The use of swimming pools by bats in a game reserve in South Africa

James E. McGee (j.e.mcgee@tcu.edu) and Victoria J. Bennett (v.bennett@tcu.edu)

Department of Environmental Sciences, Texas Christian University, Fort Worth, TX, USA

Introduction

- It is generally acknowledged that natural habitats tend to represent resource rich areas, with semi-natural habitats, in comparison, providing inferior and/or limited resource opportunities (Cassel et al. 2019).
- Currently, the use of anthropogenic resources by wildlife in natural and semi-natural habitats is largely unknown and to date, we have found few studies that suggest that anthropogenic features could improve or enhance such areas for wildlife (Newton et al. 2017; Switalski & Bateman 2017).
- Where species or communities of conservation concern are involved, any improvements to their habitats, whether it be natural or non-natural, could be of benefit to their persistence and/or recovery.
- We, therefore, conducted a study to explore the importance of artificial water sources for wildlife in a semi-natural habitat. More specifically**, we explored the use of swimming pools by bats in a game reserve in South Africa.**
- This study was accomplished by conducting acoustic and behavioral observations surveys to determine bat activity and behavior over swimming pools.

Materials and Methods

Survey Period: 19 July 2018 – 13 June 2021.

Study Area: Amakhala Game Reserve in the Eastern Cape of South Africa (33° 32′ 22.48″ S, 26° 05′ 15.26″ E; Fig 1).

- This 66 km^2 area is a joint conservation venture started in 1999 and consists of 10 privately owned lodges.
- Natural and semi-natural water sources include the Bushman's River and several watering holes throughout the reserve.
- Artificial water sources include 9 swimming pools.

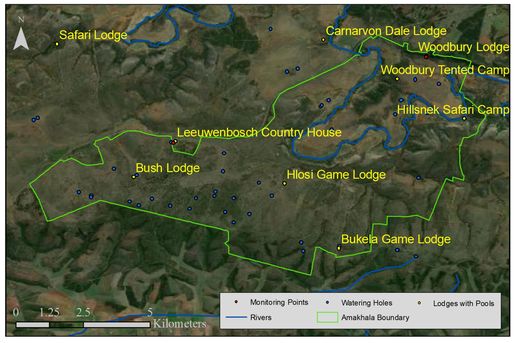

Figure 1: Amakhala Game Reserve in the Eastern Cape of South Africa.

Study Sites:

- Of the 9 lodges with swimming pools, we chose Leeuwenbosch Country House (Fig. 2) and Woodbury Lodge (Fig. 3) to conduct acoustic monitoring.

Figure 2: Swimming pool at Leeuwenbosch Country House.

Figure 3: Swimming pool at Woodbury lodge.

Acoustic monitoring:

- Song Meter SM4BAT detectors (from Wildlife Acoustics) were deployed next to the **swimming pools** at study sites with external U2 ultrasonic microphones angled towards the pools (Fig. 4).

Figure 4: SM4BAT detector at Leeuwenbosch Country House swimming pool.

- We manually identified 3 acoustically distinct activities in the calls recorded: 1) foraging, 2) feeding buzzes, and 3) drinking buzzes (Kophler et al. 2019).
- We then used both Kaleidoscope, Sonobat call analysis software, Monadjem et al. 2020, and other reference sources to identify species.

Behavioral Observation:

- Thermal camera technology and an EchoMeter Touch were used to observe bat activity at Leeuwenbosch Country House swimming pool in from 8 June 2021 to 13 June 2021 (Fig. 5).

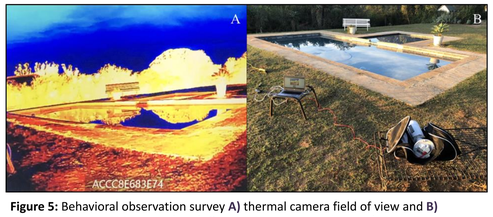

Figure 5: Behavioral observation survey **A)** thermal camera field of view and **B)** equipment set up at Leeuwenbosch Country House swimming pool.

Results

- ~125,000 bat calls recorded (~114,000 at Leeuwenbosch Country House and ~11,000 at Woodbury Lodge).
- During behavioral observations, we found a significant decrease in the number of instances where bats were both observed and acoustically recorded compared to the number of instances bats were observed only (Fig. 6; t=4.009, df=45, P<0.001).

