Literature Cited

Baker, M. R. 1980. Revision of old world species of the genus *Aplectana* Railliet & Henry, 1916 (Nematoda, Cosmocercidae). Bulletin du Muséum National d'Histoire Naturelle, Série 2, Section A 4:955–998.

———. 1987. Synopsis of the Nematoda parasitic in amphibians and reptiles. Memorial University of Newfoundland, Occasional Papers in Biology 11: 1–325.

Hasegawa, H. 1990. Helminths collected from amphibians and reptiles on Amami-oshima Island, Japan. Memoirs of the National Science Museum, Tokyo 23:83–92.

Nakamura, K., and S. Uéno. 1970. Japanese Reptiles and Amphibians in Colour. Hoikusha Publishing Company, Osaka, Japan. 214 pp.

Welch, K. R. G., P. S. Cooke, and A. S. Wright. 1990. Lizards of the Orient: A Checklist. Krieger Publishing Company, Malabar, Florida. 162 pp.

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Research Note

Hemogregarines and *Sarcocystis* sp. (Apicomplexa) in a Western Green Rat Snake, *Senticolis triaspis intermedia* (Serpentes: Colubridae), from New Mexico

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ABSTRACT: A western green rat snake, *Senticolis triaspis intermedia* (Boettger, 1883), was collected from southwestern New Mexico and examined for endoparasites. Gamonts of 3 different hemogregarines were found in erythrocytes, and oocysts and free sporocysts of a *Sarcocystis* sp. were present in intestinal contents and feces. Measurements of small, medium, and large forms of intraerythrocytic gamonts were 12.8 × 3.4 (10.4–14.4 × 2.8–4.2) μm ($N = 20$), 17.0 × 4.0 (16.0–18.4 × 3.2–4.8) μm ($N = 20$), and 17.8 × 7.4 (16.0–20.0 × 6.2–8.8) μm ($N = 20$), respectively. Sporocysts of the *Sarcocystis* sp. were 12.7 × 10.6 (12.0–13.6 × 10.0–11.2) μm ($N = 20$) and had a shape index (length/width) of 1.20 (1.07–1.24). Although anecdotal information is available on parasites of *E. triaspis intermedia,* this is the first documentation of detailed information.

KEY WORDS: Apicomplexa, coccidia, gamonts, hemogregarines, Protozoa, *Sarcocystis* sp., *Senticolis triaspis intermedia,* western green rat snake, Colubridae, New Mexico.

The western green rat snake, *Senticolis triaspis intermedia* (Boettger, 1883), is a moderately large colubrid that ranges from southeastern Arizona, southwestern New Mexico, and southern Tamaulipas, Mexico, southward along the western Mexican highlands to Costa Rica (Stebbins, 1985; Garrett and Painter, 1992). It inhabits wooded and rocky canyon bottoms near streams in mountainous areas. Little is known about the biology of this snake (Wright and Wright, 1957; Dowling, 1960; Dowling and Fries, 1987; Cranston, 1989, 1990), and only anecdotal data are available on its parasites (Cranston, 1990). Herein, we report detailed information on 4 species of apicomplexan parasites found in a *S. triaspis intermedia.*

On 27 April 1992, an adult male *S. triaspis intermedia* (snout–vent length = 734 mm, University of New Mexico Museum of Southwestern Biology, MSB 54161) was collected by 1 of us (C.M.G.) in Guadalupe Canyon of the Peloncillo Mountains of extreme southwestern Hidalgo County, New Mexico (31°21′N, 109°03′W). This snake represented the first voucher specimen from the state (Garrett and Painter, 1992). The spec-

Table 1. Measurements of 20 gamonts of 3 types of hemogregarines found in erythrocytes of *Senticolis triaspis intermedia*.

Morphological type	Length (μm) $\bar{x}$ ± SD (range)*	Width (μm) $\bar{x}$ ± SD (range)†
Small form	12.8 ± 1.0 (10.4–14.4)	3.4 ± 0.4 (2.8–4.2)
Medium form	17.0 ± 1.0 (16.0–18.4)	4.0 ± 0.4 (3.2–4.8)
Large form	17.8 ± 1.3 (16.0–20.0)	7.4 ± 0.8 (6.2–8.8)

