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RESEARCH NOTE

SOLAR ECLIPSE HAS LITTLE DISCERNIBLE EFFECT ON BAT ACTIVITY

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Anecdotal accounts of observations made during solar eclipses suggest that animals exhibit atypical activity during and following an eclipse (Fazekas 2017). This aberrant behavior is expected because the rarity of a solar eclipse ensures that most animals never experience this novel event, therefore it evokes novel behaviors. Unfortunately, few data concerning the activity patterns of bats surrounding an eclipse are available to infer the influence an eclipse has on bat activity. In fact, the paucity of research conducted during solar eclipses hampers our understanding of how solar eclipses influence behavior of any mammalian group. Despite this dearth of data, many mammals use light intensity as an exogenous cue that influences behaviors, so effects of a solar eclipse are plausible. Bats, in particular, are one mammalian group likely to exhibit some type of behavioral response to an eclipse because of their exceptional sensitivity to light. For instance, the timing of roost emergence in bats is due in part to light intensity, and many species emerge earlier when cloud cover or habitat conditions limit light intensity at twilight (Russo et al. 2007). During a solar eclipse, roosting bats may perceive the decreasing light as twilight and increase their activity as they typically do prior to emergence (Winchell and Kunz 1996; Codd et al. 2003). Observations made by Sanchez et al. (1999) support the possibility that bats may misconstrue a solar eclipse as night as they observed bats flying and foraging during an extended diurnal eclipse in Mexico. However, observations made by Sanchez et al. (1999) indicate species-specific responses to solar eclipses, and others have concluded that many mammals do not alter behavior in response to solar eclipses (Wheeler et al. 1935). Because of the general lack of data, and sometimes conflicting observations made by previous researchers, more research is warranted to better understand how and if these novel eclipse events produce novel bat behaviors.

A solar eclipse in northern Georgia during August 2017 presented us with the opportunity to assess the influence of a solar eclipse on bats in the southeastern United States. Our objective was to determine the influence of a solar eclipse on the nocturnal foraging activity of bats following the eclipse. Specifically, we wanted to determine if activity was appreciably different from normal during the night following the eclipse in relation to 1) bats' overall activity and 2) the temporal distribution of their activity during the night. We hypothesized that the solar eclipse, although likely not of sufficient duration or intensity to initiate daytime emergence and foraging, would result in an atypical concentration of activity at the beginning of the night and an overall increase in foraging activity which would compensate for the energetic costs of an assumed eclipse induced "false dusk".

We recorded bat calls at a single sample point in Flowery Branch, Georgia, using an Anabat SD2 detector (Titley Scientific, Brendale QLD, Australia). Our sample point experienced >99% eclipse totality with maximum coverage occurring at 14:37 on 21 August 2017 (G. Feiden, University of North Georgia, pers. comm.), but no bats were observed by the authors during the eclipse. Nightly recordings began the evening of the solar eclipse and continued through the night of 26 August 2017. All acoustic data were processed using BCID software (version 2.7d; Bat Call Identification, Inc., Kansas City, Missouri) to remove non-call files and identify calls to species using the default program settings. All files containing one or more call pulses were used to assess activity, whereas only files containing a minimum of five call pulses were used for identification. Call files were placed into hourly bins to determine the distribution of activity within each night. We calculated the average number of calls per night and per hour for all non-eclipse nights to define typical activity for comparison purposes.

We recorded 300 files containing at least one bat call, of which 159 files contained five or more call pulses, during the 21–26 August 2017 sample period. An average of 50 calls per night (range: 35–81) were recorded during the sample period. Activity was distributed throughout the night with an average of five call files per hour. Slightly more calls than average were recorded on the night following the eclipse than the average of the subsequent nights (55 versus 49), but the highest activity was recorded on 25 August (n = 81; Figure 1). Bat activity during the first hour of sampling on the night of the eclipse was marginally higher than normal, but activity was not distinctly concentrated at the beginning of the night, and was not appreciably higher than normal except during the 12 am bin (Figure 2). Activity during the 12 am hour was approximately five times greater than the average activity recorded during the same period on subsequent nights. The most commonly identified species was the silver-haired bat (*Lasionycteris noctivagans*), which accounted for 36% of the identified calls. Additional species identified at our sample point using the BCID software included the big-brown bat (*Eptesicus fuscus*; 23%), the tri-colored bat (*Perimyotis subflavus*; 11%), the red bat (*Lasiurus borealis*; 9%), the hoary bat (*Lasiurus cinereus*; 8%), the gray bat (*Myotis grisescens*; 4%), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*; 3%), the evening bat (*Nycticeius humeralis*; 2%), the little brown bat (*Myotis lucifugus*; 1%), and 4% of calls were classified as unknown. The identity and relative abundance of calls identified to species during the eclipse night did not differ from calls identified during the subsequent nights.

