

2016

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Recommended Citation

Connior, M. B.; McAllister, C. T.; Durden, L. A.; Trauth, S. E.; and Robison, H. W. (2016) "New Chigger (Acari) Records from Arkansas Amphibians (Caudata, Anura) and Reptiles (Sauria)," *Journal of the Arkansas Academy of Science*: Vol. 70 , Article 43. Available at: <http://scholarworks.uark.edu/jaas/vol70/iss1/43>

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New Chigger (Acari) Records from Arkansas Amphibians (Caudata, Anura) and Reptiles (Sauria)

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Running Title: New Chigger Records from Arkansas Amphibians and Reptiles

Little is known about chiggers of Arkansas herpetofauna, but 2 species, *Hannemania dunnii* Sambon and *Eutrombicula cinnabaris* (Ewing) have been reported from amphibians (McAllister et al. 2013 and references therein) and lizards (McAllister 1980) from that state. There are also reports of *Eutrombicula alfreddugesi* (Oudemans) from Arkansas lizards, but that species has been synonymized with *E. cinnabaris*. Here we report these 2 chiggers from 8 species of amphibians and 5 species of reptiles from Arkansas and provide a detailed summation of previously published herpetofaunal hosts of these 2 chiggers from the state.

During June 1973 and again between June 2013 and August 2015, we examined the following 5 reptiles and 8 amphibians from Calhoun, Carroll, Hempstead, Independence, Lincoln, Montgomery, Nevada, Polk, and Union counties for chiggers as follows: **AMPHIBIA: CAUDATA:** one Ouachita dusky salamander (*Desmognathus brimleyorum*), 12 Caddo Mountain salamanders (*Plethodon caddoensis*), 2 Fourche Mountain salamanders (*P. fourchensis*), and 9 Ouachita Mountain salamanders (*P. ouachitae*); **ANURA:** 29 dwarf American toads (*Anaxyrus americanus charlesmithi*), 4 bird-voiced treefrogs (*Hyla avivoca*), 63 southern leopard frogs (*Lithobates sphenoccephalus utricularius*), 7 pickerel frogs (*L. palustris*); **REPTILIA: SAURIA:** one prairie lizard (*Sceloporus consobrinus*), 2 eastern collared lizards (*Crotaphytus collaris*), one prairie racerunner (*Aspidoscelis sexlineatus*), one five-lined skink (*Plestiodon fasciatus*), and one broadhead skink (*P. laticeps*). *Desmognathus conanti* from southern Arkansas is now referred to as *D. brimleyorum* (Kozak et al. 2005); therefore, the populations around Nevada and Ouachita that were previously identified as *D. conanti* are now synonymized with *D. brimleyorum*.

Chiggers were collected, preserved in 70% (v/v) ethanol, cleared in lactophenol, slide-mounted in Hoyer's medium (Walter and Krantz 2009) and identified using appropriate guides (Sanbon 1928, Loomis 1956, Brennan and Goff 1977, Loomis and Wrenn 1984). *Hannemania* chiggers were carefully removed from encapsulations on amphibian hosts using dissecting scissors and fine forceps and stored in vials of 70% ethanol until they could be cleared and slide-mounted. Chigger vouchers are deposited in the General Ectoparasite Collection in the Department of Biology at Georgia Southern University (accession nos. L3644-3645, L3647-3652, L3654-3656, L3658, L3660-3662, L 3681, L3685, L3692, L3705, L3725, L3734-3735, L3737). Host vouchers are deposited in the Arkansas State University Museum, Herpetological Collection (ASUMZ), State University, Arkansas or the Henderson State University Museum, Herpetological Collection (HSU), Arkadelphia, Arkansas.

