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Recent collections and additional records of Collembola from Arkansas caves.

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Abstract

Recent collections and additional records of Collembola from caves in Arkansas are reported. Based on these collections and review of the literature, 35 collembolan species are known from Arkansas caves. Included in this group are 10 troglolithic, or cave-limited, species: *Lethemurus missus*, *Pygmarrhopalites buffaloensis*, *Pygmarrhopalites clarus*, *Pygmarrhopalites dubius*, *Pygmarrhopalites youngsteadtii*, *Pseudosinella dubia*, *Pseudosinella testa*, *Sinella barri*, *Sinella cavernarum*, and *Typhlogastrura fousheensis*. Three of these species, *Py. buffaloensis*, *Py. youngsteadtii*, *T. fousheensis*, are endemic to Arkansas, while *Ps. dubia* is known only from the Ozark Plateaus Ecoregion. The remaining species are more widespread. *Lethemurus missus*, *Ps. georgia*, *Ps. testa*, and *S. cavernarum* are reported for the first time in Arkansas. On the basis of this information, revisions to the current rarity rankings for collembolan species classified as trogloliths are recommended.

Introduction

Perhaps the earliest collections of Collembola (springtails) from Arkansas caves were those collected by T.C. Barr in 1958. Those specimens contributed to the description of *Pseudosinella dubia* and *Pygmarrhopalites* (as *Arrhopalites*) *clarus*, while giving the first Arkansas cave records for *Pseudosinella argentea* and *Pygmarrhopalites* (as *Arrhopalites*) *pygmaeus* (Christiansen 1960a, Christiansen 1966). At that time, *Ps. dubia* was known from a few caves in Washington County, while *Py. clarus* was reported from caves in both Arkansas and Missouri. The species *Ps. argentea* and *Py. pygmaeus* were more widespread and included non-cave records from other states (Christiansen 1960a, Christiansen 1966). McDaniel and Smith (1976) reported the first Arkansas cave records for *Sinella barri*, *Folsomia candida*, and *Neanura barberi*, and added new cave locations across several counties for *Ps. argentea*, *Py.*

(as *Arrhopalites*) *clarus*, and *Py.* (as *Arrhopalites*) *pygmaeus*. Nearly twenty years after Barr's collections, Peck and Peck (1982) revisited one location for *Ps. dubia*, Devils Den Cave, and reconfirmed its presence there. Also from this cave, they reported *Folsomia candida*, and the first Arkansas cave records for *Deuteraphorura pseudofimetaria* (as *Onychiurus pseudofimetarius*) and *Tullbergia tullbergia iowensis*. The same year Dunivan et al. (1982) reported *Sinella barri* from a cave in Randolph County, adding a second county to the Arkansas portion of its range (Christiansen 1960b).

More recently, Christiansen and Bellinger (1998) reported county occurrences in Boone, Clay, Newton, Randolph, Searcy, Stone, and Washington for cave populations of *Ps. argentea*, and added a third county for *S. barri*. Graening et al. (2006) summarized cave faunal inventories conducted within the Buffalo National River and reported collembolan records for *Deuteraphorura pseudofimetaria* (as *Onychiurus pseudofimetarius*), *Folsomia novalis*, *Hypogastrura antra*, *Isotoma notabilis*, *Pogonognathellus* (as *Tomocerus*) *flavescens*, *Proisotoma ballistura antiqua*, *Pseudosinella aera*, *Ps. argentea*, *Pseudosinella collina*, *Pseudosinella folsomi*, *Pseudosinella violenta*, *Py.* (as *Arrhopalites*) *clarus*, *Py.* (as *Arrhopalites*) *pygmaeus*, *Ptenothrix ptenothrix marmorata*, *Smithurides hyogramme*, and *Tomocerina lamellifera* (as *Tomocerus lamelliferus*). In the same year, the species, *Typhlogastrura fousheensis*, was described from Foushee Cave, Independence County (Christiansen and Wang 2006). Finally, Zeppelini et al. (2009) described *Pygmarrhopalites buffaloensis* and *Pygmarrhopalites youngsteadtii* from individual caves in Newton County, added new cave records for *Py. pygmaeus*, and reported the first Arkansas cave record for *Pygmarrhopalites dubius*.

Over the past 6 years, a consortium of researchers, land managers, and agency personnel have conducted faunal inventories in Arkansas caves under an umbrella project called the Ozark Subterranean Biodiversity Project, and some of these inventories included collections of collembolans. The purpose of this study

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is to report these new springtail records, summarize Arkansas distributions for those species known typically from caves (troglobionts), and revise current rarity rankings of these troglobionts for future use in conservation planning.

