

Are all available water sources in an urban environment accessible to local bats?

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Introduction

- ❖ **Bats provide many ecosystem services**, including pest control, pollination, and seed dissemination, which are economically beneficial to humans (Ramirez-Franciel et al. 2021).
- ❖ However, as human populations continue to grow, leading to the increasing loss, degradation, and fragmentation of natural habitats to urban sprawl, wildlife species including **bats are having to adapt to this unnatural environment** (Gehrt & Chelsvig 2008).
- ❖ **One important resource is water.** In natural landscapes, bats drink from ponds, lakes, streams, rivers, and even puddles, but in human-modified areas, studies have shown that bats can drink from drainage ditches, cattle troughs, and residential swimming pools (Nystrom & Bennett 2019).



Figure 1: Research team in the field.



Figure 2: Bat drinking from a water source.

- ❖ However, it is generally assumed that these resources are not preferred and, if present, more semi-natural water sources, such as retention and ornamental ponds, would be preferentially used. But what if we are incorrectly assuming that all semi-natural water sources are readily accessible and available to bats?
- ❖ To explore this uncertainty, we conducted behavioral observation surveys using thermal cameras and acoustic detectors to determine whether semi-natural water sources within Fort Worth, including the retention pond on the Texas Christian University (TCU) campus, were suitable for bats.

Results

We conducted surveys at the retention ponds on **30 nights** from September 16 to November 9, 2020 just at Frat Pond (n = 15) and from March 23 to September 20, 2021 at both Foster and Frat Ponds (n = 15).

- ❖ A total of **345 drinking events** were recorded at the Foster Park retention pond.
- ❖ A total of **14 drinking events** were recorded at Frat Pond.
- ❖ We determined that drinking activity to be significantly different between the ponds (Fig. 7; $t = 3.941$; $df = 14$; $p < 0.001$).

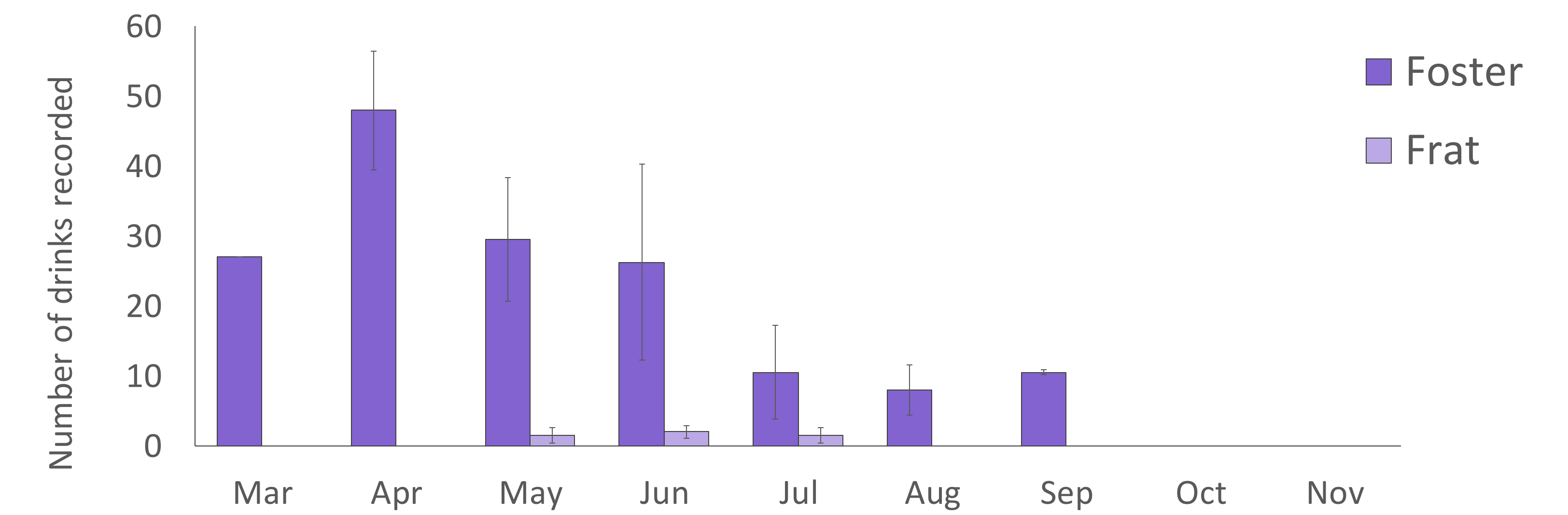


Figure 7: Average number of bats observed drinking from our two pond sites each month in Fort Worth, TX. Error bars show \pm standard error of the monthly mean.

- ❖ We noted that bats were only recorded drinking when the flood lights from the soccer field were turned off.

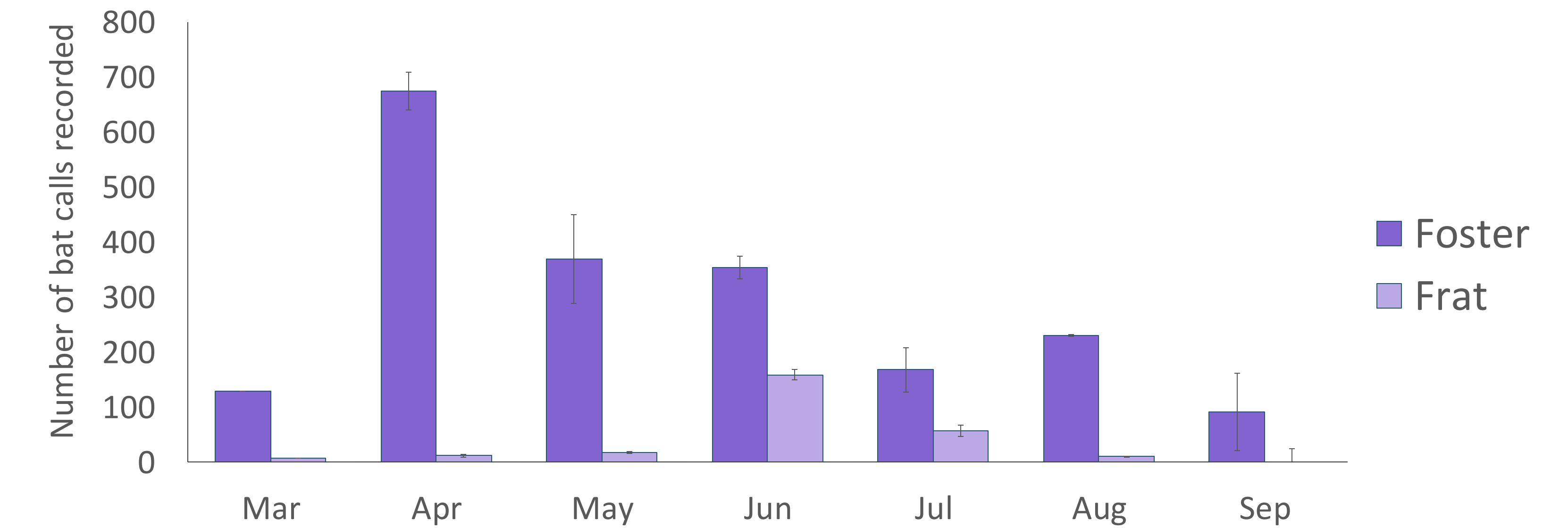


Figure 8: Average number of bat call detected at our two pond sites each month in Fort Worth, TX. Error bars show \pm standard error of the monthly mean.

- ❖ A total of **2234 acoustic calls** were recorded at the Foster Park retention pond.
- ❖ A total of **354 acoustic calls** were recorded at Frat Pond.
- ❖ We determined that acoustic activity to be significantly different between the ponds (Fig. 8; $t = 4.330$; $df = 14$; $p < 0.001$).

- ❖ **All 6 local species** were detected at the Foster Park retention pond.

- ❖ **Only the evening bat** was recorded at Frat Pond (Fig. 9).

