

**An extreme case of a trematode infection of a larval Ozark Blind Salamander, *Eurycea spelaea* (Caudata: Plethodontidae) from the Ozark Highlands of Missouri, USA**

**Danté B. Fenolio<sup>1,2</sup>, Chris T. McAllister<sup>3</sup>, Matthew L. Niemiller<sup>4</sup>, Daphne Soares<sup>5</sup>, and Jim Cooley<sup>6</sup>**

<sup>1</sup>Department of Conservation Research, Atlanta Botanical Garden, 1345 Piedmont Ave NE, Atlanta, Georgia 30309, USA. (corresponding author)

<sup>2</sup>San Antonio Zoo, Department of Research and Conservation, 3903 N. St. Mary's St., San Antonio, TX 78212. E-mail: [dfenolio@sazoo.org](mailto:dfenolio@sazoo.org) (present address)

<sup>3</sup>Science and Mathematics Division, Eastern Oklahoma State College, 2805 Lincoln Rd., Idabel, Oklahoma 74745, USA. E-mail: [cmcallister@se.edu](mailto:cmcallister@se.edu)

<sup>4</sup>Department of Ecology and Evolutionary Biology, Yale University, 21 Sachem St. 368 ESC, New Haven, Connecticut, USA. E-mail: [cavemander17@gmail.com](mailto:cavemander17@gmail.com)

<sup>5</sup>Department of Biology, University of Maryland, College Park, Maryland 20742. E-Mail: [daph@umd.edu](mailto:daph@umd.edu)

<sup>6</sup>Cave Research Foundation/Missouri Speleological Survey, 819 West 39<sup>th</sup> Terrace, Kansas City, Missouri 64111-4001. E-Mail: [coolstoi@kc.rr.com](mailto:coolstoi@kc.rr.com)

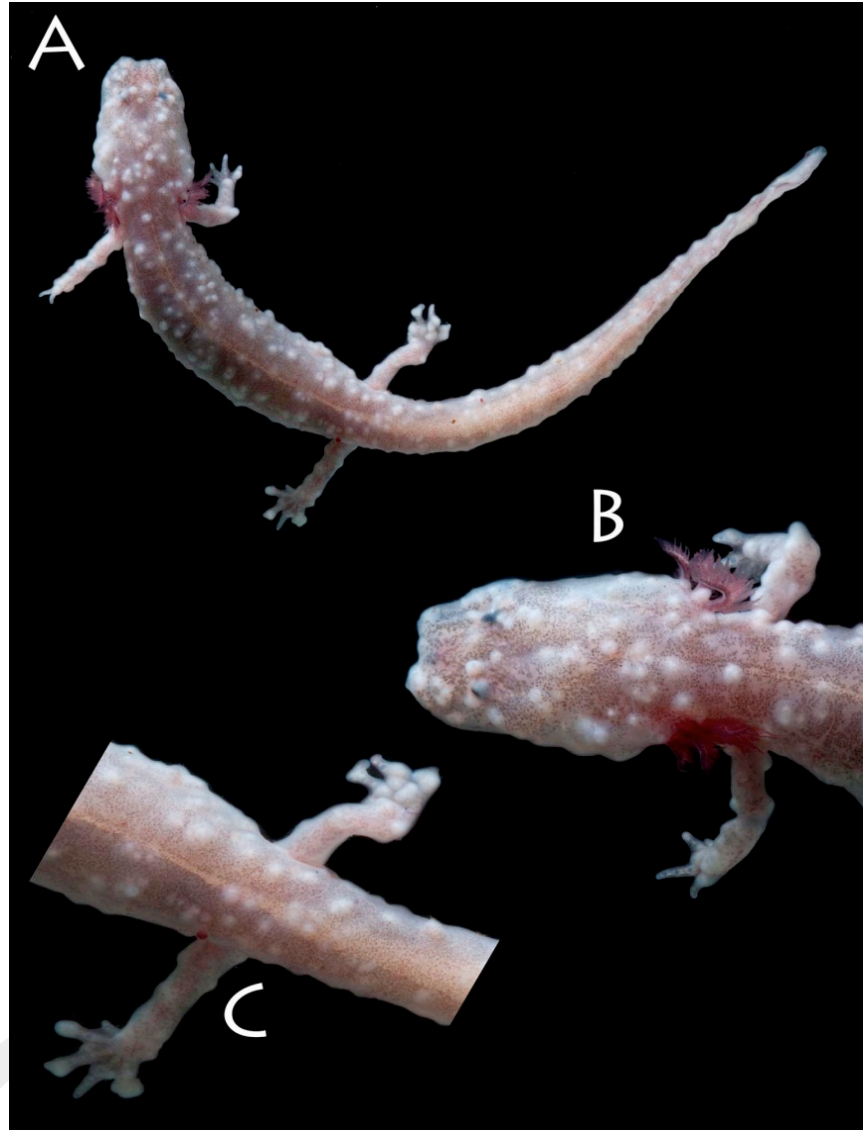
**Key Words:** Amphibia, Plethodontidae; Spelerpinae; *Eurycea spelaea*; Ozark Blind Salamander; helminth parasite; Trematoda; Digenea; strigeoid metacercariae; subterranean ecology, Ozark Highlands, Shannon County, Missouri, USA.

