

## Phenology of an urban population of *Lyssomanes jemineus* Peckham & Wheeler (Araneae: Salticidae) with a list of other jumping spiders from the same Costa Rican site

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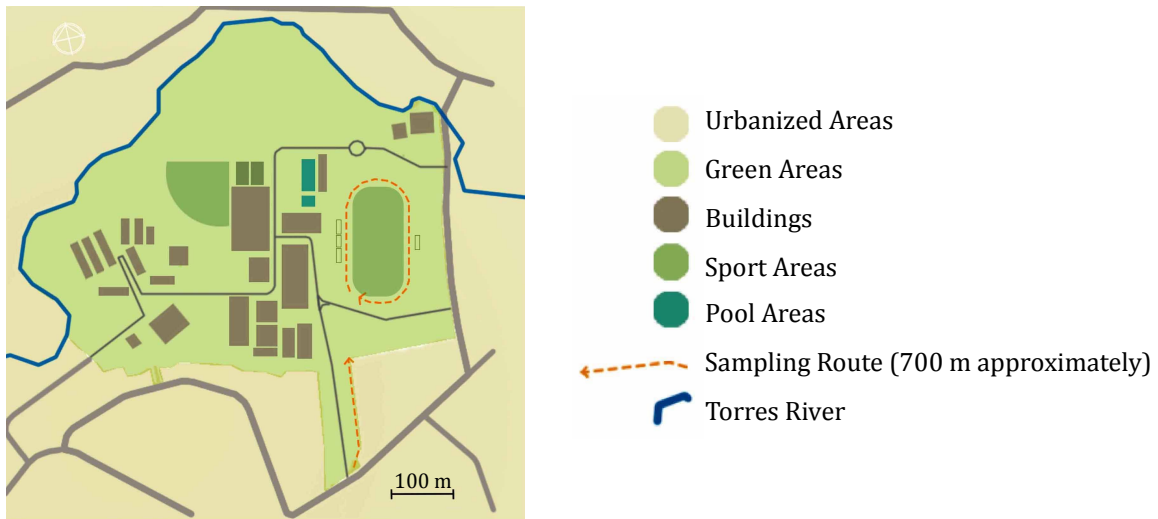
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**Abstract.** Jumping spiders were sampled for 24 months in a Costa Rican urban environment and one of the species collected, *Lyssomanes jemineus*, was observed in detail in order to document its phenology in this disturbed habitat. Nine other species of salticids were also identified from the same site.

**Keywords.** *Bagheera*, *Balmaceda*, *Colonus*, *Corythalia*, *Messua*, *Mexigonus*, *Nagaina*, *Paraphidippus*, San Pedro de Montes de Oca, urban ecosystems

