

## Hunchback flies (Diptera: Acroceridae) as endopredators of jumping spiders (Araneae: Salticidae)

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Most often, larval acrocerids are referred to as *parasitoids*. However, this term suggests that these fly larvae represent a kind of parasite, when in fact they actively hunt for spiders, penetrate the cuticle, and then feed on the spider so captured *from the inside*. The term *endopredation* better describes this behavior, as a special kind of *predation*. Acrocerid endopredation on jumping spiders has been documented previously (Table 1). Minute larvae actively hunt for their prey and are generally thought to enter through a small hole in the cuticle, later emerging to pupate (Schlinger 1987; Winterton 2012; Winterton & Barraclough 2017; Gillung & Borkent 2017). In the laboratory, first instar *Acrocera orbicula* (Fabricius) larvae were observed to attach themselves to the cuticle of a lycosid spider *Pardosa prativaga* (L. Koch), cutting an *attachment hole* through the integument. After molting to the second instar, each larva inserted itself through this hole into the respective spider (Nielson, Funch & Toft 1999).

**Table 1.** Documented records for acrocerid endopredation on jumping spiders. In cases where the location was not given, it has been inferred from the distribution of the respective species.

salticid prey	acrocerid predator	location	reference
<i>Aelurillus insignitus</i> (Clerck 1757)	<i>Ogcodes pallipes</i> Latreille, <i>O. varius</i> Latreille	Europe	Séguy 1926; Millot 1938; Schlinger 1987
<i>Asemonea tenuipes</i> (O. Pickard-Cambridge 1869)	(not identified)	Karnataka	Abhijith, Hill & Ramesh 2022 (this paper)
<i>Brancaus calebi</i> Kanesharatnam & Benjamin 2018	(not identified)	Karnataka	Abhijith, Hill & Ramesh 2022 (this paper)
<i>Cobanus</i> F. O. Pickard-Cambridge 1900	<i>Terphis</i> Erichson 1840	Central America to Colombia	Schlinger 1987
<i>Cosmophasis bitaeniata</i> (Keyserling 1882)	<i>O. basalis</i> (Walker), <i>O. doddi</i> Wandolleck	Queensland	Dodd 1906; Wandolleck 1906; Schlinger 1987
<i>Eris militaris</i> (Hentz 1845)	<i>Acrocera</i> Meigen 1803	Québec	Larivière & Borkent 2009
<i>Euophrys frontalis</i> (Walckenaer 1802)	<i>Acrocera orbicula</i> (Fabricius 1787)	Netherlands	Noordam 2021
<i>Evarcha jucunda</i> (Lucas)	<i>O. reginae</i> Trojan	Portugal	Kehlmaier & Almeida 2014
<i>Habronattus hallani</i> (Richman 1973)	<i>O. eugonatus</i> Loew 1872	southwestern North America	Schlinger 1987 (as <i>Pellenes</i> )
<i>Heliophanus</i> C. L. Koch 1833	<i>O. zonatus</i> Erichson, <i>O. pallipes</i> Latreille	Afroeurasia	Millot 1938
Lyssomanidae	<i>O. guttatus</i> (Costa)	Neotropical	Schlinger 1987
<i>Maratus banyowla</i> Otto & Hill 2019	(not identified)	Western Australia	Otto & Hill 2019
<i>Metaphidippus</i> (?)	<i>A. bulla</i> Westwood, <i>O. boharti</i> Schlinger	North America	Schlinger 1987
<i>Metaphidippus manni</i> (Peckham & Peckham 1901)	<i>Pterodontia vix</i> Townsend	western North America	Schlinger 1987
<i>Myrmarachne platealeoides</i> O. Pickard-Cambridge 1879	(not identified)	Karnataka	Abhijith, Hill & Ramesh 2022 (this paper)
<i>Pelegrina aeneola</i> (Curtis 1892)	<i>A. bulla</i> Westwood, <i>O. boharti</i> Schlinger, <i>O. borealis</i> Cole	western North America	Beckwith, Mason & Paul 1987; Schlinger 1987
<i>Pelegrina proterva</i> (Walckenaer 1837)	<i>O. melampus</i> Loew 1872, <i>O. eugonatus</i> (Loew 1872)	Québec	Larivière & Borkent 2009
<i>Phlegra fasciata</i> (Hahn 1826)	<i>O. pallipes</i> Latreille	Europe	Millot 1938
<i>Phidippus</i> C. L. Koch 1846	<i>Acrocera</i> Meigen 1803	North America	Schlinger 1987
<i>Phidippus ardens</i> Peckham & Peckham 1901	<i>O. boharti</i> Schlinger	western North America	Schlinger 1987
<i>Phidippus clarus</i> Keyserling 1885	<i>O. eugonatus</i> (Loew 1872)	North America	Schlinger 1987 (as <i>Phidippus rimator</i> )
<i>Phidippus comatus</i> Peckham & Peckham 1901	<i>O. boharti</i> Schlinger	western North America	Schlinger 1987
<i>Phidippus johnsoni</i> (Peckham & Peckham 1883)	<i>O. adaptatus</i> Schlinger, <i>O. boharti</i> Schlinger, <i>O. eugonatus</i> (Loew 1872)	western North America	Schlinger 1987
<i>Phidippus princeps</i> (Peckham & Peckham 1883)	<i>O. eugonatus</i> (Loew 1872)	eastern North America	Schlinger 1987
<i>Sassacus</i> Peckham & Peckham 1895	<i>O. eugonatus</i> (Loew 1872)	North America	Schlinger 1987
<i>Servaea</i> Simon 1887	<i>O. pygmaeus</i> White 2014	Australian Capitol Territory	Yuan et al. 2020
Salticidae	<i>Terphis</i> Erichson 1840	Madagascar	Schlinger 2003 (as <i>Sidusa</i> )

