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## ***Caryospora duszynskii* (Apicomplexa: Eimeriidae) from the Speckled Kingsnake, *Lampropeltis holbrooki* (Reptilia: Ophidia), in Arkansas, with a Summary of Previous Reports**

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The speckled kingsnake, *Lampropeltis holbrooki* Stejneger (= *L. getula holbrooki*) is a medium sized colubrid that ranges from southern Iowa south through Missouri, Arkansas, western Tennessee, eastern Oklahoma, eastern Texas, Mississippi, and Louisiana to the Gulf of Mexico (Conant and Collins 1998). In Arkansas, *L. holbrooki* can be found statewide where it inhabits forested woodlands and rocky hillsides in the Interior Highlands (Ozark and Ouachita mountains) to floodplains and swampy wetlands in the Gulf Coastal Plain (Trauth et al. 2004).

Much is known about the ecology of this snake (see Trauth et al. 2004); however, less is known about its coccidian parasites. Fully sporulated oocysts and free sporocysts of *Sarcocystis montanaensis* Dubey were reported in a naturally infected *L. holbrooki* from Benton County, Arkansas by Lindsay et al. (1992) where they determined this snake species was the definitive host in a previously unknown speckled kingsnake-prairie vole (*Microtus ochrogaster*) life cycle. However, after carefully examining the same isolate, Duszynski and Upton (2009) found minor differences in sporocyst size and in the primary sarcocyst wall and named it as a new species, *Sarcocystis lampropeltii*. In addition, *Eimeria zamenis* Phisalix has been reported from *L. holbrooki* in Illinois and Iowa (see Duszynski and Upton 2009). Herein, we document a new host record for another coccidian parasite of *L. holbrooki* as well as a summary of hosts of this coccidian.

Between March 2010-August 2011, 11 adult colubrid snakes, including 2 southern black racers, *Coluber constrictor priapus* from Polk County, 2 western ratsnakes, *Scotophis obsoletus* from Pike and Sevier counties, 1 prairie kingsnake, *Lampropeltis calligaster calligaster* from Hot Spring County, 2 *L. holbrooki* from Franklin and Pope counties, 1 Great Plains ratsnake, *Pantherophis* (= *Elaphe*) *emoryi* from

Pope County, Arkansas, 1 Great Plains rat snake, *Pantherophis emoryi* from McCurtain County, Oklahoma, and 2 Texas patchnose snakes, *Salvadora grahamiae lineata* from Johnson County, Texas were collected by hand and examined for coccidian parasites. Snakes were killed with an overdose of sodium pentobarbital (Nembutal®) and a mid-ventral incision was made to expose fecal contents. Feces was collected and placed in individual vials containing 2.5% (w/v) aqueous potassium dichromate (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>) and examined by light microscopy following flotation in Sheather's sugar solution (specific gravity = 1.30). Negative samples were discarded and a single positive sample with unsporulated oocysts was allowed 1 week of sporulation at room temperature (ca. 23°C) in a Petri dish containing a thin layer of 2.5% K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. This sample was shipped to R.S. Seville and oocysts were concentrated with Sheather's sugar solution (sp. gr. 1.30) and examined using a compound microscope equipped with Nomarski interference-contrast (DIC) optics. Thirty-six oocysts were photographed and measured using Olympus Microsuite® software. Measurements are reported in micrometers (µm) with means followed by the ranges in parentheses. Oocysts were ca. 71 days old when measured and photographed. Standardized abbreviations for characteristics of oocysts and sporocysts are per Wilber et al. (1998) as follows: oocyst length (L) and width (W), their ranges and ratios (L/W), micropyle (M), oocyst residuum (OR), polar granules (PG), sporocyst length (L) and width (W), their ranges and ratio (L/W), Stieda body (SB), substieda body (SSB), parastieda body (PSB), and sporocyst residuum (SR). A photovoucher of a sporulated oocyst (Fig. 1) was accessioned into the United States National Parasite Collection, Beltsville, Maryland as USNPC 104376. A host voucher specimen was deposited in the Henderson State University Herpetology Collection (HSU),

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Arkadelphia, Arkansas as HSU 1517. Host taxonomy follows Collins and Taggart (2008, 2009), Pyron and Burbrink (2009) or the Reptile Database (Uetz 2011).

