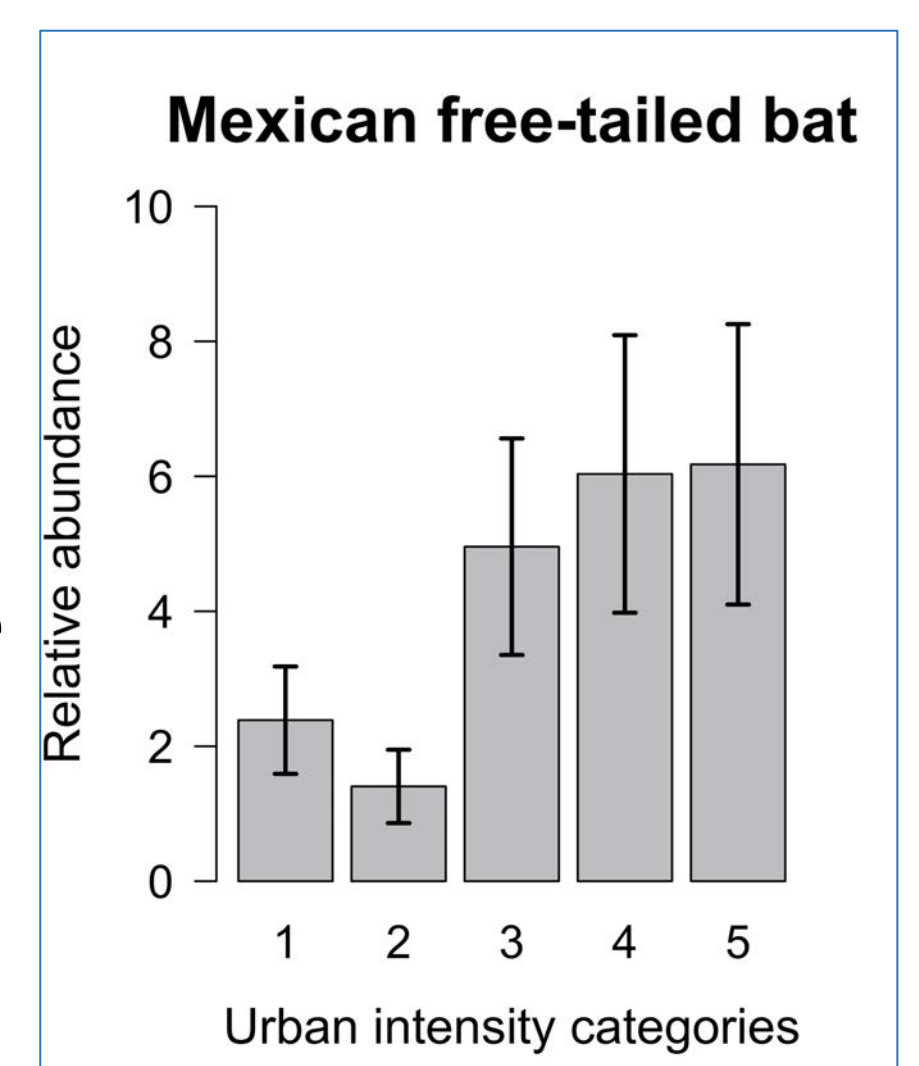


Fig 6. Relative abundance of TABR

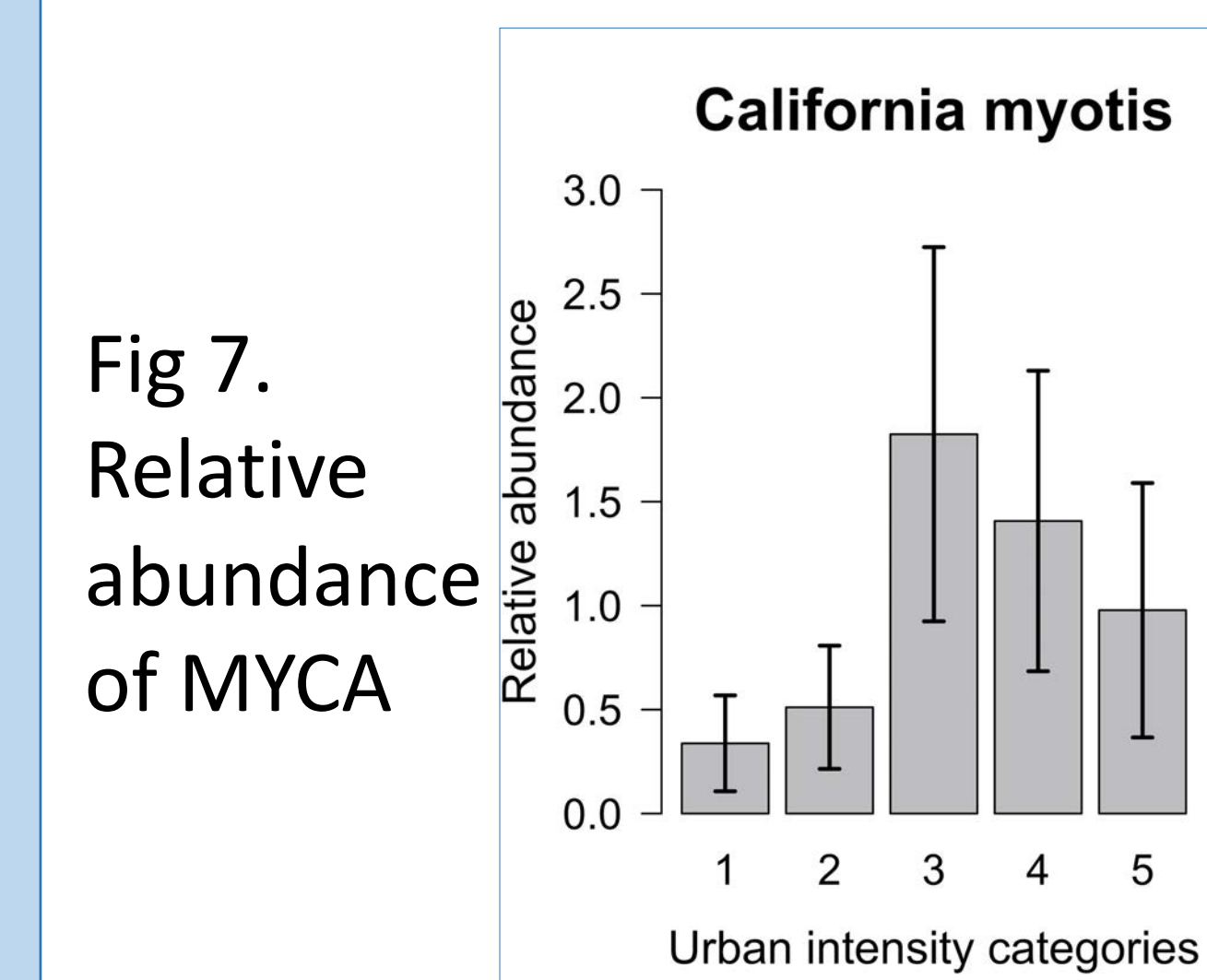


Fig 7. Relative abundance of MYCA

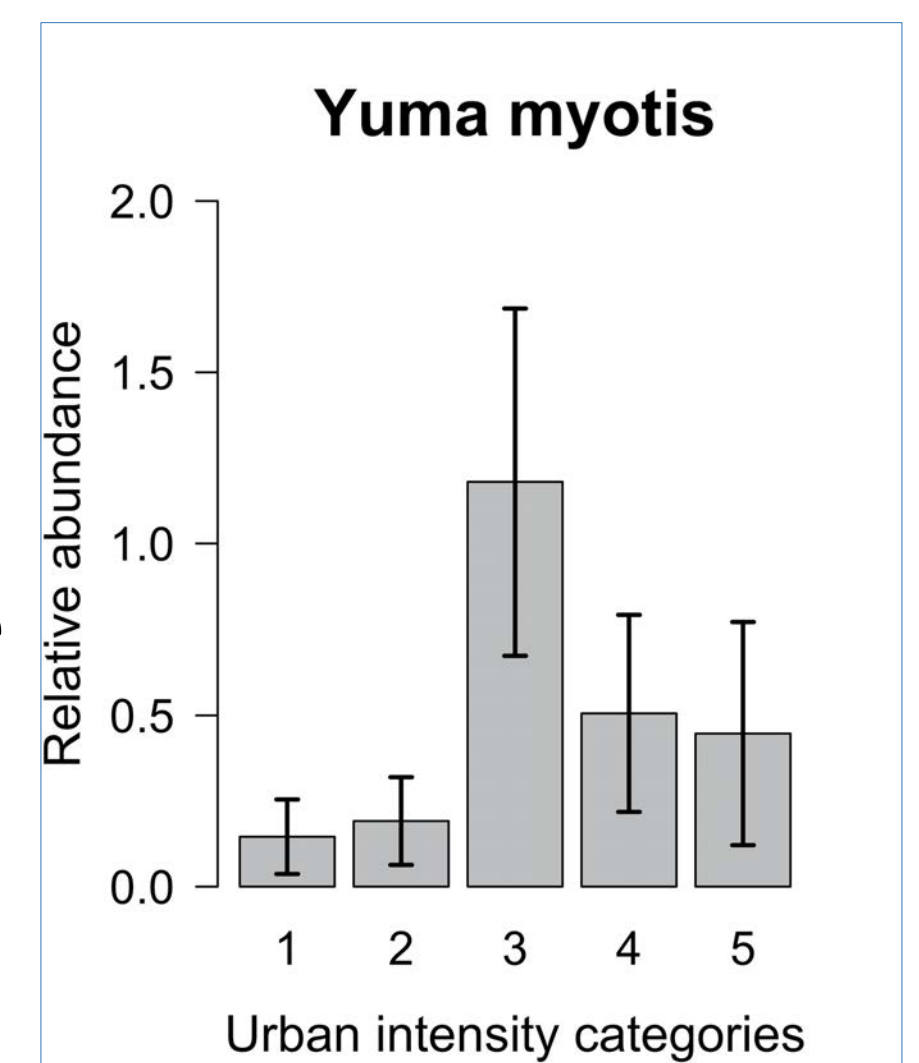


Fig 8. Relative abundance of MYYU

## DISCUSSION

- Our results suggest that PAHE, urban avoider, should be closely monitored as urbanization expands across the Valley.
- TABR dominated urban areas, with high relative abundance in areas with moderate and high levels of urbanization.
- MYCA, urban adapter, had a higher abundance in moderate levels of urbanization than expected. This species could be using urban areas in the summer to obtain limited resources, such as water.
- This fundamental information on bat distribution adds to the continued effort of CAP LTER to understand our desert ecosystem.
- The next steps for this project are to evaluate species richness in the summer season, and changes in distribution across seasons.

## Acknowledgments: