

HELMINTHS OF THE SALAMANDERS *GYRINOPHILUS PORPHYRITICUS*, *PSEUDOTRITON RUBER*, AND *PSEUDOTRITON MONTANUS* (CAUDATA: PLETHODONTIDAE) FROM OHIO¹

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ABSTRACT. Examination of 79 *Gyrinophilus porphyriticus* (Green), 13 *Pseudotriton ruber* (Latreille) and 9 *Pseudotriton montanus* Baird as a part of a general survey of the helminth fauna of Ohio amphibia yielded 9 species of helminths. Species recovered from *G. porphyriticus* were the trematodes **Allocreadium pseudotritoni* Rankin 1937, *Plagioporus gyrinophili* Catalano and Etges 1981, and *Brachycoelium salamandrae* (Froelich 1789) Luhe 1909; the cestode **Bothriocephalus rarus* Thomas 1937; the nematodes **Capillaria inequalis* Walton 1935, **Cosmocercoides dukae* (Holl 1928) Wilkie 1930, and *Omeia papillocauda* Rankin 1937; and the acanthocephalan **Fessisientis necturorum* Nickol 1967. *Pseudotriton ruber* harbored *A. pseudotritoni*, *P. gyrinophili*, *B. salamandrae*, **B. rarus*, **C. inequalis* and **C. dukae*. *Pseudotriton montanus* was infested with *A. pseudotritoni* and **Megalodiscus temperatus* (Stafford 1905) Harwood 1932. A review of the literature reveals 16 species previously reported for these caudate hosts; of these, 5 were encountered in the present study.

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INTRODUCTION

Relatively few investigations of the parasites of amphibians in the United States have included salamanders of the closely related genera *Gyrinophilus* and *Pseudotriton*. With the exception of a new species of trematode discovered during the present study and reported elsewhere (Catalano and Etges 1981), there are no published reports of helminths from Ohio specimens of the 3 species which occur there, *Gyrinophilus porphyriticus* (Green), *Pseudotriton ruber* (Latreille) and *Pseudotriton montanus* Baird. Studies by Leidy (1851, 1856); Stiles and Hassall (1894); Walton (1927, 1933); Rankin (1937 a, b); Parker (1941); Fischthal (1955) and Nickol and Heard (1973) record a total of 15 species of

helminths from these salamander species elsewhere in the United States (table 1).

The present study, initiated in 1972 as part of a general survey of the helminth parasites of Ohio amphibia, included examination of 79 spring salamanders, *G. porphyriticus* (18 adult and 61 larvae); 13 red salamanders, *P. ruber* (9 adult and 4 larvae); and 9 mud salamanders, *P. montanus* (4 adult and 5 metamorphosing larvae), collected from sites in 5 Ohio counties (Adams, Geauga, Ross, Scioto, and Vinton). All were collected in the immediate vicinity of springs or intermittent streams. Larvae of *G. porphyriticus* were found hidden under rocks and debris in shallow pools during daylight hours and often in open areas of pools at night. Adult *G. porphyriticus* were found under rocks and logs on the creek bank and dry sections of creek bed or walking in open creekside areas at night. *Pseudotriton ruber* and *P. montanus* occurred in similar habitats but were also collected in drier forest areas adjacent to the streams.

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*New host records

TABLE 1
*Previous published records of helminths in Gyrinophilus porphyriticus, Pseudotriton ruber
 and Pseudotriton montanus.*

A. Helminths of <i>Gyrinophilus porphyriticus</i> (Green)			
Trematoda:			
<i>Plagioporus gyirinophili</i>	Catalano and Etges 1981		OH
<i>Brachycoelium salamandrae</i>	Fischthal 1955		NY
* <i>Distomum cygnoides</i>	Leidy 1851, 1856		PA
Nematoda:			
<i>Omeia papillocauda</i>	Rankin 1937b		NC
<i>Oxysomatium longicaudata</i>	Fischthal 1955		NY
<i>Spirogonura</i> sp.	Fischthal 1955		NY
<i>Pharyngodon</i> sp.	Fischthal 1955		NY
B. Helminths of <i>Pseudotriton ruber</i> (Latreille)			
Trematoda:			
<i>Allocreadium pseudotritoni</i>	Rankin 1937a,b		NC
<i>Plagioporus gyirinophili</i>	Catalano and Etges 1981		OH
<i>Brachycoelium salamandrae</i>	Rankin 1937b		NC
† <i>Brachycoelium storeriae</i>	Parker 1941		GA
* <i>Distomum cygnoides</i>	Leidy 1851, 1856		PA
<i>Gorgoderina bilobata</i>	Rankin 1937a,b		NC
Cestoda:			
<i>Crepidobothrium cryptobranchi</i>	Rankin 1937b		NC
Nematoda:			
†† <i>Oxysomatium brevicaudatum</i>	Walton 1927		PA
** <i>Oxyuris dubia</i>	Leidy 1856		PA
C. Helminths of <i>Pseudotriton montanus</i> Baird			
Trematoda:			
<i>Allocreadium pseudotritoni</i>	Rankin 1937a,b		NC
<i>Gorgoderina bilobata</i>	Rankin 1937a,b		NC
Nematoda:			
<i>Physaloptera</i> sp. (larva)	Rankin 1937b		NC
Acanthocephala:			
<i>Fessisientis necturorum</i>	Nickol and Heard 1973		GA