We collected chiggers from a total of 13 species of amphibians and reptiles (Table 1). The following species were infested with *H. dunnii*: *D. brimleyorum* (Polk Co.: 3 Oct. 2013 [2 hosts]; Nevada Co.: 25 Oct. 2013 [2 hosts]); *P. caddoensis* (Montgomery Co.: 19 Oct. 2013 [3 hosts], 25 Oct. 2013 [3 hosts]); *P. fourchensis* (Polk Co.: 18 Oct. 2013 [2 hosts]); *P. ouachitae* (Polk Co.: 3 Oct. 2013 [2 hosts]; 4 Oct. 2013 [1 host]; 18 Oct. 2013 [6 hosts]); *A. a. charlesmithi* (Union Co.: 15 Oct. 2013 [1 host]); *L. palustris* (Independence Co.: 5 Apr. 2014 [2 hosts]); and *L. s. utricularius* (Union Co.: 15 Oct. 2013 [2 hosts]; 18 Feb. 2014 [14 hosts]). The following species were infested with *E. cinnabaris*: *H. avivoca* (Calhoun Co.: 22 Jul. 2014 [1 host]); *P. fasciatus* (Hempstead Co.: 21 May 2014 [individual]); *P. laticeps* (Lincoln Co.: 29 Jun. 2014 [1 host]); *A. sexlineatus* (Baxter Co.: 4



Figure 1. *Hannemania dumni* chiggers infesting a *Plethodon fourchensis* from Polk Co. Arrows indicate chiggers on the toes and leg regions. Photo by SET.

Jun. 1973 [1 host]); *S. consobrinus* (Polk Co.: 10 Jun. 2013 [1 host]); and *C. collaris* (Carroll Co.: 1 Aug. 2015 [1 host]).

Arthropoda: Acarina: Leeuwenhoekiiidae
***Hannemania dumni* Sambon, 1928**

This chigger has been reported from a variety of amphibians, including both anurans and caudates (Walters et al. 2011). The geographic range includes the midwestern and eastern United States (Walters et al. 2011, McAllister et al. 2013), with a recent report from adjacent Union Parish, Louisiana (Connior et al. 2016). This is the most common chigger of Arkansas amphibians (Appendix). It has been previously reported in Arkansas from *D. brimleyorum*, Oklahoma salamander, *Eurycea tynerensis*, Ozark zig-zag salamander, *Plethodon angusticlavius*, *P. caddoensis*, *P. fourchensis*, Kiamichi Mountain salamander, *P. kiamichi*, *P. ouachitae*, and *L. palustris*. We report, for the first time, this chigger parasitizing *A. a. charlesmithi* and *L. s. utricularis* from Arkansas. Several authors (Brandt 1936, Loomis, 1956, Murphy 1965, Westfall et al. 2008) have also reported leopard frogs as hosts from other states.

The chigger infestation of salamanders within the Ouachita Mountains is interesting. Several endemic salamanders (*P. caddoensis*, *P. fourchensis*, *P. kiamichi*, and *P. ouachitae*) as well as *D. brimleyorum* can have high infestation rates as noted by previous studies (McAllister et al. 2002, Winter et al. 1986).

These high infestations can lead to deformed limbs as seen in Fig. 2. Yet, neither western slimy salamanders (*Plethodon albagula*) nor southern red-backed salamanders (*Plethodon serratus*), which occur sympatrically with these endemic hosts, has been reported as a host of *H. dumni*. Indeed, we have examined numerous (>100) individuals from both Arkansas and Oklahoma within the Ouachita Mountains (Connior and McAllister, *unpubl. data*) and have not found a single host infested with *H. dumni*. This is also supported by previous studies of not detecting any infested *P. albagula* and/or *P. serratus* (Duncan and Highton 1979, Winter et al. 1986, McAllister et al. 1993, 2002, Anthony et al. 1994).