One of 11 (9%) of the snakes was infected with coccidia. A single *L. holbrooki* (female, 472 mm snout-vent length) collected on 23 April 2010 from 3.2 km S of Cass off St. Hwy 23, Franklin County (35.587387°N, 92.852596°W) was found to be passing oocysts of a coccidian fitting the description of *Caryospora duszynskii* Upton, Current and Barnard, 1984 (Fig. 1). Oocysts were spheroidal to subspheroidal, L × W = 24.9 × 23.3 (22.0-27.5 × 21.2-25.6), L/W ratio 1.1 (1.0-1.1), PG present, oocyst wall bilayered, ~ 1.9 (1.7-2.2), rough outer 2/3 thickness with no OR or M; sporocysts were ovoidal, L × W = 17.7 × 12.9 (15.4-19.2 × 11.5-13.9), L/W ratio 1.4 (1.3-1.5), SB and SSB prominent, PSB absent, SR composed of numerous spheroidal granules dispersed into small and large granules. No gross pathology was observed in this host.

*Caryospora duszynskii* was originally described from the eastern corn snake, *Pantherophis* (= *Elaphe*) *guttatus* from Georgia (Upton et al. 1984). Since then the species has been found in other North American colubrid snakes, including those in the genera *Lampropeltis*, *Masticophis*, *Pantherophis* and *Scotophis* (Table 1; Arkansas State University Museum

of Zoology = ASUMZ). Upton et al. (1984) provided the first published photomicrograph and line drawing of an oocyst of *C. duszynskii*, which compare favorably to oocysts we describe herein (Figs. 1-2). We did observe some minor differences in measurements between the two isolates (Table 2), but all other morphological features were essentially the same. Perhaps the use of molecular tools, rather than relying on morphology alone, could help elucidate whether coccidians found are truly the same species or represent cryptic species in separate host species (Williams et al. 2010).

Modrý et al. (2005) recently demonstrated that mice (*Mus musculus*) are capable of indirectly transmitting infections of *C. duszynskii* to uninfected snakes (*P. guttatus* and *S. obsoletus*). Since speckled kingsnakes and other hosts of *C. duszynskii* primarily eat rodents (Green 1997), this finding may be an integral part of the natural history of these hosts. In addition, Modrý et al. (2005) demonstrated the direct transmission of *C. duszynskii* from *P. guttatus* to *P. obsoletus*. Interestingly, *L. holbrooki* in Arkansas has been shown to eat other reptiles (including hosts of *C. duszynskii*) and their eggs (Trauth and McAllister 1995). Additional studies are suggested to investigate this ecological phenomenon in other Arkansas snakes.

Table 1. Seven known hosts of *Caryospora duszynskii*.

Host	State	Prevalence <sup>1</sup>	Reference
<i>Pantherophis guttatus</i>	Georgia	1/1 (100%)	Upton et al. (1984)
	Florida	2/3 (67%)	Modrý et al. (2005)
<i>P. emoryi</i>	Oklahoma <sup>2</sup> ; Texas <sup>3</sup>	2/2 (100%); 2/8 (25%)	McAllister (1989); McAllister et al. (1995); McAllister and Upton (pers. obs.)
<i>Scotophis obsoletus</i>	Missouri	1/1 (100%)	Upton et al. (1984)
	Texas	1/4 (25%)	McAllister (1989); McAllister et al. (1995)
<i>Lampropeltis calligaster calligaster</i>	Arkansas <sup>4</sup> ; Oklahoma	2/2 (100%); 1/1(100%)	McAllister et al. (1995) McAllister and Upton (pers. obs.)
<i>L. holbrooki</i> <sup>5</sup>	Arkansas	1/2 (50%)	This report
<i>L. triangulum sypila</i> <sup>5</sup>	Arkansas <sup>6</sup>	1/6 (17%)	McAllister and Upton (pers. obs.)
<i>Masticophis flagellum flagellum</i>	Arkansas	1/3 (33%)	Upton et al. (1994)

<sup>1</sup>Prevalence in collected samples = number infected/number examined (percent); prevalence values may not represent reality as larger sample sizes may yield more relevant prevalence.

<sup>2</sup>Collected on 29 September 1992 from Greer County, Oklahoma (ASUMZ 18601).

<sup>3</sup>Collected on 26 April 1991 from Jim Hogg County, Texas (host released).

