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## Observations of Undescribed Diel Activity in the Wolf Spider *Rabidosa rabida* Show Cathemeral Behavior

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Running Title: First Description of *R. rabida* Diel Activity

We describe the diel activity patterns of animals as being either diurnal, nocturnal, or crepuscular. These terms do not appropriately describe animals that are active equally during both day and night. Fortunately, there is another term to cover this situation. This term is cathemeral. There are a number of terms in the literature used to describe widespread diel activity including circumdiel (Stiles *et al.* 2017), metaturnal (Tattersall 1987), “around-the-clock activity” (Bloch *et al.* 2013) and cathemeral. Terms are used inconsistently in the literature. We chose cathemeral due to its previous, though limited, use with spiders.

Tattersall first used the term cathemeral in 1987. He defined cathemeral as an organism’s activity being distributed approximately evenly through the 24 hours of the daily cycle or when significant amounts of activity, particularly feeding or traveling, occur within both the light and dark portions of the cycle (Tattersall 1987). The term cathemeral is not common in ecological or behavioral literature. Most applications are limited to primate behavior, where the term was first defined. We expect that cathemeral behavior is more common in arthropods than in the primates, due to arthropod diversity of physiology and behavior.

We find the only applications of the term cathemeral to arthropods in a paper describing jumping spider and Philodromid spider circadian rhythms (Mezofi *et al.* 2019). Spiders are an ecologically diverse group of arthropods both physically and behaviorally (Foelix 2011). Most spiders have never had their diel activity described. This gap in our ecological knowledge may lead us to miss important characteristics of arthropod communities that are now under threat from a changing environment.

*Rabidosa rabida* is a large wolf spider commonly found in the Eastern half of North America (Brady & McKinley 1994). We know very little about the ecology of this spider. While working with *R. rabida*, we discovered that there were no clear descriptions of its diel behavior in the field. Looking at the original descriptive literature for this spider, we find that there

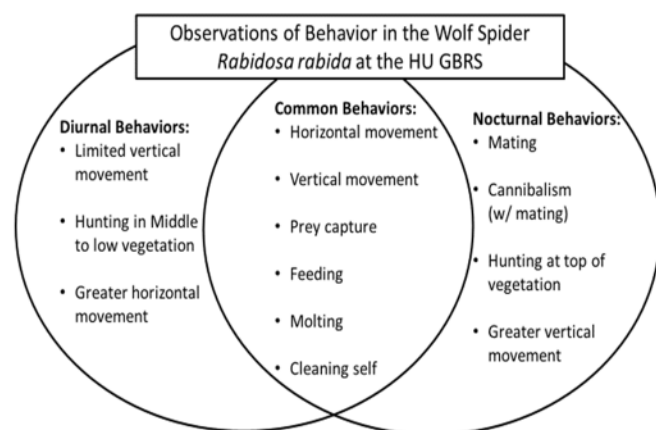
are almost no descriptions of behavior, as is common in biological literature from the 1800s (Walckenaer 1837; Simon 1898). We decided to make the first known, clearly reported observations of the diel activity of *Rabidosa rabida* to decide if this spider is nocturnal, diurnal, or cathemeral.

We captured *R. rabida* at the Harding University Gilliam Biological Research Station in White County, Arkansas, in July 2019. We captured 26 adult, female spiders nocturnally. To each, we attached a Biomark Inc. mini HPT8 RFID tag with a drop of cyanoacrylate on the opisthosoma. We released marked spiders at the location where we had previously captured them. The following days we tracked each spider using a Biomark HPR Lite RFID microreader. Capturing individuals during diurnal and nocturnal periods allowed us to observe and record behaviors of individual spiders during both diel periods. We made observations of behavior during the morning, midday, and mid-afternoon times. Crepuscular observations were limited due to the difficulty of finding spiders by either the visual or spotlighting methods under twilight lighting conditions. In previous fieldwork, we made personal observations of behaviors similar to the reported activity for this species made here. We also made observations of unmarked spiders during diurnal tracking to confirm the observations made of marked spiders. Males and juveniles lacked the body size necessary to attach tags but were included in the untagged observations, which included over 200 spiders of all sexes and sizes.

Twenty-six spiders were marked nocturnally. We recaptured 17 of these spiders diurnally. These recaptures provided us with nocturnal and diurnal observations of multiple individual spiders in both diel periods. These observations, along with additional notes on unmarked spiders, give us confidence that our observations here are ordinary in this population.

We have previously observed spiders moving both vertically and horizontally, hunting, eating, molting, mating, and demonstrating cannibalism of mates

nocturnally (Figure 1). Diurnally we were able to observe spiders moving vertically and horizontally, hunting, and eating (Figure 1). Vertical movements were limited diurnally compared to nocturnal behavior but horizontal movements were more common or possibly more visible diurnally. We were able to observe 1 case of a spider molting in the vegetation during daylight (Figure 1). We have in previous studies, observed wasp predators carrying paralyzed spiders away during the daylight. While we did not observe any predator avoidance behaviors here, we suggest that these behaviors should be either diurnal or cathemeral, if these behaviors are present in this spider. Nocturnal predation on this species has never been explored and the scientific literature contains no descriptions of predator avoidance behaviors as of yet.



**Figure 1:** Venn diagram of observed behavior in *Rabidosa rabida* compared between daylight hours (diurnal behaviors), after dark (nocturnal behaviors), and behaviors observed at both times (Common behaviors).

According to the definition given by Tattersall (1987), we can classify an animal as cathemeral if it performs important functions during both day and night. We observed *R. rabida* hunting, eating, moving, and molting during both diurnal and nocturnal diel periods causing us to conclude that we should classify its behavior as cathemeral.

The description made here is the first published description of the field diel activity in *Rabidosa rabida*. Previous work, focusing on pesticide influences on behavior, indirectly suggest cathemerality in this species, in a laboratory setting, but did not directly provide a clear description of diel patterns or make field observations (Tietjen & Cady 2007). We have still not documented the full range of times and conditions that this spider is active during the day nor have we made enough daylight

observations to be confident of all of the behaviors occurring during daylight.

The changing climate is making changes to arthropod communities that we cannot at this time describe due to a lack of basic knowledge about the animals in these communities. We need to describe multiple traits of these communities before they are at best changed, or worse, lost forever. These observations of an influential predator are a start to this work, but we need much more work for this species and many others in Arkansas and around the world.

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