

Journal of the Arkansas Academy of Science

Volume 58

Article 24

2004

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Recommended Citation

McAllister, Chris T.; Upton, Steve J.; and Bursey, Charles R. (2004) "Parasites (Coccidia, Trematoda, Nematoda) from Selected Bats of Arkansas," *Journal of the Arkansas Academy of Science*: Vol. 58 , Article 24.

Available at: <http://scholarworks.uark.edu/jaas/vol58/iss1/24>

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Parasites (Coccidia, Trematoda, Nematoda) from Selected Bats of Arkansas

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Little is known about the helminth and, particularly, coccidian parasites of bats. Duszynski (2002) provided a summary on the coccidia of bats in which he reported that of the 86 species of bats that have been previously surveyed for coccidia, only 11% harbored infections. He further suggested that there are at least 1,800 more species of coccidia yet to be discovered from the 920 bat species of the world. There are about 31 named species of *Eimeria* from bats worldwide, but only 9 (29%) of these are reported from North America (see Duszynski, 2002). Obviously, many of the species of bats worldwide remain to be surveyed, including 42 which occur in North America alone.

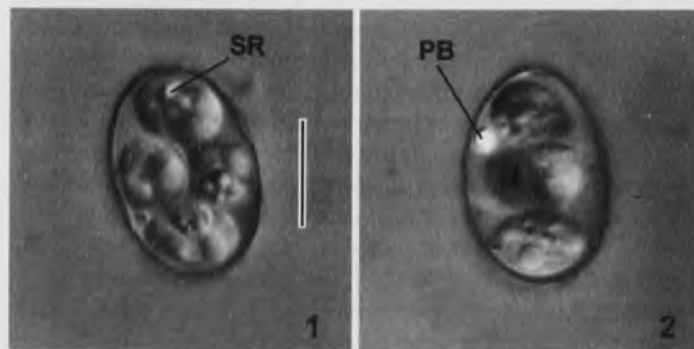
Of 16 species of bats found in Arkansas (Sealander and Heidt, 1990), only one, the eastern pipistrelle, *Pipistrellus subflavus*, has been reported to harbor coccidia, namely, *Eimeria macyi* Wheat, 1975 (McAllister et al., 2001). In other parts of the Ark-La-Tex tri-states region (and even Louisiana, Oklahoma, and Texas as a whole), no bats, to our knowledge, have ever been reported to harbor coccidia, although the region is rich in chiropteran diversity (Lowery, 1974; Caire et al., 1989; Schmidly, 1991, 2004).

Between June 2001 and June 2004, 83 bats (73 vespertilionids and 10 molossids) were collected with mist nets over watercourses or by hand from caves or abandoned mines (see Table 1). Bats were returned to the lab within 24 hr and processed and examined for coccidia following conventional methods (Wilber et al., 1998; McAllister et al., 2001). Measurements were made on 25 oocysts using a calibrated ocular micrometer and are reported in micrometers (μm). Descriptions of coccidian oocysts follow guidelines of Wilber et al. (1988) for abbreviations of eimerian morphology: length (L), width (W), micropyle (M), oocyst residuum (OR), polar granule (PG), ratios (L/W), Stieda body (SB), substieda body (SSB), parastieda body (PSB), sporocyst (SP), sporocyst residuum (SR), and sporozoite (SZ). Oocysts were 120 days old when measured and photographed. Selected bats ($n = 14$) also were examined for helminth parasites. Trematodes were stained with Semichon's acetocarmine, dehydrated through a graded series of ethanols, cleared in xylene, and mounted in Permout®. Nematodes were placed in a drop of glycerol on microscopic slides, and identifications were made from these temporary mounts. Voucher specimens of hosts were deposited in the Texas A&M University-Texarkana

Collection of Vertebrates (TAMU-TCV 1011-1015) and Arkansas State University Museum of Zoology (ASUMZ 30000). Parasites were deposited in the Harold W. Manter Laboratory of Parasitology (HWML), Lincoln, Nebraska, USA or the U.S. National Parasite Collection (USNPC), Beltsville, Maryland, USA as follows: *Eimeria catronensis* (photosyntypes, HWML 45797); *Acanthatrium lunatum* (USNM 93271); *Prosthodendrium transversum* (USNM 93270); *Seuratium cancellatum* (USNM 93428).