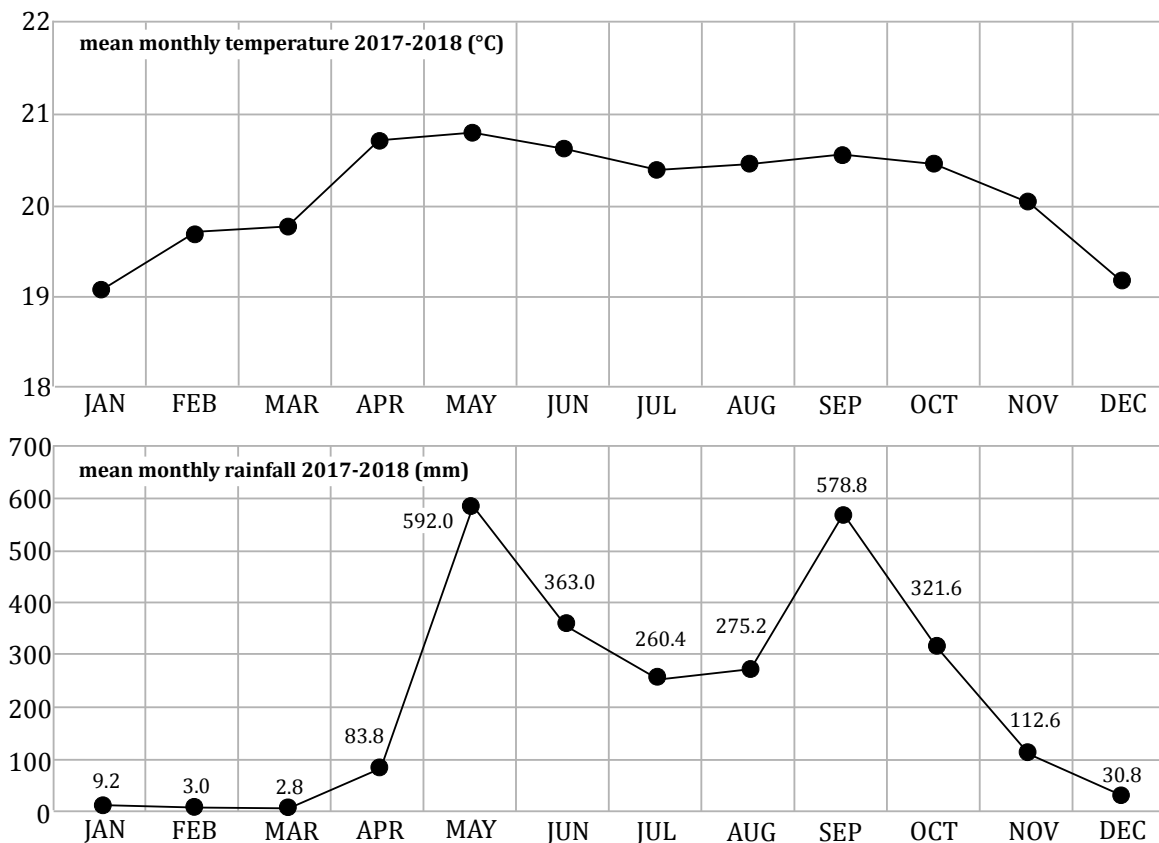
The salticid subfamily Lyssomaninae is comprised of just two genera, *Lyssomanes* Hentz, 1845 and *Chinoscopus* Simon, 1900, both restricted to the New World (Maddison 2015). Nearly a hundred species of Lyssomaninae are currently recognized, most of which occur in tropical forests of the Amazonian region (Logunov 2014; Prószyński 2016; Rubio et al. 2017). There have been relatively few studies of the jumping spider fauna of Costa Rica. To encourage future research on this group, we carried out a year-long inventory in a patch of urban forest located on the campus of the University of Costa Rica. The most abundant species collected, *Lyssomanes jemineus*, was observed in greater detail to determine its phenology in this disturbed habitat.

**Methods.** We collected salticid adults and juveniles monthly from January 2017 to December 2018. For *L. jemineus*, egg sacs were also collected. Collecting was done on Finca 2 of the University of Costa Rica, San Pedro Montes de Oca, San José, Costa Rica (N9°56'07", W84°03'04") (Figure 1). This site is located in a disturbed urban environment that is now covered with semi-woodland vegetation including both native and introduced herbaceous plants (Biamonte et al. 2011). Spiders were collected from 0 to 1.5 m above ground level. Since many of the plants were quite widely spaced, the transect consisted of 15 to 30 places where diverse herbaceous plants were haphazardly searched. Adults were collected individually using 15 ml Falcon tubes. Each tube had an opening for aeration, a small fragment of the plant from which the specimen was collected, and a small piece of damp cotton. Specimens were kept individually in these tubes for no more than two hours, and then quickly transferred to the laboratory. Specimens were identified by G.B. Edwards. Some of the specimens collected for identification were either undescribed or juveniles and therefore could not be identified to species level.