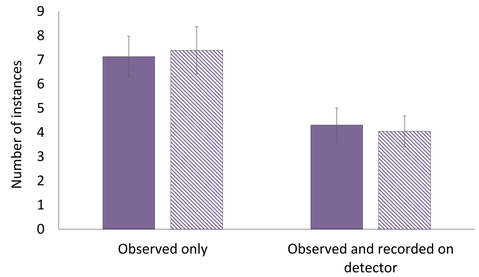

Figure 6. Average number of instances where bats were both observed actively flying in the field of view and acoustically recorded on the SM4BAT FS (solid bar) and Echo Meter Touch (striped bar) bat detectors with the average number of instances bats were observed only. Error bars show ± standard error of the mean for 15 min intervals.

- Overall, we identified 7 species using both swimming pools as a resource during our acoustic surveys and a significant difference in in pool use by species (Fig. 7; F=37.088, df = 6, p<0.001).

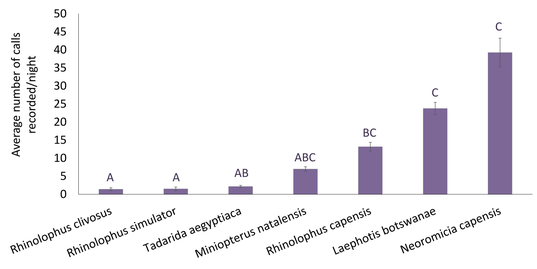

Figure 7. Average number of feeding and drinking buzzes recorded for each species at both study sites. Error bars show ± standard error of the mean for 15 min intervals. Letters indicate significant differences as shown in the posthoc Tukey test.

- We found there to be a significant difference in the hourly use of the swimming pools by species (Fig. 8; F=3.437, df = 49, p<0.001).

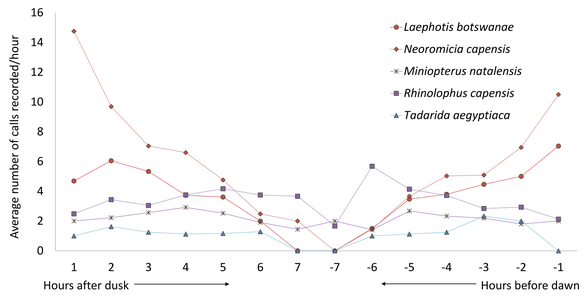

Figure 8: Average number of feeding and drinking buzzes for each hour from dusk until dawn by species, including *Rhinolophus* spp. Letters indicate significant differences as shown in the posthoc Tukey test.

- We also found a significant difference between seasonal use of the swimming pools by species (Fig. 9; F=7.915, df=12, p<0.001).

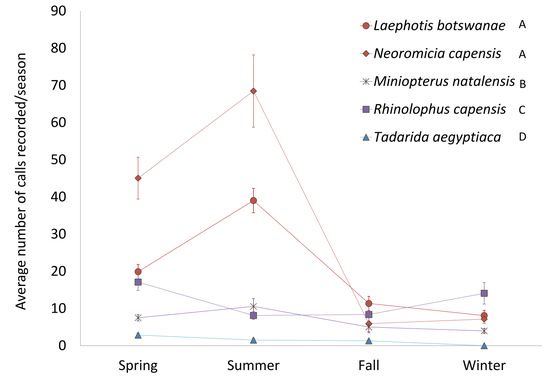

Figure 9: Average number of feeding and drinking buzzes for each season by species. Error bars show ± standard error of the nightly mean. Letters indicate significant differences as shown in the posthoc Tukey test.

Conclusions

- **Bats are using swimming pools** in a semi-natural habitat as a resource.
- Behavioral observations indicated **we are underestimating pool use** by up to 60%.
- The presence of foraging and feeding buzzes indicate that the **swimming pools were used as a foraging resource** by at least 7 bat species.
- The presence of drinking buzzes indicates that **pools were used as drinking resource** by at least 4 bat species.
- Our results suggest that anthropogenic features could **increase water availability** for bats in semi-natural habitats.
- Ensuring that swimming pools are accessible to bats could, therefore, enhance game reserves, such as Amakhala, for bats and **aid their conservation**.

Acknowledgements

Thank you to the Department of Environmental Sciences and the College of Science and Engineering at TCU for providing funds to support this project.

Special thanks to Amakhala Game Reserve, including Steve Maartens, Lisa Graham, the Fowlds Family, and Natalie Fowler.

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