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A NOTEWORTHY INFECTION OF
CLINOSTOMUM COMPLANATUM (DIGENEA: CLINOSTOMIDAE)
 IN A CAVE SALAMANDER, *EURYCEA LUCIFUGA*
 (CAUDATA: PLETHODONTIDAE),
 FROM NORTHCENTRAL TENNESSEE

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The cave salamander, *Eurycea lucifuga* inhabits karst areas of the Central Highlands of Arkansas, Kansas, Missouri, and Oklahoma east through the Appalachians of Kentucky and

Tennessee to Virginia and West Virginia (Conant & Collins 1998). It prefers the twilight zone of caves and occasionally is found near springs and seepage areas in riparian habitat. This salamander has been the subject of several parasite surveys, including those of Dyer & Brandon (1973) in southern Illinois, Dyer & Peck (1975) in Alabama and Tennessee, Castle et al. (1987) in western Kentucky, and McAllister et al. (2001) and McAllister & Bursey (2004) in northcentral Arkansas. Herein is presented new host and distributional data on a trematode parasite of this salamander from Tennessee.

On 28 May 2006, an adult male *E. lucifuga* (SVL = 62 mm) was collected by hand from the aphotic zone of Flat Rock Cave (Tennessee Cave Survey Number SM66) in Smith County, Tennessee (36° 14.06'N, 86° 05.57'W). On closer examination, an 11.1 by 4.3 mm oval-shaped bloody lesion was noted on the right upper quadrant of the integument of this salamander (Fig. 1). This salamander was euthanized with a dilute Chloretone® (chlorobutanol) solution and the lesion was excised to reveal an unknown helminth, 2.5 mm deep within a capsule. The parasite was fixed in 10% buffered formalin, transferred to 70% ethanol, stained with Semichon's acetocarmine, and mounted in Canada Balsam. A voucher specimen of the helminth was deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland, USA, as USNPC 98667. A host voucher specimen was deposited in the Middle Tennessee State University Collection, Murfreesboro, Tennessee, USA, as MTSU 358C.

On further examination, the helminth was identified as a metacercaria of *Clinostomum complanatum* (Rudolphi 1814). The identification is based on the morphology of cuticular spines as follows: in *Clinostomum attenuatum*, cuticular spines measure 13-16 µm in length by 5-9 µm in thickness; in *Clinostomum complanatum*, cuticular spines measure 7-11 µm in length by 1.5-2 µm in thickness (Cort 1913). The cuticular spines of this specimen fall within the latter range. Interestingly, a total of only 1 of 549 (0.18%) *E. lucifuga* (391 adults, 25 juveniles, and 133 larvae) from

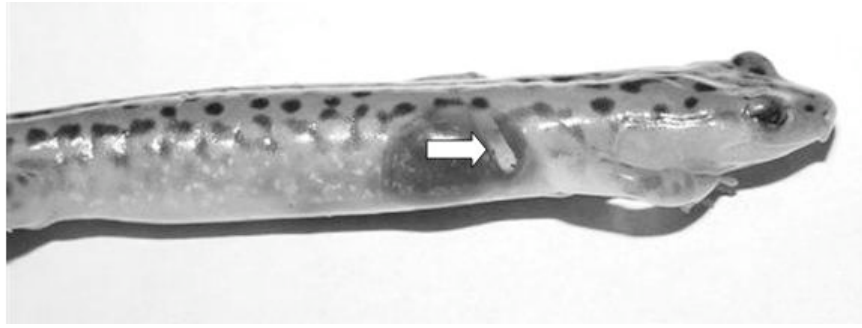


Fig. 1. Adult *Eurycea lucifuga* showing encysted metacercaria of *Clinostomum complanatum* (arrow).

the current site and 67 other localities in Tennessee harbored this worm. This represents a new host and distributional record for *C. complanatum*.

Metacercariae of *C. complanatum* have been previously reported in other North American amphibians, including three species of ranid frogs (Manter 1938; Walton 1949; Fried & Foley 1970) and five species of salamanders (summarized in Table 1). In addition, metacercariae of *Clinostomum attenuatum* has been reported from five of eight (62.5%) barred tiger salamanders, *Ambystoma tigrinum mavortium* in Texas (Miller et al. 2004), and a *Clinostomum* sp. was reported from 12 of 163 (7.4%) eastern newts, *Notophthalmus viridescens* from Michigan (Muzzall 1991).

Dermal cysts of *Clinostomum* sp. metacercariae have been reported on the head and body of a spotted salamander, *Ambystoma maculatum* from Maryland (Fowler 1947). Indeed, metacercariae of *Clinostomum* spp. are typically found in large, raised cysts randomly distributed on or within the host's body; the cysts develop as surface structures and do not infiltrate adjacent tissues (i.e., significant pathological changes are rarely associated with the cysts, although occasionally increased numbers of melanomacrophages surround a cyst) (Miller et al., 2004). A similar pathology was observed in the host noted herein (see Fig. 1).

Table 1. Metacercaria of *Clinostomum complanatum* in North American salamanders.

Family/Host Species	Locality	Prevalence ¹	Reference
Amphiumidae			
<i>Amphiuma tridactylum</i>	Louisiana	6/85 (7.1%)	Bennett & Humes 1938
Plethodontidae			
<i>Eurycea lucifuga</i>	Tennessee	1/549 (0.2%)	This study
<i>Eurycea neotenes</i>	Texas	1/86 (1.2%)	McAllister 1990
Salamandridae			
<i>Notophthalmus viridescens</i>	Massachusetts	1/1 (100%)	McAllister 1990
Sirenidae			
<i>Siren</i> sp. ²	Florida	1/1 (100%)	Manter 1938

¹ Number infected/number examined (percent).

² Host is thought to be a greater siren, *S. lacertina* (see Bennett & Humes 1938; Fowler 1947).

In the life cycle of *Clinostomum* spp., embryonated eggs pass in the feces of the definitive host and miracidia hatch and penetrate tissues of a snail (first intermediate host). Sporocysts and two generations of rediae develop producing cercariae that eventually encyst in fishes or amphibians (second intermediate hosts). The adult worm develops in the mouth or esophagus of various piscivorous birds (herons, gulls, and bitterns) that serve as definitive hosts (Hopkins 1933; Hunter & Hunter 1933; Schell 1985; Aohagi et al., 1992; Dias et al. 2003). It is unknown what specific host life cycle is followed in this cave environment since other potential second intermediate hosts are found within, including southern two-lined salamanders, *Eurycea cirrigera*, northern green frogs, *Lithobates (Rana) clamitans melanota*, American bullfrogs, *Lithobates (Rana) catesbeianus*, and the southern cavefish, *Typhlichthys subterraneus*. Indeed, no definitive bird hosts have ever been observed at the cave entrance (situated in a wooded ravine) although domestic cattle seeking a cooler environment frequent the entrance during summer.

ACKNOWLEDGMENTS

We thank the Tennessee Wildlife Resources Agency for Scientific Collecting Permit No. 1450 issued to B.T.M. and the private landowner for allowing access to Flat Rock Cave.

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