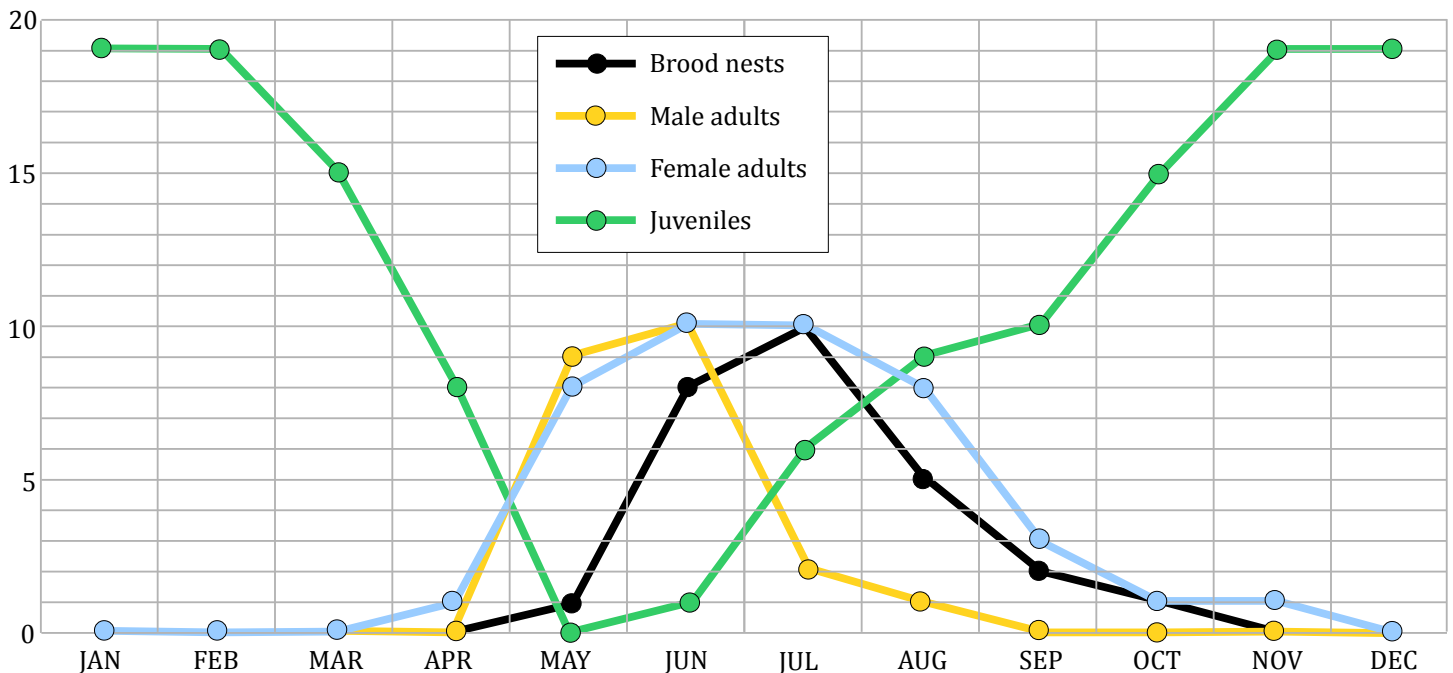
**Figure 1.** Study area at the University of Costa Rica in San Pedro de Montes de Oca, northwest of the central campus, usually referred to as Instalaciones Deportivas, Finca 3. The dashed orange line shows the transect used to sample specimens.

*Climate.* The mean temperature in the study site generally varied from 19.1° to 20.8°, and rarely dropped below 15° or rose above 29°C. The warmest months were April to November with a mean temperature of 20.6°C. The amount of rainfall per month varied considerably throughout the year, whereas the temperature was quite constant (Figure 2).



**Figure 2.** Average month temperature and rainfall during two years of field sampling at the study site. Compiled from data posted by Instituto Meteorológico Nacional de Costa Rica (IMNCR 2019).