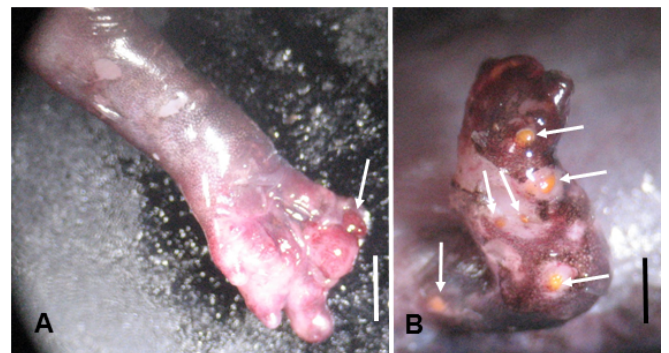


Figure 2. Chigger infestation on *Desmognathus brimleyorum*, Polk Co. A. Massive infestation showing deformed limb (stump missing digits) with encapsulated chigger (arrow). B. Another deformed limb with encapsulated chiggers (arrows). Scale bars = 5 mm. Photos by CTM.

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Trombiculidae, *Eutrombicula cinnabaris* (Ewing, 1920)

This is a widely-ranging chigger that parasitizes a large variety of vertebrates including amphibians (Fig. 1) and, primarily, reptiles (both lizards [Figs. 3-4] and snakes) (Mertins et al. 2011; Walters et al. 2011). It has been previously reported on herpetofauna throughout the midwest and eastern United States, including Arkansas (Walters et al. 2011) and Texas (Mertins et al. 2011). It has been previously reported on herpetofauna throughout the midwest and eastern United States including Arkansas (Walters et al. 2011). This is the most common chigger of Arkansas reptiles (Table 1) and free-living larvae were reported from 55 Arkansas counties by Wicht and Rowland (1987). It has been previously reported in Arkansas from *S. consobrinus*, *C. collaris*, *P. fasciatus*, and *P. laticeps* (Wolfenbarger 1952, McAllister 1980). We provide additional records for the previously listed hosts, as well as *A. sexlineata*, and an amphibian, *H. avivoca*. Numerous authors (see Walters et al. 2011) have reported this chigger from the prairie racerunner. Additionally, Trauth et al. (2004) show an image of *A. sexlineata* from Arkansas infested by chiggers, presumably, *E. cinnabaris*. The bird-voiced treefrog represents a new host for *E. cinnabaris* and the first chigger reported to infest this anuran. Reports of *E. cinnabaris* from amphibians are relatively rare (Mertins et al. 2011).

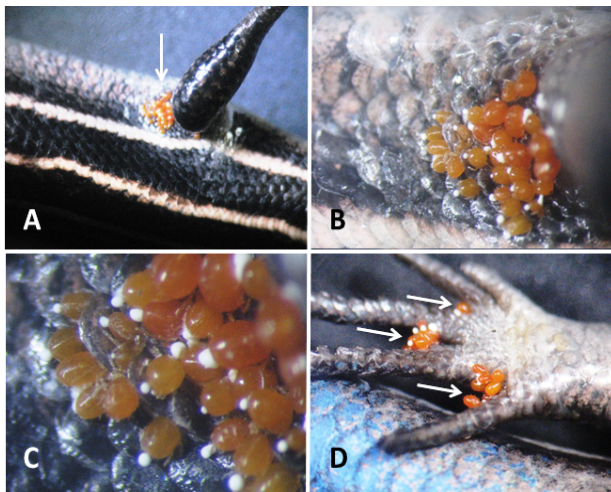


Figure 3. *Eutrombicula cinnabaris* chiggers infesting *Plestiodon fasciatus*, Hempstead County. A. chiggers on axilla (arrow). B. Close-up of chiggers on axilla. C. Aggregation of chiggers. D. Chiggers on digits (arrows). Photos by CTM.

There are at least 30 species of salamanders, 29 species or subspecies of frogs, and 13 native species and subspecies of lizards in Arkansas (Trauth et al. 2014). Although we have provided information on several species of herpetofauna infested with ectoparasitic chiggers, many species still need to be surveyed. We expect additional hosts and perhaps new distributional records will be reported with further study.