Four of 20 (20%) northern long-eared myotis (*Myotis septentrionalis*) were found to harbor coccidia, two of seven (29%) collected in September-October 2002, and two of 13 (15%) collected on 9 June 2004; the remaining 63 bats were negative. Sporulated oocysts (Figs. 1-2) from this host were found to match the description of *Eimeria catronensis* Scott and Duszynski, 1997, previously reported from 3/27 (11%) little brown bats (*Myotis lucifugus*) and 8/29 (28%) Yuma myotis (*Myotis yumanensis*) from Catron County, New Mexico (Scott and Duszynski, 1997). More recently, Seville and Gruver (2004) reported *E. catronensis* from 3/23 (13%) *M. lucifugus* from central Wyoming.

Ovoidal oocysts measured 19.9 L x 14.3 W (17.6-22.0 L x 13.2-15.2 W) with a rough oocyst wall ca. 1.0 (outer wall 0.6, inner wall 0.4), and L/W of 1.4 (1.2-1.6). An asymmetrically located M was present, ca. 2.0 W, and an OR was absent; usually large PGs were present. The SPs were football-shaped, 9.1 L x 6.7 W (8.8-9.8 L x 6.4-7.2 W),



Figs. 1-2. Photomicrographs of sporulated oocysts of *Eimeria catronensis* from *Myotis septentrionalis* in Arkansas. Scale bar = 10 μm . Abbreviations: SR, sporocyst residuum; PB, polar body.

with L/W of 1.4 (1.3-1.4). An indistinct SB was present, SSB and PSB bodies were absent; SRs of various sizes were clustered among SZ, small to large, coarse granules. The SZs were elongate, arranged head-to-tail within the SP, 11.4 L x 2.7 W (10.4-12.8 L x 2.4-3.0 W) in situ, and contain both anterior (1.7 L x 1.7 W) and posterior (3.6 L x 2.6 W) refractile bodies. *Eimeria catronensis* is reported from Arkansas and this host species for the first time. In addition to the new host record, the Arkansas collection site is over 1,288 km (800 mi) due east of the type locale for *E. catronensis*.

Twelve lecithodendrid trematodes, *Prosthodendrium transversum* Byrd and Macy, 1942, were found in the small intestine of 1/5 (20%) *M. septentrionalis* from Pipistrelle Mine, Polk County, Arkansas. This parasite was originally described from the eastern red bat (*Lasiurus borealis*) from Reelfoot Lake, Tennessee (Byrd and Macy, 1942). This is only the second report of *P. transversum* and represents a new host record and locality for the trematode. In the life cycle, snails and anopheline mosquitoes serve as intermediate hosts, and the adult worm develops in the intestinal tract of bats, which have most likely ingested mosquitoes (Abdel-Azim, 1936).

Four additional lecithodendrid trematodes, *Acanthatrium lunatum* Williams, 1960 were found in the small intestine of 1/7 (14%) *P. subflavus* from the same Polk County site above. This flatworm was originally described from 7/51 (14%) big brown bats (*Eptesicus fuscus*) from Carter County, Kentucky, and Franklin County, Ohio (Williams, 1960). The only other known host is *L. borealis* from Iowa (Blankespoor and Ulmer, 1970). The life cycle of *Acanthatrium* spp. includes snails and caddisfly larvae, and bats become infected from eating infected caddisflies (Knight and Pratt, 1955; Burns, 1961).

Seven ascarid nematodes, *Seuratium cancellatum* Chitwood, 1938, were found in the small intestine of 1/5 (20%) *M. septentrionalis* from Polk County. This nematode was originally described from the Mexican funnel-eared bat, *Natalus mexicanus* (= *stramineus*) from the Yucatan, Mexico (Chitwood, 1938). Several other bats have been reported as hosts of this parasite, including the pallid bat (*Antrozous pallidus*), *E. fuscus*, the western bonneted bat (*Eumops perotis*), the California myotis (*Myotis californicus*), *M. yumanensis*, the western pipistrelle (*Pipistrellus hesperus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and the Brazilian free-tailed bat (*T. brasiliensis*), all from Brewster County, Texas (Specian and Ubelaker, 1976). The life cycle of *S. cancellatum* has not been studied, but *S. cadarachense* and *S. nguyenvanai* require insect intermediate hosts (Anderson, 2000).