<sup>4</sup>Collected on 29 June 1993 from Conway County, Arkansas (ASUMZ 19104).

<sup>5</sup>New host record.

<sup>6</sup>Collected on 30 June 1992 from Lee County, Arkansas (ASUMZ 18524); mixed infection with *Caryospora lampropeltis*.

Table 2. Selected comparative measurements for 3 isolates of *C. duszynskii*.

Host	Oocysts <sup>1</sup>	Sporocysts <sup>2</sup>	Reference
	L × W (range) μm	L × W (range) μm	
<i>Pantherophis guttatus</i>	25.7 × 24.3 (23.0-28.5 × 22.0-28.0)	18.3 × 14.8 (17.0-21.5 × 13.5-16.5)	Upton et al. (1984)
<i>Scotophis obsoletus</i>	27.7 × 26.0 (25.6-29.6 × 24.8-28.0)	19.3 × 14.3 (18.4-20.8 × 13.6-15.0)	McAllister (1989)
<i>Lampropeltis holbrooki</i>	24.9 × 23.3 (22.0-27.5 × 21.2-25.6)	17.7 × 12.9 (15.4-19.2 × 11.5-13.9)	This report

<sup>1</sup>Oocyst L/W ratios = 1.1 (1.0-1.1) vs. 1.1 (1.0-1.1) vs. 1.1 (1.0-1.1).

<sup>2</sup>Sporocyst L/W ratios = 1.2 (1.1-1.3) vs. 1.4 (1.3-1.4) vs. 1.4 (1.3-1.5).

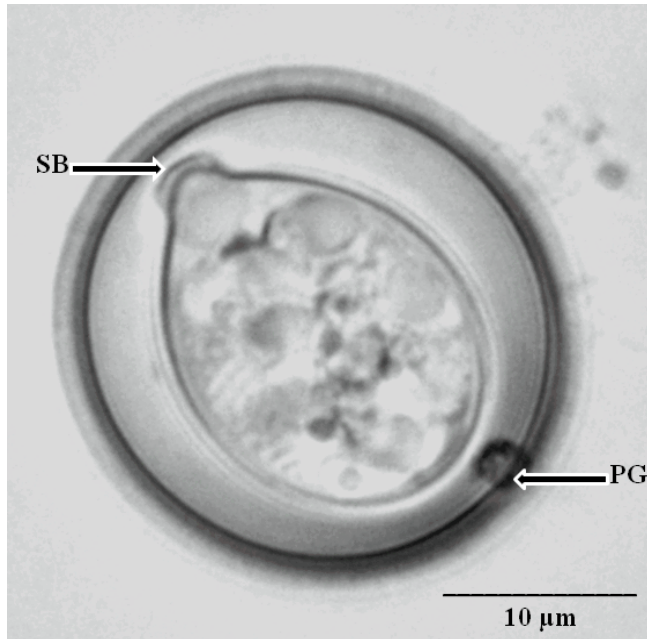


Figure 1. Sporulated oocyst of *Caryospora duszynskii* from *Lampropeltis holbrooki* collected in Franklin County, Arkansas. PG = polar granule; SB = Stieda body.

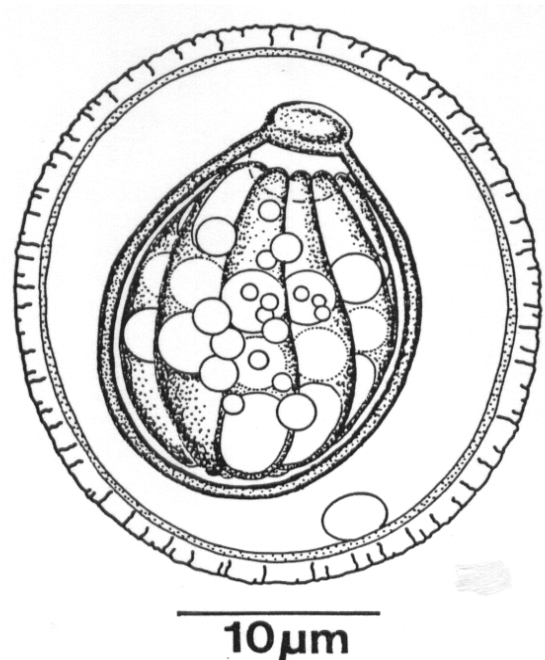


Figure 2. Line drawing of *Caryospora duszynskii* from *Pantherophis* spp. (Redrawn from Upton et al. 1984; see McAllister 1989, Fig. 16).