Based on field observations at the *Indraprastha Organic Farm* of the senior author in Karnataka, we can add three salticid species to the list of salticids subject to acrocerid endopredation, *Asemonea tenuipes*, *Brancus calebi* and *Myrmarachne plataleoides* (Figures 1-4). Based on the appearance of larvae that were subsequently reared to adulthood (Figures 1:3-4, 4), at least two different acrocerid species preyed on salticids in the area. Of five instances of predation on *M. plataleoides* that we observed, two involved predation by two different acrocerid larvae on a single spider. This suggests a relatively high population density for acrocerids in this area in this monsoon season, something that might be expected to vary by year. We have no indication that the acrocerids that we observed have a preference for certain prey species.



**Figure 1.** Salticids and acrocerid predators in Karnataka. **1-2**, *Asemonea tenuipes* and pupating larva of an acrocerid. **3-4**, Two views of the adult acrocerid from (1-2) that was soon reared to adulthood after it fed on the *A. tenuipes*. Dipteran pupation time is temperature-dependent (Zhang et al. 2019). **5-6**, Remains of a female *Myrmarachne plataleoides* (#1) in her nest with two acrocerid predators, one (at upper left) beginning to pupate, and the second just after molting to the pupal stage. An exit hole used by at least one of the acrocerids is shown with an arrow.



**Figure 2.** *Brancus calebi* and its acrocerid predator. **3,** Note the acrocerid exit hole in the abdomen of this *Brancus* (arrow). **4-6,** Three views of this acrocerid larva after emergence.



**Figure 3.** Four more examples of acrocerid predation on female *Myrmarachne plataleoides*. **1-2**, Female (#2) preyed upon by two acrocerids, before (1) and after (2) their pupation. **3-4**, Acrocerid pupae in nests of two different *M. plataleoides* (#3-4). **5-6**, Another female *M. plataleoides* (#5) with the pupa of its acrocerid predator. This pupa was reared to maturity so that the adult could be photographed (Figure 4).



**Figure 4.** Adult acrocerid fly reared after predation on a female (#5) *Myrmarachne plataleoides* (Figure 3:5-6). 3, Note the acrocerid exit hole in the abdomen of this spider (arrow).

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