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## Occurrence of Tetrathyridia of *Mesocestoides* sp. (Cestoidea: Cyclophyllidea) in North American Anurans (Amphibia)

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**ABSTRACT:** A new host and geographic locality record is reported for tetrathyridia of *Mesocestoides* sp. in two species of ranid frogs (*Rana berlandieri* and *R. pipiens*) from Texas and New York, respectively. Tetrathyridia were found encapsulated in liver and mesenteries of the hosts. Morphological examination and experimental inoculation of these tetrathyridia into mice demonstrated the absence of capacity for asexual proliferation. Overall prevalence of infection was low in anurans from Arkansas, Texas and New York, but intensities can be generally high. In addition, a summary of frogs and toads from North America reported as hosts of tetrathyridia of *Mesocestoides* sp. is presented.

**Key words:** Cestoidea, tetrathyridia, *Mesocestoides* sp., anurans, frogs, toads, survey, Cyclophyllidea, *Rana berlandieri*, *Rana pipiens*, prevalence, intensity.

A plethora of helminth surveys reporting various cestodes in frogs and toads from North America have been published, but in most cases, investigators do not find *Mesocestoides* sp. (Fortner, 1923; Harwood, 1932; Holl, 1932; Trowbridge and Hefley, 1934; Brandt, 1936; Ingles, 1936; Kuntz, 1941; Kuntz and Self, 1944; Rankin, 1945; Bouchard, 1951; Odlaug, 1954; Campbell, 1968; Brooks, 1976; McAllister and Upton, 1987). However, a few reports have noted anuran intermediate hosts to be infected with tetrathyridia of *Mesocestoides* sp. (James and Ulmer, 1967; James, 1969; Ulmer and James, 1976; Williams and Taft, 1980; McAllister, 1987; McAllister et al., 1989).

Between April 1986 and October 1989, we surveyed 419 anurans from Arkansas, New York and Texas (USA) for tetrathyridia of *Mesocestoides* sp. During that period, we found this metacestode in two hosts. Herein, we provide a new host and geographic locality record for *Mesocestoides* sp., along with a summary of the frogs

and toads from North America known to be hosts of this cestode.

Anurans were collected by hand or dip-net from Clay, Lonoke and Polk counties of Arkansas (34°35'N to 36°17'N, 94°14'W to 90°03'W), Dallas, Denton, Hood, Johnson and Somervell counties of Texas (32°16'N to 33°15'N, 97°35'W to 97°53'W) and Franklin, Jefferson and St. Lawrence counties of New York (44°00'N to 45°00'N, 74°15'W to 76°25'W). Specimens were killed by pithing or with an overdose of sodium pentobarbital (Nembutal®, Abbott Laboratories, North Chicago, Illinois 60064, USA). A midventral incision was made to expose viscera, and the body cavity, musculature and organs were examined for encapsulated or free parasites. Some free tetrathyridia (*Mesocestoides* sp.) were processed as whole mounts and all tissues suspected of being infected with tetrathyridia were processed following methods of McAllister et al. (1989). Forty of the 161 tetrathyridia from the New York *Rana pipiens* (see below) were inoculated intraperitoneally into each of three male laboratory mice (*Mus musculus*). Two of the mice were necropsied at approximately four and seven months postinoculation to check for asexual proliferation. The third mouse was not necropsied. Representative specimens of *Mesocestoides* are deposited in the USNM Helminthological Collection (United States Department of Agriculture, Beltsville, Maryland 20705, USA; Accession Numbers 80837 and 80942).

Only two of 419 (<1%) anurans were found to be infected with *Mesocestoides* sp. (Table 1). One of the hosts was an adult female Rio Grande leopard frog, *Rana berlandieri* [snout-vent length (SVL) = 95



FIGURE 1. Tetrathyridium of *Mesocystoides* sp. encapsulated in the liver of *Rana berlandieri*. Characteristic features include the epithelium of the excretory antrum (E), solid cellular hindbody (H), deep invagination canal (I), tetra-acetabulate scolex (S), and syncytial tegument (T). Note the absence of buds, multiple scoleces, or other evidence of asexual proliferation. Also note the thin host capsule, normal appearance of hepatic parenchyma, and pigment deposition. H&E.

mm, Arkansas State University Museum of Zoology, ASUMZ 8587] collected on 1 May 1987 in Somervell County, Texas (32°16'N, 97°44'W). An undetermined number of encapsulated tetrathyridia were found in the liver (Fig. 1) and mesenteries (USNM Accession Number 80837). None of these showed any morphological evidence for asexual proliferation (e.g., buds or multiple scoleces).

The other host, an adult female northern leopard frog, *R. pipiens* (84 mm SVL) was collected on 29 July 1989 in Jefferson County, New York (44°19'N, 76°00'W). An undetermined number of tetrathyridia were found encapsulated in the liver (USNM Accession Number 80942) and in-

TABLE 1. Anurans examined for tetrathyridia of *Mesocystoides* sp. from Arkansas, New York and Texas.