- ❖ Note that all 6 local species have been recorded in acoustic monitoring conducted <450 m from the Frat Pond from 2015 to 2020 (Fig. 10) demonstrating the **area is suitable for bats.**

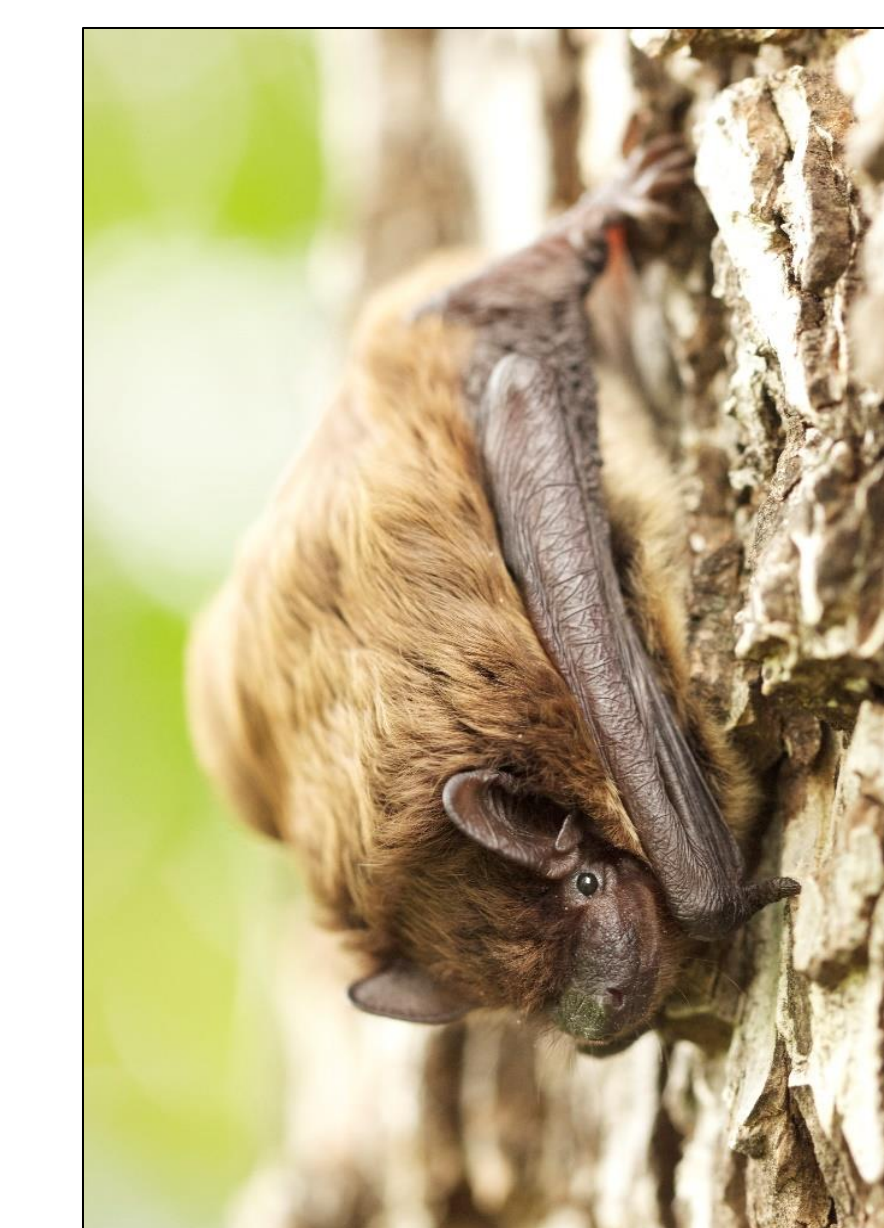


Figure 9: The evening bat (*Nycticeius humeralis*).