The Ozark Blind Salamander, *Eurycea spelaea* (Stejneger, 1892), is endemic to the Ozark Highlands ecoregion in the states of Arkansas, Kansas, Missouri, and Oklahoma, USA and is a common inhabitant of caves throughout much of this region (Petranka 1998). While adult salamanders are obligate inhabitants of the subterranean habitat, the larvae have fully functional eyes and often inhabit surface streams and spring runs. The diet of larval *E. spelaea* is broad and includes unusual food items such as bat guano (Fenolio et al. 2006), which might expose the salamander to a great variety of parasites. Despite its broad distribution and high abundance, relatively few observations of parasites have been reported for this species (Smith 1948; Reeves 1949; Dyer 1975; Ashley 2004; McAllister et al. 2006).

On 25 April 2012, the authors conducted a biological inventory of Banker Cave (SHN-009) in Shannon County, Missouri, USA. A perennial stream flows from inside the cave into a pond outside the cave entrance and then into a local stream. Approximately 150 m inside the cave, the stream is broad and shallow

(water depth 2 cm or less) with a chert/gravel/cobble substrate. A late-stage larval Ozark Blind Salamander ca. 70 mm total length (likely a third year animal; Rudolph 1978, 1980) was captured from the cave stream. The larva was covered with light-colored nodules over about half of its body surface (**Figure 1A**). The large number and size of the nodules are such that the shape of its head (**Figure 1B**) and the digits of its feet (**Figure 1C**) had become disfigured. Permits for the collection of specimens in Missouri had not been obtained so the specimen was not collected and precluded detailed study of these nodules in the laboratory. However, based on visual examination of high-resolution photographs of this salamander, we hypothesize that the nodules most likely resulted from infection by strigeoid metacercariae of an unidentified trematode (Trematoda: Digenea). Strigeoid metacercariae have been found encysted in the integument and gills of *E. spelaea* from two other nearby caves. In addition, similar unidentified parasitic infections have been reported from other cave-dwelling salamanders, including populations of the Berry Cave Salamander (*Gyrinophilus gulolineatus* Brandon 1965) and cave-dwelling populations of the Spring Salamander (*G. porphyriticus*) (Green, 1827) (Niemi et al. 2010). Although two noted parasite specialists both agree on our diagnosis (one of the authors here (CTM) and Dr. Charles Bursey of Pennsylvania State University), we could not follow up with laboratory examinations of the nodules because the specimen was not collected for lack of a permit. Therefore, we cannot exclude the hypothesis that the nodules we report here were caused by another condition, such as bacterial, viral or fungal infections, or by another parasite, such as mites or nematodes. However, the size and gross morphology of these nodules are consistent with trematode infections previously observed in this species and other plethodontid salamanders.

Severe parasitic infestations undoubtedly affect the larval development of salamanders, as significant infections may delay metamorphosis or, in extreme cases, can be fatal (Johnson and Buller 2011). The epidemiology of this trematode infection in Ozark Blind Salamanders is unknown and mechanisms for the spread and extent of infection remain a mystery. For example, several additional larval *E. spelaea* as well as larval Cave Salamanders (*E. lucifuga* Rafinesque, 1822) were also observed in the same cave stream with the infected individual, yet they exhibited no obvious signs of infection (i.e., encysted nodules in the integument). Because larval *E. spelaea* can also be found in surface habitats, this species may be at greater risk of parasitic infections compared to other cave restricted salamanders. The epidemiology of parasitic infections in subterranean species warrants further study as it likely affects the ecology of host species and might possibly alter the dynamics of some subterranean ecosystems.



**Figure 1.** A larval Ozark Blind Salamander, *Eurycea spelaea*, from Shannon County, Missouri, hypothesized to suffer from an exceptionally severe infection of strigeoid metacercariae of an unidentified trematode. The infection, assumed to be caused by the encysted trematode metacercariae, was found over the Fig. 1A depicts the entire body of the salamander (A) causing disfigurements of the head (B) and feet (C), respectively.

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