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SHORT COMMUNICATION

Pre-ballooning in *Ummidia* Thorell 1875 (Araneae: Ctenizidae) from the Interior Highlands, USA: second account from the region and review of mygalomorph ballooning

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Abstract. The present study represents the second record of pre-ballooning behavior in Arkansas *Ummidia* Thorell 1875 (Ctenizidae). Mygalomorph ballooning is discussed and our observations are compared with previous authors' observations. Photographs and video of the behavior are included. Images and discussion are provided detailing genus-level identification of the spiderlings.

Keywords: Trapdoor spider, aerial dispersal, videography

Although most non-araneomorph spiders do not disperse aerially like many araneomorphs, ballooning has been recorded from mygalomorphs in three families. Bell (2005) reviewed ballooning accounts across arthropods and listed five mygalomorph ballooners: *Missulena insignis* (Cambridge 1877) (Actinopodidae); *Atypus affinis* Eichwald 1830 and *Sphodros atlanticus* Gertsch & Platnick 1980 (Atypidae); and *Conothele malayana* (Doleschall 1859) and *Ummidia* Thorell 1875 (Ctenizidae). This list combined accounts of confirmed ballooning (*M. insignis* [Main 1976, 1981; Brunet 1994]; *S. atlanticus* [Coyle 1983, Coyle et al. 1985]; and an unidentified *Ummidia* [Coyle 1985]), as well as pre-ballooning accounts without observed ballooning (*A. affinis* [Enock 1885; Bristowe 1941]; *S. rufipes* [Latreille 1829] [Muma & Muma 1945]; *C. malayana* [Main 1957, 1976]; and *U. carabivora* (Atkinson 1886) [Baerg 1928]). Additionally, Eberhard (2005) described ballooning in Costa Rican *Ummidia*. Main (1981) noted the oddity that *Missulena* Walckenaer 1805 and *Actinopus* Perty 1833 have similar distributions across Australia, even though *Actinopus* was not known to balloon. Solving this mystery and adding to the list of ballooning mygalomorphs, Ferretti et al. (2013) confirmed ballooning in an unidentified *Actinopus*. Most of these species have in common large ranges that cross water barriers, including accounts on islands (e.g., *Ummidia* from St. Vincent [Simon 1891]; *Conothele* from Pacific Islands and Seychelles [Pocock 1898; Berland 1938; Roewer 1963, Saaristo 2002]).

The present study provides information for *Ummidia*, which are the most common ctenizids in the eastern U.S. They are immediately identifiable by a dorsal saddle-shaped indentation on the third tibiae, which has been suggested to aid in securing them in the burrow (Coyle 1981). There are 25 described species of *Ummidia*, with 18 in the New World (10 USA, five Central America, three South America) and seven in the western Mediterranean (Platnick 2014). However, perhaps as many as 100 (Platnick, via Bond & Coyle 1995) are left undescribed (Bond & Hendrixson 2005). The trans-Atlantic distribution has traditionally been considered the result of human introduction, but this hypothesis was recently rejected with molecular evidence (Opatova et al. 2013). Instead, *Ummidia* were likely widespread in Laurasia, rendering Old World species much older than previously suspected. Interestingly, unlike other organisms, New and Old World lineages diverged later than the breakup of Laurasia, which the authors attributed to gene flow on either side of the newly opening Atlantic ocean due to the ability of *Ummidia* to disperse by ballooning. A related genus, *Conothele*, has a non-overlapping Australasian distribution and the characters differentiating *Conothele* from *Ummidia* are variable (Main 1985), leaving geography and burrow construction as the best distinguishers (Haupt 2005; Decae

2010). Further, the molecular analyses of Opatova et al. (2013) showed only a small amount of divergence between *Conothele* and *Ummidia*. In short, there is great need for a revision of New World *Ummidia*, as well as phylogenetic investigation of the generic complex (*Conothele* + *Ummidia*), at which point, *Conothele* will likely be lumped with *Ummidia*. Ballooning by *Conothele* spiderlings is currently unknown.

Field photographs and video were taken with an iPhone 4S, which was the only camera available at the time, highlighting an example of such technology used for natural history. Video taken of this behavior can be found at <https://www.youtube.com/watch?v=gleB4sIrDQw>. The video was compiled with Adobe Premiere Pro CS6. Morphological images were montaged from many stereomicrographs (20–30 for habitus and 8–14 for appendages) using Helicon Focus 6.

Following the accounts of Baerg (1928), this study presents the second record of pre-ballooning behavior of Arkansas *Ummidia*. On the afternoon (15:00–16:00) of 22 March 2014, on a trail that paralleled a paved road (100–200 m away) at Devil's Den State Park, Arkansas (35° 46' 51.54"N 94° 15' 22.74"W; elev. 395 m), six *Ummidia* spiderlings were observed climbing an oak (*Quercus*, Diameter at Breast Height (DBH) approx. 24 cm) on a vertical 2–6 mm wide silk band. The silk band rose approximately 6 m along the trunk and then continued along a horizontal limb where it bifurcated several times and was eventually lost after about 2 m (Fig. 1A, C). The observation spanned approximately 30 min, although all six spiderlings were discovered in the first 5 min. The oak was atop a steep slope that overlooked a valley and was therefore exposed to wind gusts (Fig. 1B). Other conditions were as follows: 13°–15°C; wind 1.8–4.5 m/s; recently turned cloudy, prior to light rain. At the base of the tree the silk band appeared to a few strands, where it was soon lost; not even single-strands could be found (Fig. 1E). Although we have previously found *Ummidia* burrows on steep slopes in the area, careful examination of the area surrounding the ballooning tree failed to uncover either the maternal burrow, or ground silk trails. Ballooning spiderlings were not directly observed, but this silk band-making behavior as an antecedent to ballooning in *Ummidia* is well known (Coyle 1985, Eberhard 2005).