Materials and Methods

A review of the literature was conducted, and a request for information was sent to Kenneth Christiansen in 2003 for Arkansas cave records listed in a Collembola Database maintained at Grinnell College. These records are not included in the results because they are publically available online (http://web.grinnell.edu/courses/bio/collembola/maintainable_menu.asp). All troglobiotic (or cave limited) species records from the Collembola Database, literature records, and recent collections were used to update rarity rankings. Field collections were made from 2001 to 2006. Most often, specimens were hand collected during visual inspection of woody debris, animal feces, or other organic material. Occasionally, specimens were extracted from organic material using a Berlese funnel. Collections were identified by one of three collembolan taxonomists: Kenneth Christiansen (Grinnell College, Iowa), Joseph Reznik (University of Vermont, Vermont), or Jeffery Batigelli (Earthwork Research Group, Alberta, Canada). An asterisk (*) by the species name indicates the species is a troglobiont. A "troglobiont" is a species that is only known from subterranean environments such as caves, and the use of this term is preferred instead of the word "troglobite" (Sket 2008).

Results

Twenty species of Collembola in 7 families were collected during field surveys, and these records are reported herein.

Family Arrhopalitidae Stach

**Pygmarrhopalites clarus* – Baxter County: Bonanza Cave, 07-October-2002, G. Graening, S. McGinnis, D. Kampwerth; Benton County: Rootville Cave, 01-July-2002, D. Kampwerth, V. Brahana; Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey; Carroll County: Huckleberry Point Cave, 18-September-2002, B. Wagner; Independence County: Cave Spring Cave, 05-October-2002, G. Graening, S. McGinnis, H. Bryant, C. Blevins; Madison County: Whipporwill Cave, 10-

October-2000, M. Slay, D. VanLuewen; Womack Spring Cave, 13-August-2000, S. Longing, G. Graening; Wounded Knee Cave, 27-May-2001, G. Graening, C. Brickey; Pope County: Sunk Bluff Cave, 19-February-2003, D. Kampwerth; Sharp County: Eckel Cave, 22-November-2002, G. Graening, D. Fenolio; Stone County: Rowland Cave, 12-June-2001, G. Graening, C. Brickey, J. Disler; Washington County: Granny Deen Cave, 28-January-2003, G. Graening, T. Snell, P. Shurgar, Z. Moon; Snyder Cave, 16-September-2001, M. Slay, R. Honebrink, B. Potter.

Pygmarrhopalites pygmaeus – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey; Independence County: Foushee Cave, 01-March-2005, Norman Youngsteadt, Jean Youngsteadt; Madison County: Whipporwill Cave, 12-May-2001, M. Slay, C. Brickey.

Pygmarrhopalites whitesidei – Newton County: Tweet's Cave, 26-October-2001, M. Slay, M. Covington.

Family Entomobryidae Schäffer

Coecobrya tenebricosa – Benton: Logan Cave, 22-January-2003, G. Graening, M. Slay, D. Kampwerth; Old Pendergrass Cave, 22-October-2001, G. Graening, G. Graening; Pope County: Sunk Bluff Cave, 19-February-2003, D. Kampwerth.

Pseudosinella argentea – Independence County: Foushee Cave, 01-March-2005, Norman Youngsteadt, Jean Youngsteadt.

Pseudosinella folsomi – Washington County: Fincher Cave, 07-July-2001, G. Graening, J. Gunter, A. Gunter; Snyder Cave, 16-September-2001, M. Slay, R. Honebrink, B. Potter.

Pseudosinella georgia – Washington County: Fincher Cave, 07-July-2001, G. Graening, J. Gunter, A. Gunter.

**Pseudosinella testa* – Washington County: Fincher Cave, 07-July-2001, G. Graening, J. Gunter, A. Gunter; Snyder Cave, 16-September-2001, M. Slay, R. Honebrink, B. Potter.

Pseudosinella violenta – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey; Marion County: Marble Falls Cave, 07-September-2001, G. Graening, M. Slay; Searcy

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County: Cyner Cave, 24-October-2002, D. Kampwerth, R. Schroeder, S. Martinez, S. Lowrance; Washington County: Granny Deen Cave, 28-January-2003, G. Graening, T. Snell, P. Shurgar, Z. Moon.

**Sinella cavernarum* – Independence County: Cave Spring Cave, 05-October-2002, G. Graening, S. McGinnis, H. Bryant, C. Blevins.

Family Isotomidae Schäffer

Folsomia candida – Stone County: Gustafson Cave, 06-October-2001, G. Graening, S. McGinnis, C. Brickey.

Folsomia fimetaria – Benton County: Old Pendergrass Cave, 22-October-2001, G. Graening, M. Slay; Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey; Stone County: Herald Hollow Cave, 23-March-2001, G. Graening, M. Slay.

Isotoma notabilis – Independence County: Foushee Cave, 01-March-2005, N. Youngsteadt, J. Youngsteadt.

Proisotoma dubia – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey.

Family Neanuridae Börner

Neanura serrata – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey.

Family Neelidae Folsom

Neelus minus – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey.