Species	State	Prevalence*
<b>Bufonidae</b>		
<i>Bufo americanus</i>		
<i>charlesmithi</i>	Arkansas	0/3 (0%)
<i>B. americanus</i>		
<i>americanus</i>	New York	0/17 (0%)
<i>B. debilis debilis</i>	Texas	0/28 (0%)
<i>B. woodhousii</i>		
<i>woodhousii</i>	Texas	0/25 (0%)
<b>Hylidae</b>		
<i>Acris crepitans</i>		
<i>blanchardi</i>	Texas	0/43 (0%)
<i>Pseudacris clarkii</i>	Texas	0/40 (0%)
<i>P. streckeri</i>		
<i>illinoensis</i>	Arkansas	0/8 (0%)
<b>Microhylidae</b>		
<i>Gastrophryne</i>		
<i>carolinensis</i>	Arkansas	0/2 (0%)
<i>G. olivacea</i>	Texas	0/125 (0%)
<b>Ranidae</b>		
<i>Rana berlandieri</i>	Texas	1/2 (50%)
<i>R. blairi</i>	Texas	0/7 (0%)
<i>R. catesbeiana</i>	Arkansas	0/2 (0%)
	New York	0/11 (0%)
	Texas	0/16 (0%)
<i>R. clamitans</i>		
<i>melanota</i>	New York	0/34 (0%)
<i>R. pipiens</i>	New York	1/34 (3%)
<i>R. septentrionalis</i>	New York	0/2 (0%)
<i>R. sphenoccephala</i>	Arkansas	0/2 (0%)
	Texas	0/13 (0%)
<i>R. sylvatica</i>	New York	0/5 (0%)

\* Number infected/number examined (Margolis et al., 1982).

testinal wall, and 161 occurred free in the body cavity and muscle fascia. Each of two mice experimentally inoculated with 40 of these tetrathyridia was found at necropsy several months later to contain 24 and 37 tetrathyridia, respectively. All tetrathyridia were alive and apparently healthy. No morphological evidence for asexual proliferation was exhibited by any of the tetrathyridia taken from the frog or from the mice.

Seven species of North American frogs and toads of the families Bufonidae, Hylidae and Ranidae are known hosts of tetrathyridia (*Mesocystoides* sp.), and one

TABLE 2. Anurans reported as hosts of tetrathyridia of *Mesocestoides* sp.

Species	State	Reference(s)
<b>Bufonidae</b>		
<i>Bufo americanus</i>	Iowa, South Dakota	James and Ulmer, 1967; James, 1969; Ulmer and James, 1976
<i>B. cognatus</i>	Iowa, South Dakota	James, 1969; James and Ulmer, 1976
<i>B. houstonensis</i> *	Texas	Thomas et al., 1984
<i>B. valliceps</i>	Texas	McAllister et al., 1989
<b>Hylidae</b>		
<i>Pseudacris streckeri</i>	Texas	McAllister, 1987
<b>Ranidae</b>		
<i>Rana berlandieri</i>	Texas	McAllister and Conn, this report
<i>R. clamitans</i>	Wisconsin	Williams and Taft, 1980
<i>R. pipiens</i>	Iowa, Minnesota, New York, South Dakota, Wisconsin	James and Ulmer, 1967; James, 1969; Ulmer and James, 1976; Williams and Taft, 1980; McAllister and Conn, this report

\* Possible host since Thomas et al. (1984) found unidentifiable tetrathyridia.

additional anuran is a suspected host (Table 2). As in North American lizards (see McAllister, 1988), overall prevalence in anurans appears to be rather low for *Mesocestoides* sp., whereas intensity of infection is frequently rather high. The present report provides a good example of this tendency. In New York, only one of 103 (1%) anurans surveyed were infected with *Mesocestoides*, but the single infected frog harbored more than 161 tetrathyridia. The present data are similar to those of several other authors (reviewed by Conn, 1990) in demonstrating that high intensities of infection by tetrathyridia do not usually result from asexual proliferation. Only one verified case of asexually proliferative tetrathyridia has been reported; this involved a single lizard population in southern California (Specht and Voge, 1965). One possible explanation for overdispersion of tetrathyridia is that en masse packaging of the eggs in the parauterine organ of adult worms (Conn et al., 1984) might result in en masse transmission to the intermediate host. Undoubtedly, the epizootiological basis of overdispersion among tetrathyridia will remain unclear until a complete life cycle has been elucidated.

To our knowledge, *Mesocestoides* sp. has

not been reported in caudate amphibians. Recently, McAllister and Upton (1987) surveyed 52 smallmouth salamanders (*Ambystoma texanum*) from Dallas County, Texas, USA, for endoparasites. Although several salamanders were infected by a cyclophyllidean cestode (*Cylindrotaenia americana*), no *Mesocestoides* sp. were found. Interestingly, three of 42 (7%) Strecker's chorus frogs (*Pseudacris streckeri streckeri*) from the same pond harbored *Mesocestoides* sp. (McAllister, 1987). On the other hand, an adult white footed mouse (*Peromyscus leucopus*) from the same Johnson County site noted herein for anurans harbored a high intensity of tetrathyridia (*Mesocestoides* sp.) in its abdominal cavity (C. T. McAllister and D. B. Conn, unpubl.) and 3 of 23 (13%) Gulf coast toads (*B. valliceps valliceps*) from neighboring Hood County were infected with tetrathyridia (McAllister et al., 1989). Additional studies are certainly warranted which may help unlock the mystery surrounding the life cycle of the enigmatic cestode.

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