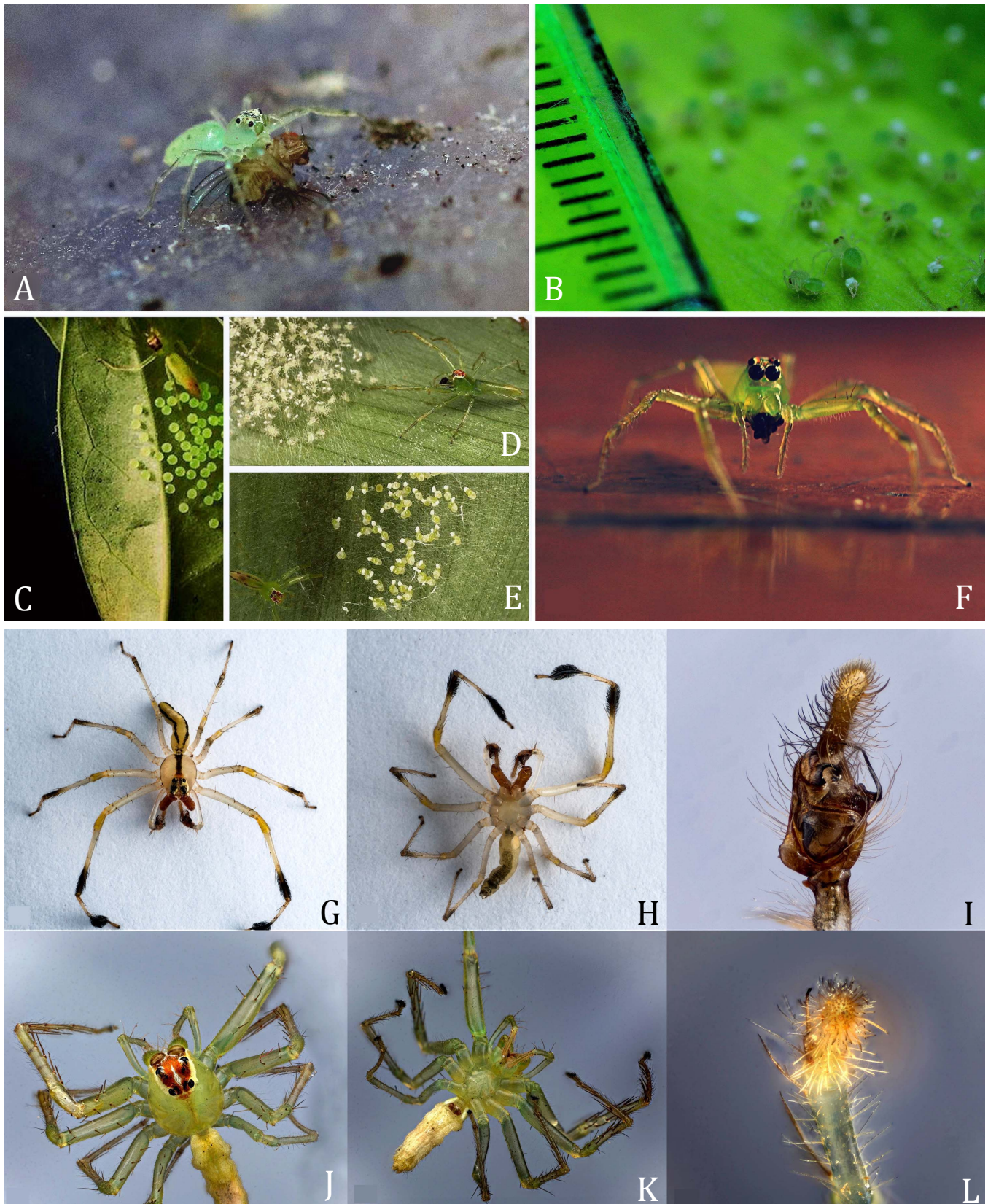
**Phenology** (Figure 3). Immatures were found throughout the year, but in greatest numbers from July through March. Most penultimates were observed from November through March. After temperatures rose a few degrees and rainy days became more frequent in April penultimate spiders developed into adults. Adult females were present for a longer period in the field (9 months) than were males (5 months), and they were detected during months with different amounts of average rainfall, from months with abundant precipitation (May, 592 mm) to months with very moderate rainfall (November, 112 mm). They were abundant from May through November. However, during months with very little rain, such as February and March (mean 5 mm), the population of females was drastically reduced and it became very difficult to find specimens. The presence of adult males coincided with the rainy season from April to June. Adult males were scarce and even disappeared from September through the first part of the year, only appearing once again in April.



**Figure 3.** Count of brood nests, adult males, adult females, and juveniles of *Lyssomanes jemineus* by month, based on sampling from 1 JAN 2017 to 12 DEC 2018.