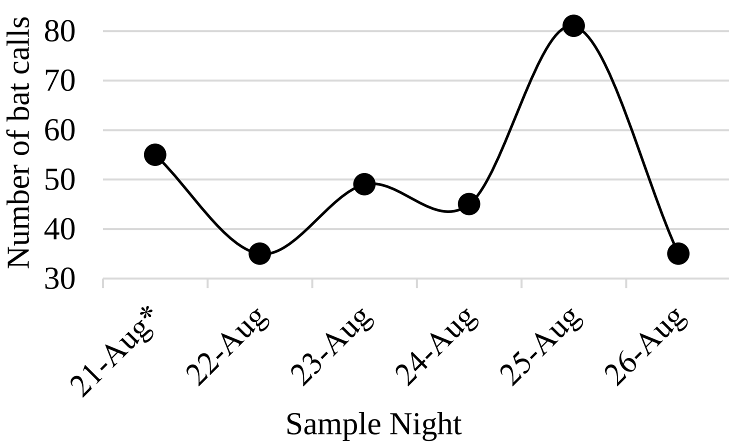

Figure 1. Number of bat calls recorded using an Anabat SD2 detector during the night following a solar eclipse (21 August 2017) and the five subsequent nights at a single sample point in Flowery Branch, Georgia. BCID software (version 2.7d) was used to automatically filter out all noncall files from the data using the default settings and all files containing one or more call pulse were included in totals. * = the night preceded by the solar eclipse with >99% totality.

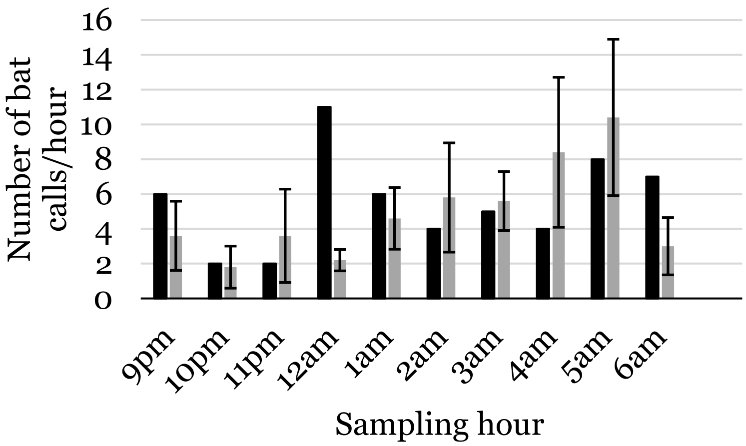

Figure 2. Number of bat calls recorded during each hourly bin using an Anabat SD2 detector during the night following a solar eclipse and averaged over the five subsequent nights at a single sample point in Flowery Branch, Georgia. Solid black bars = number of calls recorded during the night of the solar eclipse, gray bars = the average number recorded during the subsequent five nights. Error bars show 90% confidence intervals.

Although our data represent valuable additions to the dearth of information concerning the influence of solar eclipses on bat behavior, we were unable to establish any conclusive evidence that the solar eclipse influenced nocturnal foraging activity of bats. Our data did support our hypotheses of higher and earlier than normal activity following the eclipse. Unfortunately, the highly variable nature of nocturnal foraging activity (Hayes 1997) makes us hesitant to conclude that the solar eclipse had a definitive effect on the foraging activity of bats in Georgia. Multiple factors influence nightly activity and our experimental design did not allow us to isolate the effect of the eclipse independent of the potential influence of myriad confounding factors. Additionally, the timing of the eclipse may have mitigated the effects of the eclipse on behavior. If the eclipse happened during a different time of the year, the behavioral response might have been more pronounced and easier to attribute to the eclipse. For instance, if the eclipse occurred in the early spring, or during preparation for the maternity season when individuals are operating under a less forgiving energetic budget, the hypothesized earlier than normal and increased foraging activity may have been easier to detect and attribute as an eclipse effect. Our challenges in isolating effects of the solar eclipse on behavior are not unexpected because the rarity of solar events and likelihood of species-specific responses make the temporal and geographic replication needed to better understand the influence of solar eclipses on bat behavior logistically challenging. However, our data indicate that some effect of solar eclipses on bat behavior is plausible, although a large-scale collaborative effort will most likely be required to elucidate the relationship.

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