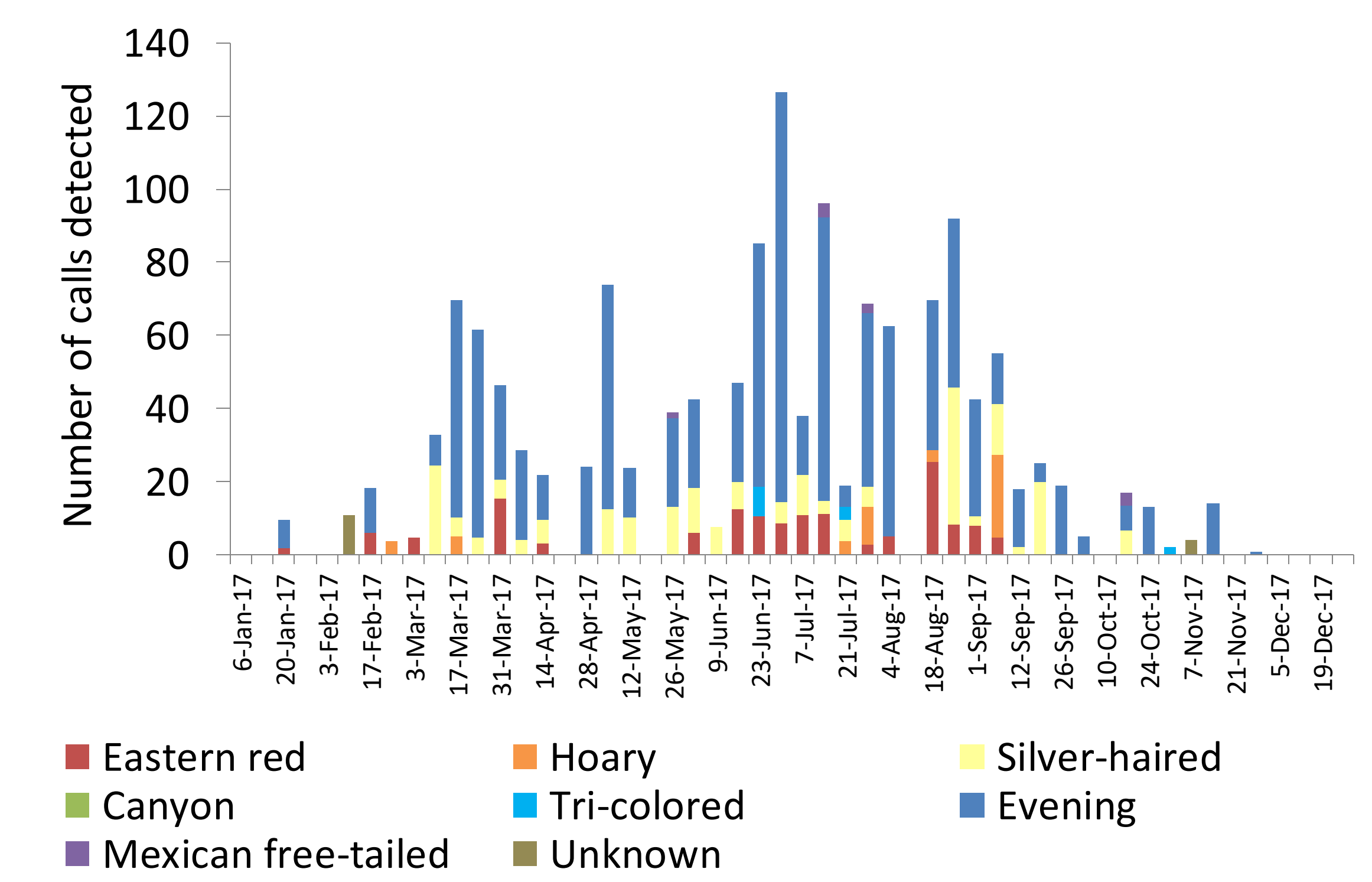


Figure 10: Average number of acoustic calls recorded for each species per survey in 2017 in the neighborhood next to Frat Pond.