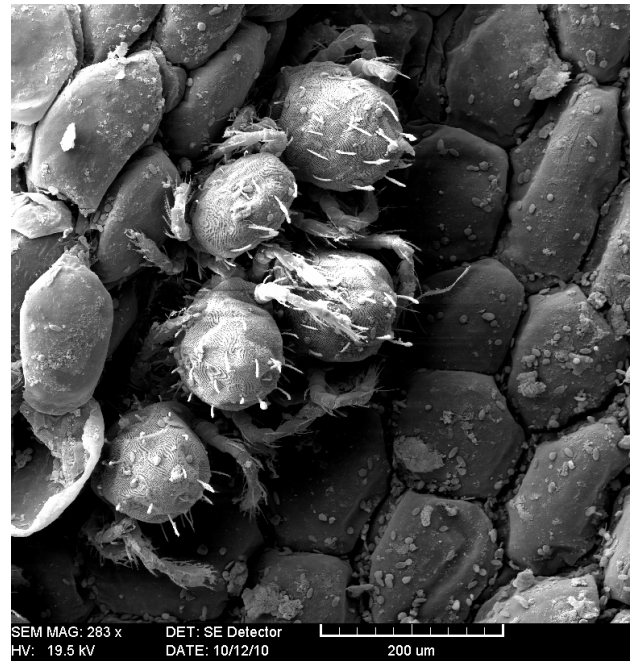


Figure 4. SEM showing *Eutrombicula cinnabaris* infesting an *Aspidoscelis sexlineatus* from Baxter County. Photo by SET.

Acknowledgments

The Arkansas Game and Fish Conservation provided scientific collecting permits to MBC, CTM and SET. We thank Drs. R. Tumilson (HSU) for expert curatorial assistance and J. O. Whitaker, Jr. (Indiana State University) for helpful comments.

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Appendix. Summary of chiggers reported from amphibians and reptiles from Arkansas.

Chigger	Host	Locality (Co.)	Reference
<i>Eutrombicula cinnabaris</i>	<i>Hyla avivoca</i> ¹	Calhoun	This study
	<i>Aspidoscelis sexlineatus</i>	Baxter	This study
	<i>Crotaphytus collaris</i>	Carroll	This study
		Izard	McAllister (1980)
	<i>Plestiodon fasciatus</i>	Hempstead	This study
		Izard	McAllister (1980)
	<i>Plestiodon laticeps</i>	Izard	McAllister (1980)
		Lincoln	This study
	<i>Sceloporus consobrinus</i>	Crawford, Newton	Wolfenbarger (1952)
		Izard	McAllister (1980)
<i>Hannemania dunni</i>	<i>Desmognathus brimleyorum</i>	Montgomery	Loomis (1956)
		Nevada	This study
		Polk	Loomis (1956); McAllister et al. (1995a); This study
	<i>Eurycea multiplicata</i>	not given	Winter et al. (1986)
		Conway	McAllister et al. (1995b)
		Franklin	McAllister et al. (2013)
	<i>Plethodon angusticlavius</i>	Montgomery	This study
	<i>Plethodon caddoensis</i>	Polk	Anthony et al. (1994); McAllister et al. (2002); This study
		Montgomery	Crossley 1960); McAllister et al. (2002)
		not given	Winter et al. (1986)
	<i>Plethodon fourchensis</i>	Polk	Loomis (1956); Duncan and Highton (1979); McAllister et al. (2002); This study
		not given	Winter et al. (1986)
	<i>Plethodon kiamichi</i>	Polk	McAllister et al. (2002)
	<i>Plethodon ouachitae</i>	Polk	Loomis (1956); Duncan and Highton (1979); McAllister et al. (2002); This study
		not given	Winter et al. (1986)
Union		This study	
<i>Anaxyrus americanus charlesmithi</i>	Union	This study	
<i>Lithobates sphenoccephalus utricularius</i>	Union	This study	
<i>Lithobates palustris</i>	Independence	McAllister et al. (1995c); This study	

¹New Host Record