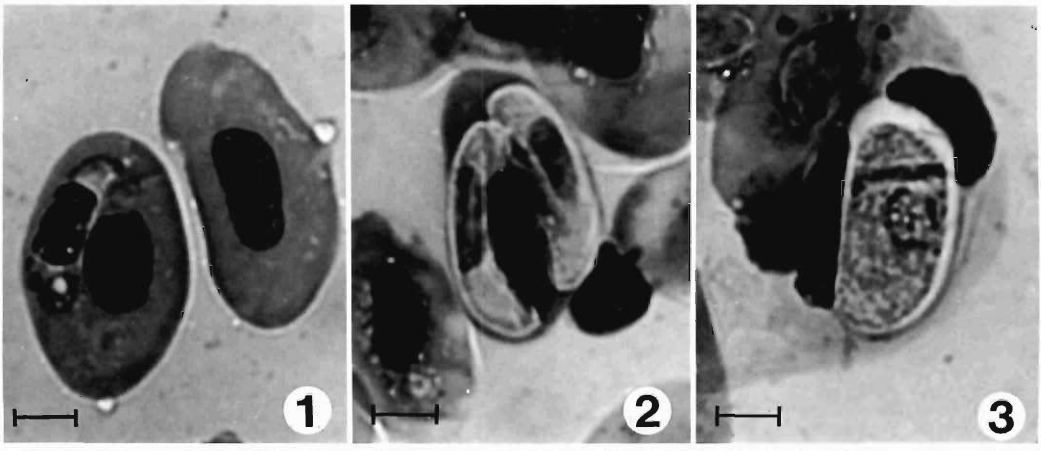
* For lengths, $P < 0.001$ from small form to medium form, $P < 0.001$ from small form to large form, and $P < 0.05$ from medium form to large form.

† For widths, $P < 0.005$ from small form to medium form, $P < 0.001$ from small to large form, and $P < 0.001$ from medium form to large form (paired Student's t-test, df = 19).

imen was returned to the laboratory and killed with an overdose of sodium pentobarbital (Nembutal®, Abbott Laboratories, North Chicago, Illinois). Prior to killing, blood was obtained from the heart and films were air-dried, fixed in absolute methanol, stained with Wright's stain, and rinsed in phosphate buffer (pH = 7.2). Intestinal contents and feces were collected, placed in 2.5% (w/v) aqueous potassium dichromate, and processed further for coccidians using previously described methods (Upton and McAllister, 1990). Measurements were made on gamonts and sporocysts using a calibrated ocular micrometer. All measurements represent the mean of 20 ± 1 SD under a ×100 oil immersion lens and are in micrometers followed by the ranges in parentheses. A blood film has been deposited in the USNM Helminthological Collection, United States Department of Agriculture, Beltsville, Maryland 20705, as USNM 82744.

Gamonts of 3 distinct morphological and statistically significant different types of hemogregarines were observed in blood smears (Table 1). The most commonly encountered gamonts were short, elongate parasites with a central nucleus containing dark-staining cytoplasmic granules (Fig. 1). Another form was elongate, with curved ends, a central nucleus, and pale blue cytoplasm (Fig. 2). The third form differed by having large, robust gamonts, lightly staining cytoplasm, and an eccentric nucleus, usually at the posterior end but occasionally centrally located (Fig. 3). Since hemogregarines cannot be consistently distinguished solely by erythrocytic stages, generic designation is not possible (Telford, 1984). Although parasites described herein may represent either a species of *Hepatozoon* or *Haemogregarina,* we refrain from assigning generic designations without complete knowledge of the life cycles.

Cranston (1990) reported hemogregarines and trypanosomes from 2 *S. triaspis intermedia* from southeastern Arizona without giving specific morphological information. In addition, related



Figures 1–3. Gamonts of 3 forms of hemogregarines in erythrocytes of *Senticolis triaspis intermedia* from New Mexico. 1. Small form. 2. Medium or elongate form. 3. Large or robust form. Scale bars = 5.0 μm.

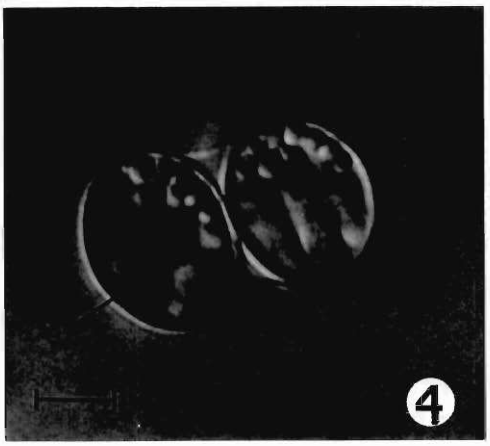


Figure 4. Oocyst of *Sarcocystis* sp. from *Senticolis triaspis intermedia* from New Mexico. Abbreviations: ow = oocyst wall, sp = sporocyst, sr = sporocyst residuum, sz = sporozoite. Scale bar = 5.0 μm.

rat snakes, *Elaphe obsoleta* (Say, 1823), from Arkansas, Louisiana, Illinois, and Ohio, and Great Plains rat snakes, *E. guttata emoryi* (Baird and Girard, 1853), from Texas have been reported to be hosts of hemogregarines (Hilman and Strandtmann, 1960; Hull and Camin, 1960; Marquardt, 1966; Daly et al., 1984; Lowichik and Yeager, 1987).