Methods

Study Sites

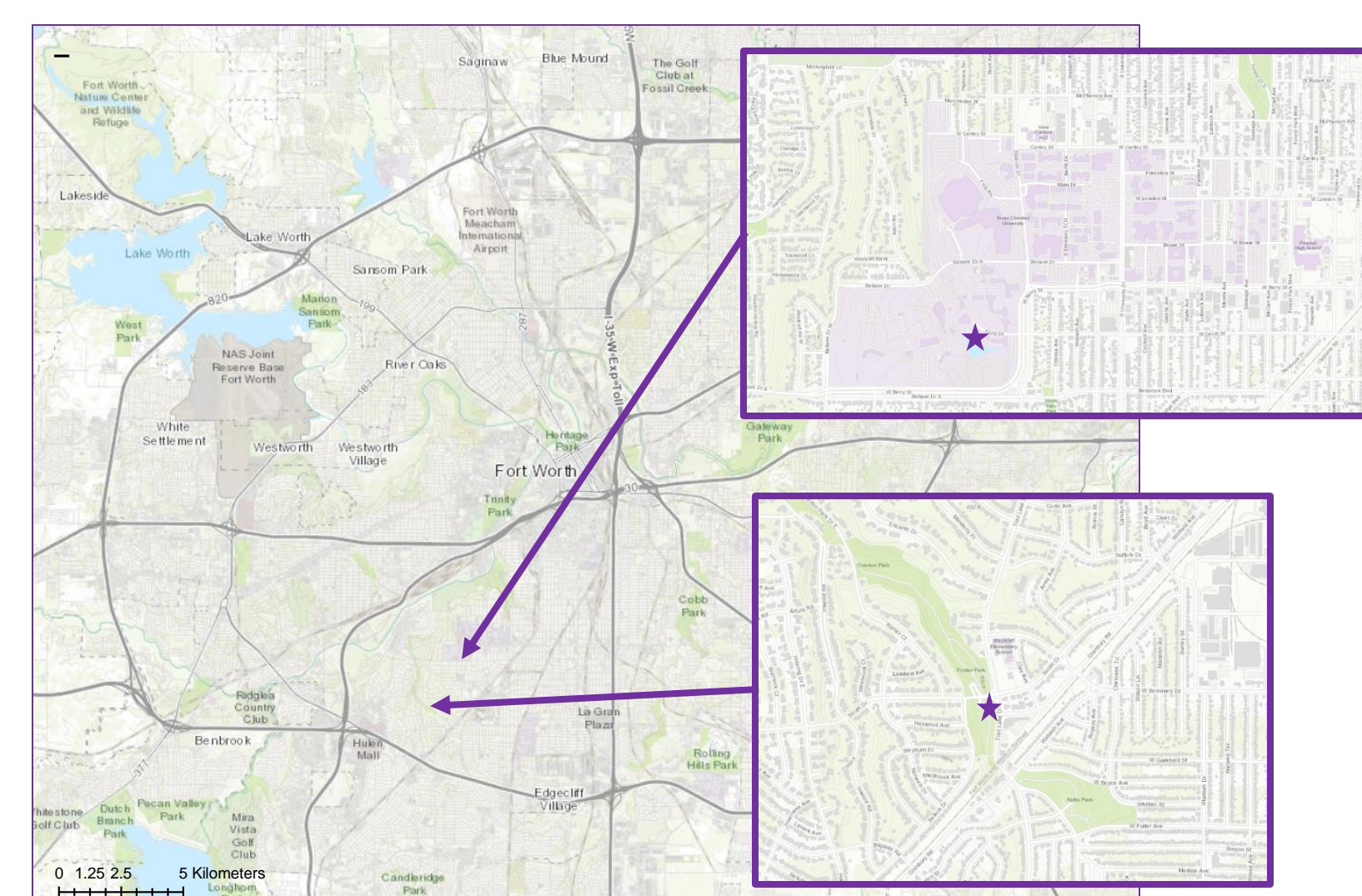