Courtship of *Lyssomanes jemineus* was observed mostly during the months of April and May. Females laid approximately 50 to 190 eggs in nests covered with a loose silk on the undersides of leaves (Figure 4C), mostly from May to July. The presence of brood nests (nests with eggs or young) coincided with months with moderate rainfall (June to August), slightly less rainy than either the previous month, May, or the subsequent month, September (Figure 2).

We found both adult and juvenile *Lyssomanes jemineus* (Figure 4) on their silk nests on the undersides of green leaves. We also observed them foraging on both stems and leaves of various plant species. Penultimate juveniles and adults were sometimes observed hunting or feeding on soft-bodied insects such as dipterans, small hemipterans, and chalcidoid wasps (Figure 4:A,F). In the majority of observations they were feeding on acalypterate flies and Chironomidae. Cannibalism of large juveniles on small juveniles was observed, and one case of a mature *Lyssomanes jemineus* feeding on another spider, *Leucauge mariana* Keyserling (Tetragnathidae) was also observed. In addition to *Lyssomanes jemineus*, 10 other salticid species were found at the study site (Table 1).



**Figure 4.** *Lyssomanes jemineus* from study site in Costa Rica. **A**, Spiderling, 18 weeks old, feeding on *Drosophila melanogaster*. **B**, Spiderlings, 2 weeks old, with a mm scale at the left. **C**, Oviposition by adult female. **D-E**, Maternal care of hatching spiderlings by female during the month of May. **F**, Adult female feeding on a microhymenopteran. **G-I**, Adult male. **G**, Dorsal view. **H**, Ventral view. **I**, Ventral view of right pedipalp. **J-L**, Adult female. **J**, Dorsal view. **K**, Ventral view. **L**, Ventral view of right pedipalp. Macrophotography with Reflex Camera 850, 20X microscope lenses and focus stacking of 180 images.

**Table 1.** Other salticid species observed at the study site. In addition to these spiders there were some juvenile dendryphantines, most likely *Messua* sp. Peckham & Peckham.

<i>Bagheera</i> sp. Peckham & Peckham	<i>Colonus</i> sp. (1) F. O. Pickard-Cambridge	<i>Mexigonus</i> sp. Edwards
<i>Balmaceda picta</i> Peckham & Peckham	<i>Colonus</i> sp. (2) F. O. Pickard-Cambridge	<i>Nagaina incunda</i> Peckham & Peckham
<i>Balmaceda</i> sp. Peckham & Peckham	<i>Corythalia</i> sp. Koch	<i>Paraphidippus funebris</i> Banks

**Discussion.** Several factors have been reported to affect the seasonal abundance of spiders (Table 2). In our study of *Lyssomanes jemineus* we observed that adult females were absent during months with very little rainfall and, like adult males, more common during the rainy months. This pattern of males and females appearing during the rainy months could be due to the fact that plant cover and water sources increase, as do many potential prey, during those months (Miyashita et al. 1998). Plants are important to spiders for a number of reasons (Table 3).

**Table 2.** Factors that may affect the seasonal abundance of spiders.

Factor	References
habitat structure	Lubin 1978; Nentwig 1993
rainfall	Wolda 1978
plant structure	Raizer & Amaral 2001; Uetz 1977
reproductive period of individual species	Sosa-Romero et al. 2016
humidity	Flórez 1998
synchrony of adult mortality	Jackson 1978
refuge sites and the presence of natural enemies	Uetz 1977

**Table 3.** Important functions of plants with respect to spiders.

Function	References
shelter from dessication	Riechert & Tracy 1975
protection from natural enemies	Gunnarsson 1996
foraging opportunities	Morse & Fritz 1982; Romero & Vasconcellos-Neto 2003
sites for mating and oviposition	Rossa-Feres et al. 2000; Smith 2000

As has been reported previously for *Lyssomanes viridis* (Walckenaer), females remained very close to their offspring during the first two instars, but in the third or fourth instar they were more distant or absent (Richman & Whitcomb 1981). Also, during the development of her eggs, an adult female was usually found guarding them on top of the brood nest or nearby, and if she was disturbed the female remained vigilant and in some cases was reluctant to move, supporting the view that maternal care is important (Hallas and Jackson 1996). With respect to juveniles, our observations support those of other authors who report that juvenile *Lyssomanes* require an entire year to mature (Richman & Whitcomb 1981).

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