Oocysts and free sporocysts of a *Sarcocystis* sp. (Fig. 4) were recovered from intestinal contents and feces. Measurements of 20 sporocysts were 12.7 ± 0.43 × 10.6 ± 0.38 (12.0–13.6 × 10.0–11.2) μm and had a shape index (length/width) of 1.20 ± 0.06 (1.07–1.29). Numerous species of *Sarcocystis* have been reported from snakes (Upton et al., 1992), and it is impossible to distinguish species without tissue stages in the intermediate host. Although Cranston (1990) reported "coccidia" from *S. triaspis intermedia,* we are not sure whether or not he was referring to a species of *Sarcocystis.*

In conclusion, other than previously published anecdotal information, this is the first report of endoparasites from *E. triaspis intermedia.* Further study surveying a larger sample size of this snake for parasites throughout its range is warranted.

Literature Cited

Cranston, T. 1989. Captive propagation and husbandry of the western green rat snake (*Senticolis triaspis intermedia*): the untold story. Pages 81–85 *in* R. L. Gowen (ed.), Proceedings of the 4th Northern California Herpetological Societies Conference on Captive Propagation and Husbandry of Reptiles and Amphibians.

———. 1990. Natural history and captive husbandry of the western green rat snake. Vivarium 2:8–11, 23.

Daly, J. J., R. C. McDaniel, J. W. Townsend, and C. H. Calhoun, Jr. 1984. Alterations in the plasma membranes of *Hepatozoon*-infected snake erythrocytes as evidenced by differential staining. Journal of Parasitology 70:151–153.

Dowling, H. G. 1960. A taxonomic study for the ratsnakes, genus *Elaphe* Fitzinger. VII. The *triaspis* section. Zoologica 45:53–79.

———, **and I. Fries.** 1987. A taxonomic study of the ratsnakes VIII. A proposed new genus for *Elaphe triaspis* (Cope). Herpetologica 43:200–208.

Garrett, C. M., and C. W. Painter. 1992. Geographic distribution: *Senticolis triaspis intermedia.* Herpetological Review 23:124.

Hilman, J. L., and R. W. Strandtmann. 1960. The incidence of *Hepatozoon serpentium* in some Texas snakes. Southwestern Naturalist 5:226–228.

Hull, R. W., and J. H. Camin. 1960. Haemogregarines in snakes: the incidence and identity of the erythrocytic stages. Journal of Parasitology 46:515–523.

Lowichik, A., and R. G. Yeager. 1987. Ecological aspects of snake hemogregarine infections from two habitats in southeastern Louisiana. Journal of Parasitology 73:1109–1115.

Marquardt, W. C. 1966. Haemogregarines and *Haemoproteus* in some reptiles in southern Illinois. Journal of Parasitology 52:823–824.

Stebbins, R. C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company, Boston. 336 pp.

Telford, S. R., Jr. 1984. Haemoparasites of reptiles. Pages 408–434 *in* G. L. Hoff, F. L. Frye, and E. R. Jacobson, eds. Diseases of Amphibians and Reptiles. Plenum Press, New York.

Upton, S. J., and C. T. McAllister. 1990. The *Eimeria* (Apicomplexa: Eimeriidae) of Serpentes, with descriptions of three new species from colubrid snakes. Canadian Journal of Zoology 68: 855–864.

———, ———, **S. E. Trauth, and D. K. Bibb.** 1992. Description of two new species of coccidia (Apicomplexa: Eimeriorina) from flat-headed snakes, *Tantilla gracilis* (Serpentes: Colubridae) and reclassification of misnomer species within the genera *Isospora* and *Sarcocystis* from snakes. Transactions of the American Microscopical Society 111: 50–60.

Wright, A. H., and A. A. Wright. 1957. Handbook of Snakes of the United States and Canada. Comstock Publishing Associates, Ithaca, New York. 1,105 pp.