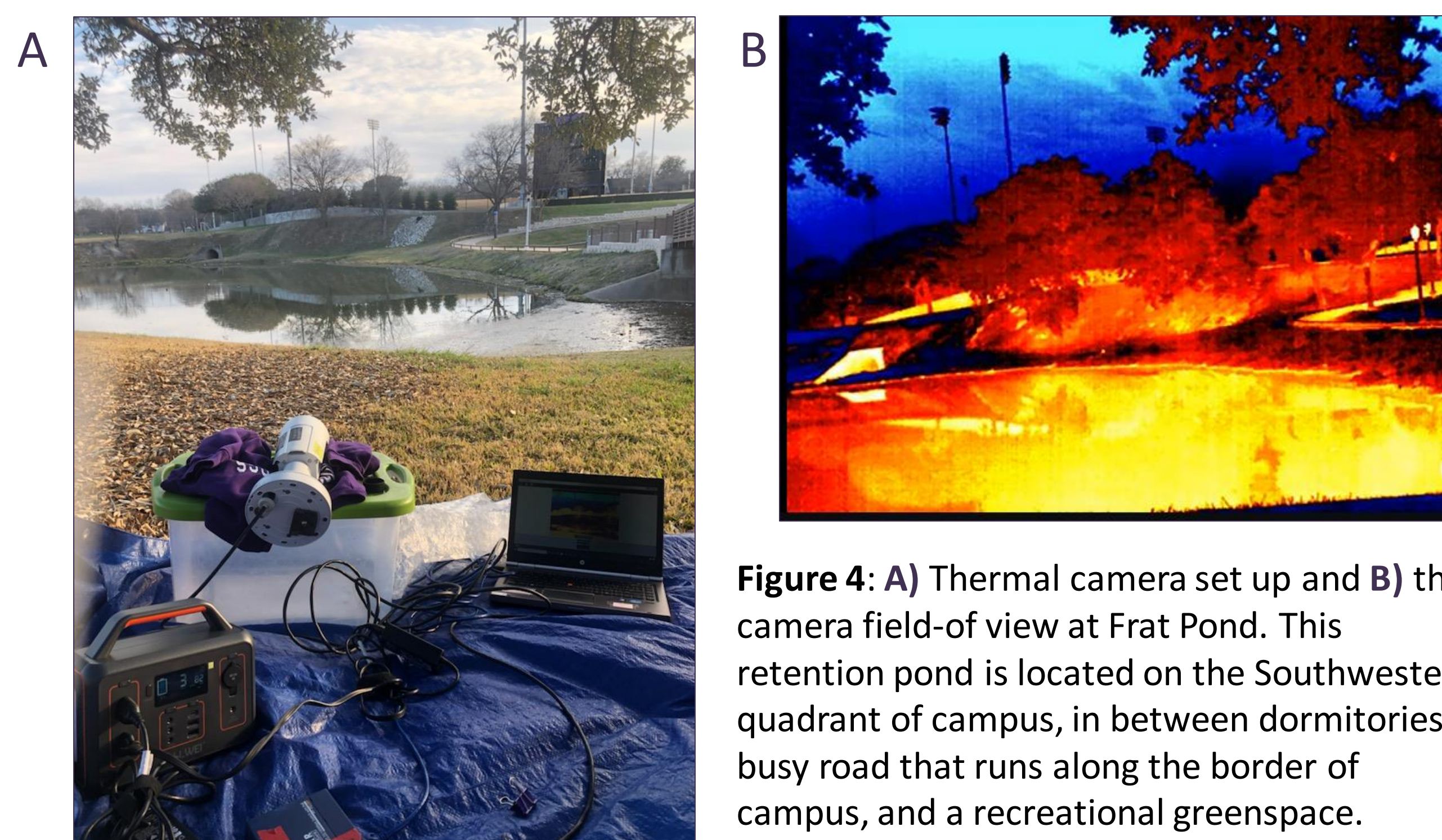