Most of these observations conform to what has been previously described for *Ummidia* by Baerg (1928) and Coyle (1985). Compared with most observations of mygalomorph ballooning, the pre-ballooning bands observed by Baerg (1928) in Arkansas were much longer both horizontally on the ground leading from the maternal burrow to the ballooning tree (3–21 m; 8.5 m avg.) and vertically along the ballooning tree (4–9 m). For example, the band observed by Coyle (1985) was only 0.9 m vertically on a tombstone and 1.5 m



Figure 1.—Ballooning site. A. south-facing view of ballooning tree overlooking the valley; B. east-facing view of ballooning tree depicting steep slope; C. pre-ballooning silk band on trunk, leading to horizontal limb; D. spiderling climbing pre-ballooning band; E. base of tree showing pre-ballooning band diffusing quickly into litter. Red arrows indicate ballooning limb.

horizontally on the ground. Our observations are similar to Baerg's in the following ways: emergence date (15–22 March); silk band width (2 mm) and height (4–9 m); silk band ending on a horizontal limb; and tree size (not less than 15 cm DBH). The present observation occurred in the afternoon and Baerg (1928) described primarily morning activity ending mid-day. However, given the sparse activity and well-developed silk band, we suspect these individuals represented the last members of a ballooning event.

Steep slopes of sparsely wooded, disturbed habitats are commonly noted as preferred *Ummidia* habitat. Baerg (1928) made many pre-ballooning observations over several years on the University of Arkansas (UA) campus, which certainly was disturbed and sparsely wooded, but lacked steep slopes. Despite continued searching over five years, we failed to find either burrows or ballooning spiderlings in the area surrounding campus, which suggests a significantly

diminished population since 1928. However, we have found many *Ummidia* burrows on steep slopes in second-growth oak/hickory forest of northwestern Arkansas, including at Devil's Den State Park. The presence of pre-ballooning behavior similar to Baerg's observations (i.e., long silk trails) in naturalized forest, which is much less open than UA's campus, confirms the use of this method outside of an urbanized setting. That said, because of the position of the ballooning tree (Fig. 1A, B) and time of year (i.e., pre-bud-break), once acquiring their position on the horizontal limb, the spiderlings were functionally in an open area for ballooning.

With regard to identification, Baerg (1928) suggested that *U. carabivora*, known from the east coast, was actually widespread in the U.S. and identified his Arkansas specimens as this species. Indeed, as discussed above, aerial dispersal does enable large distributions. However, several pieces of evidence suggest that the spiderlings we



Figure 2.—Spiderling genus-level identification. A. dorsal habitus; B. lateral prosoma (right appendages removed), note ocular tubercle (arrow); C. pedipalp, note single clavate trichobothrium (dotted arrow) and ventral curvy spines (arrows); D. leg III, note trochanteral apophysis (dotted arrow) and tibial depression (arrow); E. eye group. Not to scale.

observed may not be *U. carabivora*. First, *Ummidia* is already suspected to contain considerable undescribed diversity. Second, specimens from this region exhibit longer pre-ballooning bands than what has been previously described for the genus. And third, the Interior Highlands are known to have a high rate of endemism (Redfearn 1986; Allen 1990; Robison & Allen 1995; Skvarla et al. 2013), but these endemics are often overlooked by surveys and specimens from the region are rarely included in phylogenetic analyses. Ultimately, a large-scale, integrative investigation of the genus in the New World is needed before confidence in species identification is warranted. Therefore, we refrain from suggesting species identification at this time, but offer the following discussion on genus-level identification of juvenile *Ummidia*.

Juvenile morphology in most animals (including spiders) is regularly overlooked, despite juveniles of certain taxa being frequently noticed and collected. This is evidenced by the prevalence of amateur naturalists not only photographing spiderlings, but also documenting pre-ballooning behavior in *Ummidia* on websites like Flickr.com and Bugguide.net. However, we are not aware of primary literature containing useable information on the identification of *Ummidia* immatures.

Decae (2010) lists five characteristics that differentiate ummidiines (*Ummidia* + *Conothele*) from other tbenizids as follows: 1) proximal dorsal glabrous depression on tibia III; 2) sharp apophysis on dorsolateral trochanter III; 3) dorsal clavate trichobothria on tarsi; 4) lateral curvy spines on distal podomeres of leg I, II, and pedipalps; and 5) compact eye-group (Fig. 2E) on an ocular tubercle (Fig. 2B). Each of these characters is apparent in the spiderling, although the trochanteral apophysis (Fig. 2D) and curvy spines (Fig. 2C) are not fully developed. Additionally, clavate trichobothria are absent from the legs, but a single clavate trichobothrium (Fig. 2C) is present on pedipalpal tarsi and is proportionally larger than on adult specimens. Noteworthy are the readily apparent tibial depressions commonly implemented as a diagnostic character for adults (Fig. 2D).

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