Family Sminthurididae Börner

Sminthurides plicatus – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey.

Family Tomoceridae Schäffer

**Lethemurus missus* – Stone County: Janus Pit, 01-February-2003, G. Graening, M. Slay, D. Kampwerth, E. Corfey.

Pogonognathellus bidentatus – Independence County: Cave Spring Cave, 05-October-2002, G. Graening, S. McGinnis, H. Bryant, C. Blevins; Stone County: Gustafson Cave, 06-October-2002, G. Graening, S. McGinnis, C. Brickey.

Pogonognathellus flavescens – Boone County: Big Hole Cave, 10-November-2001, M. Slay, M. Covington, C. Brickey; Madison County: Triple Cave, 01-January-2000, G. Graening; Wounded Knee Cave, 27-May-2001, G. Graening, C. Brickey; Marion County: Brown Cave, 16-November-2001, G. Graening, B. Sasse; Newton County: Hurricane River Cave, 15-January-2006, W. Baker; Stone County: Biology Cave, 17-September-2000, D. Fenolio, C. Brickey, S. Longing; Herald Hollow Cave, 23-March-2001, G. Graening, M. Slay.

Discussion

A total of 35 collembolan species are known from Arkansas caves. *Pseudosinella georgia*, *Ps. testa*, *S. cavernarum*, and *L. missus* are reported for the first time in Arkansas. Of the total species, 10 are considered troglobionts and are listed in Table 1. The most common troglotibiotic springtail in Arkansas is *Py. clarus* with populations occurring in 13 counties. *Pseudosinella dubia* is still known from just 4 caves in Washington County, Arkansas, but it was also identified by K. Christiansen from a cave in Dent County, Missouri from specimens collected by Gardner (1986). The rarest troglobionts are the recently described *Py. buffaloensis*, *Py. youngsteadtii*, and *T. fousheensis*; each endemic to its type locality (Christiansen and Wang 2006, Zeppelini et al. 2009). Given the greater U.S. distributions for *S. barri*, *S. cavernarum*, and *L. missus*, future species inventory is likely to identify other Arkansas cave populations.

Based on our current understanding of the distribution of troglotibiotic collembola in Arkansas, new rarity rankings are suggested for the national Natural Heritage Program. Existing rankings and recommended revisions are included in Table 1. Of continuing special concern are *T. fousheensis*, *Ps. dubia*, *Ps. testa*, and the recently described *Py. buffaloensis* and *Py. youngsteadtii*. Conversely, *Py. clarus* is now known from enough Arkansas sites to warrant upgrading to a less imperiled status in the state.

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Table 1. Distribution of troglotrophic collembola reported from Arkansas caves and updated rarity rankings at the Global (G-rank) and Subnational/State (S-rank) levels. A rank of 1 indicates the species is critically imperiled and a rank of 5 indicates the species is demonstrably widespread and secure. The reader is referred to NatureServe (2009) for a complete explanation of the ranking system and access to the national database.

Species	Number of AR caves	AR County Distribution	State Distribution*	Current G-rank	New G-rank	Current S-rank	New S-rank
<i>Lethemurus missus</i>	1	Stone	AR, CO, IL, IN, KY, MO, TN	G4	no change	not ranked	S1
<i>Py. buffaloensis</i>	1	Newton	AR	not ranked	G1	not ranked	S1
<i>Py. clarus</i>	26	Baxter, Benton, Boone, Carroll, Independence, Madison, Marion, Newton, Pope, Searcy, Sharp, Stone, Washington	AR, MO, SD, VA, WA, WI, WV	G4	no change	S1	S3
<i>Py. dubius</i>	1	Newton	AR, IA, MN	G2G3	no change	not ranked	S1
<i>Py. youngsteadtii</i>	1	Newton	AR	not ranked	G1	not ranked	S1
<i>Pseudosinella dubia</i>	4	Washington	AR, MO	G1G2	no change	not ranked	S1
<i>Pseudosinella testa</i>	2	Washington	AR, WV	G2G3	no change	not ranked	S1
<i>Sinella barri</i>	7	Izard, Lawrence, Randolph, Stone	AL, AR, IL, IN, KY, MD, MO, TN, VA, WI	G5	no change	not ranked	S1S2
<i>Sinella cavernarum</i>	1	Independence	AR, IL, IN, KY, MD, MO, OH, PA, TN, VA	G5	no change	not ranked	S1
<i>Typhlogastrura fousheensis</i>	1	Independence	AR	not ranked	G1	not ranked	S1

* U.S. state distributions were determined using NatureServe (2009) and Karst Waters Institute (2003).

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The Nature Conservancy (Arkansas Field Office), University of Arkansas, U.S. Fish & Wildlife Service (Arkansas Ecological Services), U.S. Forest Service (Ozark National Forest), and U.S. National Park Service (Buffalo National River).

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