Figure 3: Frat Pond and Foster Park Pond are water sources available for bats in Fort Worth, Texas (32°42'12"N 97°22'02"W) and (32°41'02.9"N 97°22'26.6"W) respectively.

- ❖ In 2021, we conducted behavioral surveys and acoustic monitoring at two ponds in urban neighborhoods in Fort Worth (Fig. 3).

- ❖ The areas surrounding both ponds have all 6 local bat species recorded and actively flying in the area throughout March to September.



Behavioral Surveys and Acoustic Monitoring

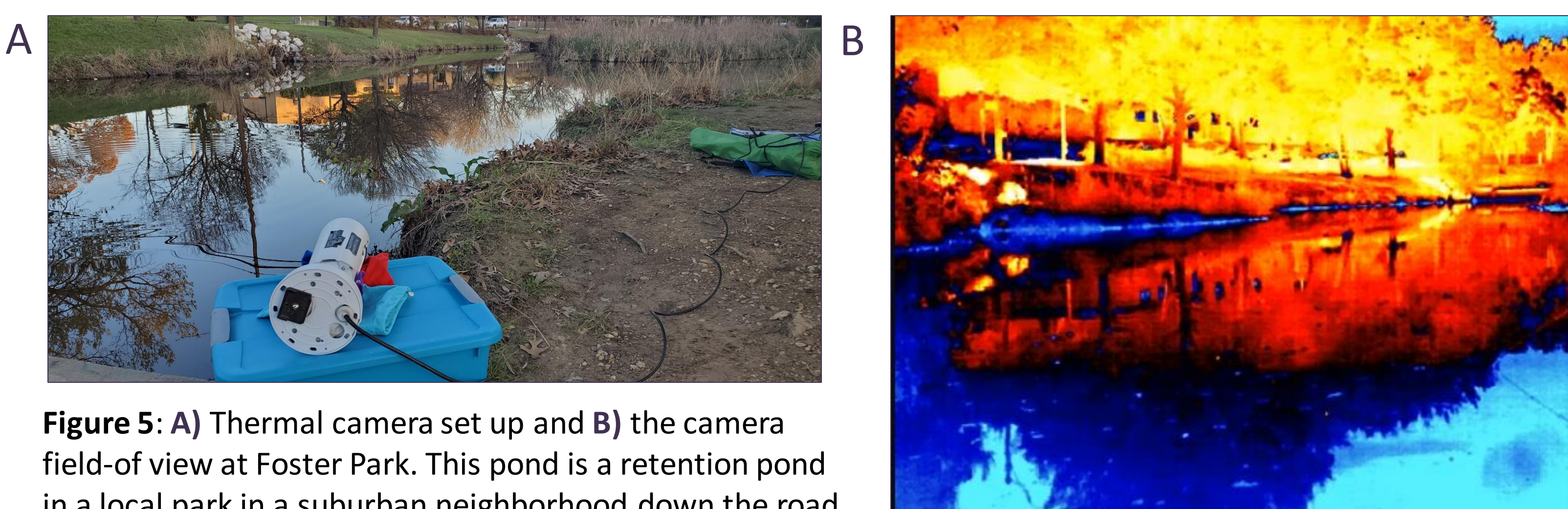
- ❖ We conducted behavioral observation surveys from September to November 2020 and from March to September 2021.

- ❖ At the start of each survey, we recorded cloud cover, wind direction, average wind speed (kmph), wind gusts (kmph), temperature (°C), humidity, dewpoint (°C), pressure (mb), moon phase, moon visibility, and moon illumination.

- ❖ We used thermal camera technology to record bats drinking at the ponds for 1 hour after dusk.

- ❖ We positioned the thermal camera about 10 meters away from the edge of each pond (Figs. 4 and 5).

- ❖ In addition, we used ultrasonic bat detectors to record any echolocation calls emitted by bats. We placed this setup in close proximity to the pond with the microphone angled toward the surface of the water.



