# Honey Bee Behavior During Annular and Total Eclipses in Texas

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## Abstract

Eclipses are known to have significant impacts on animal behavior, but research on the subject is extremely limited. Understanding how honey bees navigate during eclipses can provide valuable insights into their sensory and navigation capabilities and how they respond to changes in their environment.

An annular eclipse and a total solar eclipse occurring in the same location in a span of months presents a unique opportunity to study the effects of dramatic changes in light on honey bees. Due to the rarity of a solar eclipse, the foraging behavior of honey bees and their hive activity remains relatively unexplored.

Using acoustic recorders, our research team set out to capture differences in honey bee behavior during sudden changes in light intensity provoked by annular and solar eclipses. These findings shed light on the intricate relationship between honey bees and their environment.

Our study revealed that bee hives did not return to night-time levels of activity during either eclipse, with all hives experiencing a pulse in activity during the ~4 minute period of totality in the total eclipse, possibly corresponding to foragers returning from the hive, while no consistent pattern was observed in bee activity during the annular eclipse.

## Introduction

Honey bees play a vital role in pollination, contributing to the sustainability of ecosystems and agricultural productivity [1].

One of the most intriguing aspects of honey bees is their unfaltering methods of navigation and communication. Honey bees, like humans, use circadian rhythm for almost all physiological processes. Circadian rhythmicity affects nearly every aspect of animal and human life, from the cellular level up to behaviour [2].

Past studies have performed acoustic monitoring of bee flight buzzes during eclipses, and the data collected has indicated overall cessation of flight activity during totality [3].

By examining how bees respond to a change in sudden light intensity, we hope to gain insight on the connection between bees and their environmental cues.

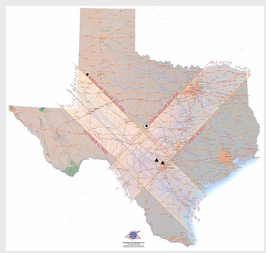
*Figure 1. Images of two campus hives.*

## Purpose

**Hypothesis: If bees are most active during the daytime, immediately following dawn, then the sound pressure level in decibels (SPL, dB) recorded during those periods will be significantly higher compared to what is expected during totality of an eclipse.**

We presume bees will increase in activity just before the eclipse, with a halt during annularity/totality. We aim to find how the annular and total eclipse impacts bee activity at the hive. During a total eclipse, we expect bees will exhibit an activity level that is more reflective of a nighttime behavioral profile.

## Methods



**Study Locations:**

1. University of Texas San Antonio campus (3 hives)
2. Deer Valley, Texas (1 hive, #6)

*Figure 2. Locations of hives with respect to the paths of the 2023 annular eclipse and 2024 total eclipse.*

**Sound Analysis:**
Hives equipped with acoustic recording devices (Song Meter Micro, Wildlife Acoustics) to capture decibel levels. The bioacoustics software Kaleidoscope (Wildlife Acoustics) was used to create time series of average sound pressure level (SPL) for bee noise. Bee noise was identified in frequencies lower than 2000 Hz and averaged across 1 minute sample periods the day before, during, and the day after the eclipse. Video cameras were placed on hive entrances to provide context

## Results

- Buzz captured from hives ranged from 15-43 dB, with most bee sound occurring below 500 Hz (range 50-2000 Hz).

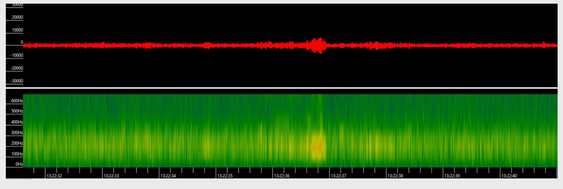


*Figure 3. Example Oscillogram (top) and Spectogram (bottom) recorded from Campus Hive . An Oscillogram reflects amplitude over time (loudness of a sound).A Spectogram provides a view of both amplitude and frequency over time.*

## Results - con't

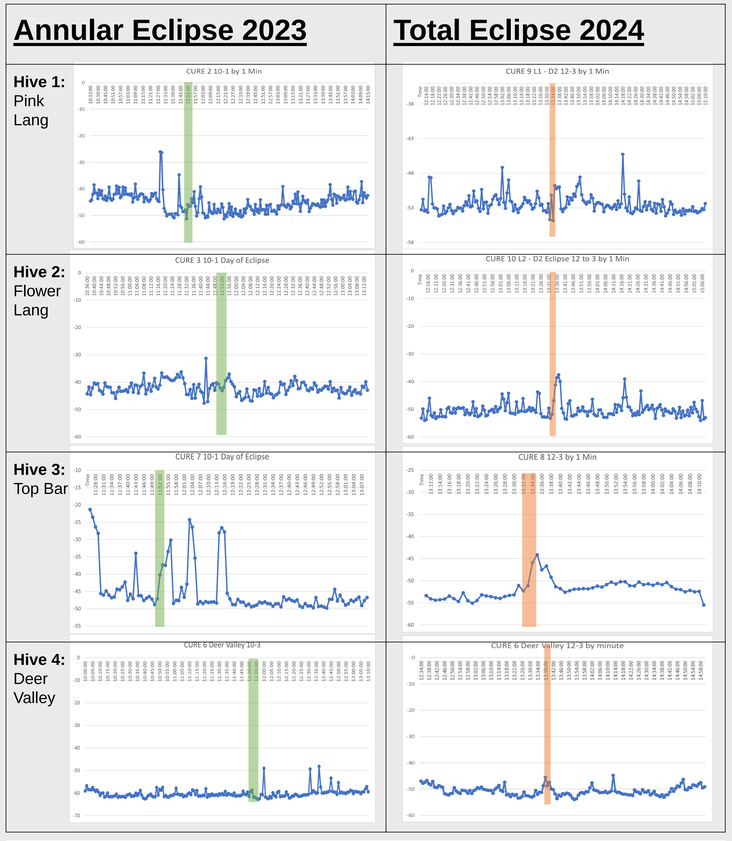



*Figure 4. Sound pressure levels (SPL) near entrance of hive from 10am to 1pm at UTSA (Hives 1-3) and in Deer Valley, Texas. Green indicates period of totality for annular eclipse. Orange indicates period of totality for total eclipse. SPL closer to 0 indicates louder sounds.*

## Conclusions

- Bee hives did not return to night-time levels of activity during either eclipse
- **Total Eclipse:** All bee hives experienced a pulse in activity during the ~4 minute period of totality—possibly corresponding to foragers returning from the hive.
- **Annular Eclipse:** No consistent pattern was observed in bee activity during the annular eclipse.
- Understanding how eclipses affect their behavior and activity ensures the continued pollination of crops and the stability of food production.
- By identifying the specific effects of solar eclipses on bees, conservationists and beekeepers can take appropriate measures to lessen any potential negative effects and ensure the well-being of bee colonies

## Acknowledgements

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## References

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