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## Literature Cited

- Collins JT and TW Taggart.** 2008. An alternative classification of the New World rat snakes (genus *Pantherophis* [Reptilia: Squamata: Colubridae]). *Journal of Kansas Herpetology* 26:16-18.
- Collins JT and TW Taggart.** 2009. Standard common and current scientific names for North American amphibians, turtles, reptiles, and crocodylians. Sixth Edition. Lawrence: Center for North American Herpetology. iv + 44 p.

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- Conant R** and **JT Collins**. 1998. Reptiles and amphibians of eastern and central North America. Third Edition, Expanded. Boston: Houghton Mifflin Company. 616 p.
- Duszynski DW** and **SJ Upton**. 2009. The biology of the coccidia (Apicomplexa) of snakes: A scholarly handbook for identification and treatment. CreateSpace: A DBA of on-demand Publishing LLC, Amazon.com Inc. 422 p.
- Green HW**. 1997. Snakes: The evolution of mystery in nature. Berkeley: University of California Press. 351 p.
- Lindsay DS**, **SJ Upton**, **BL Blagburn**, **M Tovio-Kinnucan**, **JP Dubey**, **CT McAllister** and **SE Trauth**. 1992. Demonstration that *Sarcocystis montanaensis* has a speckled kingsnake-prairie vole life cycle. Journal of the Helminthological Society of Washington 59:9-15.
- McAllister CT**. 1989. Systematics of coccidian parasites (Apicomplexa) from amphibians and reptiles in northcentral Texas. Ph.D. dissertation. University of North Texas, Denton, TX. 152 p. (Available from: University of North Texas library).
- McAllister CT**, **SJ Upton**, **SE Trauth** and **JR Dixon**. 1995. Coccidian parasites (Apicomplexa) from snakes in the southcentral and southwestern United States: New host and geographic records. Journal of Parasitology 81:63-8.
- Modrý D**, **J Šlapeta** and **B Koudela**. 2005. Mice serve as paratenic hosts for transmission of *Caryospora duszynskii* (Apicomplexa: Eimeriidae) between snakes of the genus *Elaphe*. Folia Parasitologica (Praha) 52:205-8.
- Pyron RA** and **FT Burbrink**. 2009. Systematics of the common kingsnake (*Lampropeltis getula*: Serpentes: Colubridae) and the burden of heritage in taxonomy. Zootaxa 2241:22-32
- Trauth SE** and **CT McAllister**. 1995. Vertebrate prey of selected Arkansas snakes. Proceedings of the Arkansas Academy of Science 49:188-92.
- Trauth SE**, **HW Robison** and **MV Plummer**. 2004. The amphibians and reptiles of Arkansas. Fayetteville: University of Arkansas Press. 421 p.
- Upton SJ**, **WL Current** and **SM Barnard**. 1984. A new species of *Caryospora* (Apicomplexa: Eimeriidae) from *Elaphe* spp. (Serpentes: Colubridae) of the southeastern and central United States. Transactions of the American Microscopical Society 103:240-4.
- Uetz P**. 2011. The Reptile Database [web application]. <http://www.reptile-database.org>. (Accessed April 1, 2011).
- Upton SJ**, **CT McAllister** and **SE Trauth**. 1994. *Caryospora masticophis* n. sp. (Apicomplexa: from *Masticophis flagellum* and *Coluber constrictor* (Serpentes) in Arkansas, U.S.A. Transactions of the American Microscopical Society 113:395-9.
- Williams RB**, **P Thebo**, **RN Marshall** and **JA Marshall**. 2010. Coccidian oöcysts as type-specimens: Long-term storage in aqueous potassium dichromate solution preserves DNA. Systematic Parasitology 76:69-76.
- Wilber PG**, **DW Duszynski**, **SJ Upton**, **RS Seville** and **JO Corliss**. 1998. A revision of the taxonomy and nomenclature of the *Eimeria* spp. (Apicomplexa: Eimeriidae) from rodents in the tribe Marmotini (Sciuridae). Systematic Parasitology 39:113-35.