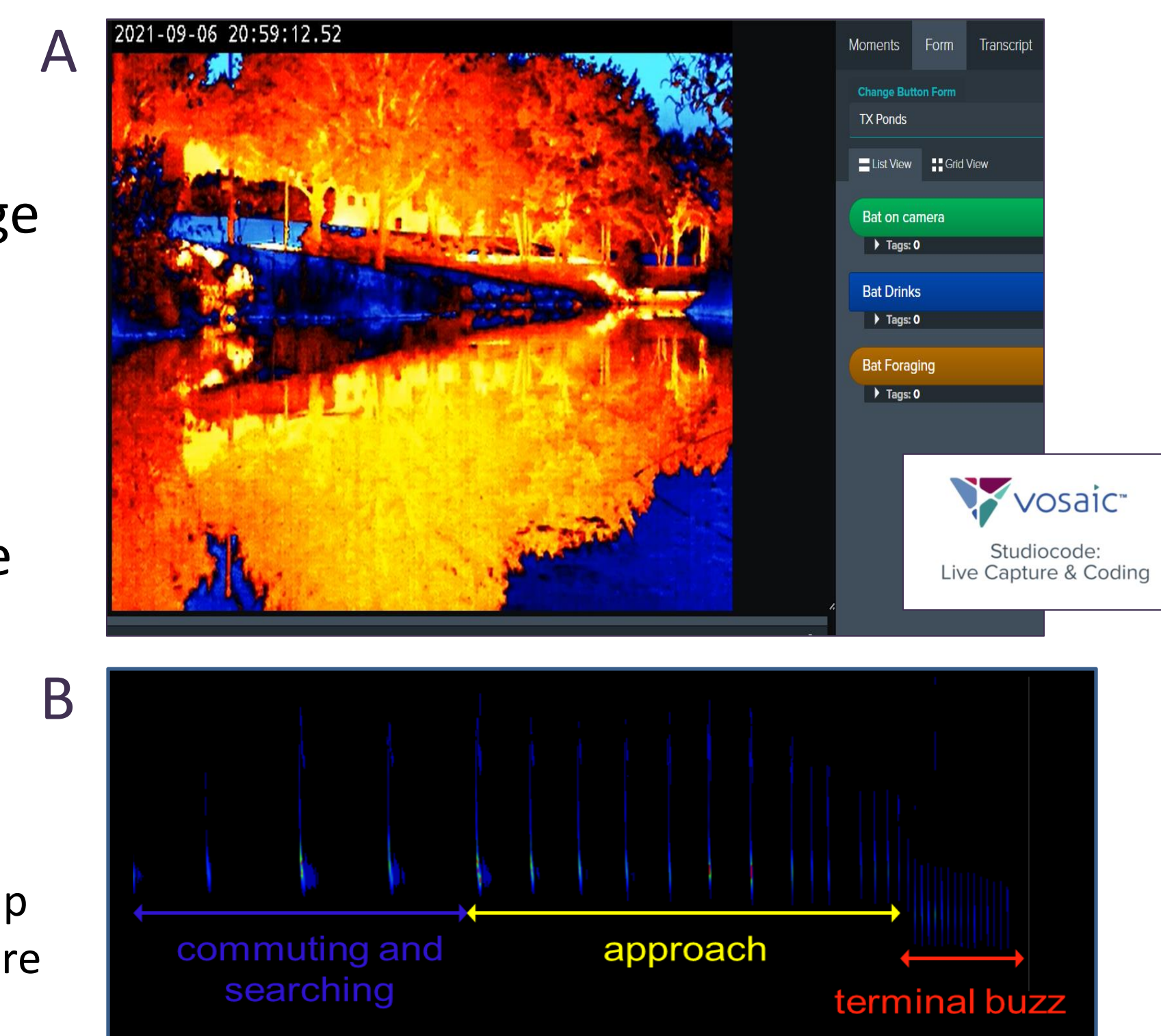
Data Processing and Analysis

- ❖ We processed all video-recorded footage using Vosaic software (v 5; Fig. 6).

- ❖ We identified bats flying in the field of view and bats drinking from the ponds.

- ❖ We used Sonobat Call Analysis Software (v 3.04) to identify any calls to species and confirm drinking through the presence of specific terminal buzzes.

Figure 6: A) Image of Vosaic software and mark up buttons and B) bat echolocation calls and structure as seen on Sonobat Call Analysis Software.



Conclusions

- ❖ Our results confirmed that **not all water sources are readily accessible and available** to bats.
- ❖ The presence of artificial **lights deterred bats.**
- ❖ In particular, we found that only when flood lights from the TCU soccer field were **turned off**, bat activity was recorded at the TCU retention pond.
- ❖ These results suggest that by **turning lights off** when they are not needed could effectively **improve water availability for bats.**
- ❖ It is findings such as these that can inform the enrichment of urban environments for bats and, therefore, **aid their conservation.**

Acknowledgments

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