Ova of the nematode, *Capillaria palmata* Chandler, 1938 were found in the feces of 2/9 (22%) *E. fuscus*. This parasite was originally described from the evening bat (*Nycticeius humeralis*) from Texas (Chandler, 1938).

Additional hosts and/or localities include Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) from Arkansas (McAllister et al., 2005), *E. fuscus* from Iowa (Blankespoor and Ulmer, 1970), Texas (Jameson, 1959), and Minnesota (Lotz and Font, 1985, 1991), *N. humeralis* from Louisiana (Lotz and Font, 1991), the silver-haired bat (*Lasiorycteris noctivagans*) from Iowa (Blankespoor and Ulmer, 1970), the southeastern myotis (*Myotis austroriparius*) from Minnesota (Lotz and Font, 1991), the gray bat (*Myotis grisescens*) from Kansas (Nickel and Hansen, 1967), *M. lucifugus* from Louisiana (Lotz and Font, 1991), Iowa (Blankespoor and Ulmer, 1970), and Wisconsin (Coggins et al., 1982), and *P. subflavus* from Minnesota (Lotz and Font, 1991).

Herein we report several new host and distributional records for parasites of Arkansas bats. Additional studies on the parasites of Ark-La-Tex bats are certainly warranted, particularly intensive surveys on the coccidia, where additional new geographic and host records, and possibly new species are anticipated.

ACKNOWLEDGMENTS.—Numerous colleagues provided help in the field, including members of the 2003 Ouachita Mountains Bat Blitz (specifically S. Fields, Z. Ramsey, B. Sasse and D. Saugey). We further acknowledge E. Britzke, B. Crump, T. Jones, and L. Wilf for providing samples from various bats. We also thank M. Kinsella for confirming the identity of *S. cancellatum*, A. Jiménez for curatorial assistance, and the Arkansas Game and Fish Commission and Oklahoma Department of Wildlife Conservation for scientific collecting permits.

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Table 1. Bat species surveyed for coccidia in this study.

Bat Family/Date	Species	Localities (State: County, Site) and Sample Sizes (parentheses)
Vespertilionidae		
July 2001	<i>Myotis austroriparius</i>	Mississippi: Sharkey Co., Delta National Forest (n = 15)
Sept. 2002	<i>M. austroriparius</i>	Arkansas: Pike Co., Lake Greeson (n = 12)
Sept./Oct. 2002	<i>Myotis septentrionalis</i>	Arkansas: Polk Co., Pipistrelle Mine (n = 5)
Aug. 2003	<i>M. septentrionalis</i>	Arkansas: Montgomery Co., Ouachita National Forest (n = 2)
June 2004	<i>M. septentrionalis</i>	Arkansas, Polk Co., Pipistrelle Mine (n = 13)
Sept. 2003	<i>Myotis velifer</i>	Oklahoma: Woodward Co., Alabaster Caverns State Park (n = 1)
June 2001	<i>Lasiurus seminolus</i>	Arkansas: Miller Co., Doddridge (n = 1)
July 2003	<i>L. seminolus</i>	Texas: Cass Co., Bloomburg (n = 1)
June 2004	<i>L. seminolus</i>	Arkansas: Miller Co., Doddridge (n = 1)
Aug. 2003	<i>Nycticeius humeralis</i>	Arkansas: Montgomery Co., Ouachita National Forest (n = 2)
June 2003	<i>Eptesicus fuscus</i>	Arkansas: Independence Co., Cushman Cave (n = 9)
Aug. 2003	<i>E. fuscus</i>	Arkansas: Montgomery Co., Mt. Ida (n = 2)
Oct. 2002	<i>Pipistrellus subflavus</i>	Arkansas: Polk Co., Pipistrelle Mine (n = 7)
Aug. 2003	<i>P. subflavus</i>	Arkansas: Montgomery Co., Ouachita National Forest (n = 2)
Molossidae		
Nov. 2003	<i>Tadarida brasiliensis</i>	Oklahoma: Major Co., Wayoka (n = 10)