*Descriptions by Leidy sketchy; may represent *Gorgoderina amplicava* or *Gorgoderina simplex*.

†Considered by Rankin (1938) as a synonym of *B. salamandrae*.

††From Leidy collection: (identified as *Oxysoma*); same specimen reported by Stiles & Hassall (1894) and by Walton (1933).

**Considered by Shad (1960) to be *nomen dubium* due to inadequate description.

METHODS AND MATERIALS

We collected salamanders by hand or with a small hand net and transported them to the laboratory in plastic bags on ice. Specimens were refrigerated until autopsied, usually within 1 wk of capture. Hosts were killed in either chlorobutanol or MS222. Internal organs were removed, placed in Amphibian Ringer's solution and examined. Trematodes were body cavity was also examined. Trematodes were killed and fixed under light coverglass pressure in either AFA or neutral buffered formalin. Cestodes and acanthocephalans were relaxed by refrigeration, then killed and fixed in hot AFA. Specimens were stained with Semichon's carmine or Delafield's hematoxylin, dehydrated, cleared and mounted in gum damar or Canada balsam. Nematodes were killed and fixed in hot 70% alcohol and mounted

in lacto-phenol. Representative specimens were deposited in the Helminthological Collection of the U. S. National Museum.

RESULTS AND DISCUSSION

Of the 101 hosts examined, 70 (69%) were positive for adult helminths. Four trematode, one cestode, 3 nematode, and one acanthocephalan species were recovered (tables 2 and 3). One adult salamander harbored 4 species of helminths; 10 adults and larvae had 3 species; 28 salamanders had 2 species; and 31 were infested with 1 species.

TABLE 2
Helminth Parasites of Gyrinophilus porphyriticus (18 adults, 61 larvae) collected in Ohio.

Helminth	Tissue Site	No. Infested	% Infested	Mean No. Per Host	Range
Trematoda:					
* <i>Allocreadium pseudotritoni</i> Rankin 1937	Sm. Intestine	25 Total	32	3.7	1-14
	near pylorus	13 Adult	72	4.9	1-14
		12 Larvae	20	2.3	1-10
<i>Plagioporus gyirinophili</i> Catalano & Etges 1981	Sm. Intestine	20 Total	25	2.9	1-13
	near pylorus	3 Adult	17	2.3	2-3
		17 Larvae	28	3.0	1-13
<i>Brachycoelium salamandrae</i> (Froelich 1789) Luhe 1909	Sm. Intestine	1 Total	1	1.0	---
		1 Adult	6	1.0	---
		0 Larvae	---	---	---
Cestoda:					
* <i>Bothriocephalus rarus</i> Thomas 1937	Sm. Intestine	10 Total	13	3.5	1-22
		3 Adult	17	1.7	1-3
		7 Larvae	11	4.3	1-22
Nematoda:					
* <i>Capillaria inequalis</i> Walton 1935	Sm. Intestine	36 Total	46	8.5	1-50
		14 Adult	78	12.0	1-50
		22 Larvae	36	6.3	1-15
* <i>Cosmocercoides dukae</i> (Holl 1938) Wilkie 1930	Lrg. Intestine	7 Total	9	2.0	1-3
		5 Adult	28	1.8	1-2
		2 Larvae	3	2.5	2-3
† <i>Omeia papillocauda</i> Rankin 1937	Stomach	1 Total	1	7.0	---
		0 Adult	---	---	---
		1 Larva	2	7.0	---
Acanthocephala:					
† <i>Fessisentis necturorum</i> Nickol 1967	Stomach and	4 Total	5	2.0	1-3
	Sm. Intestine	0 Adult	---	---	---
		4 Larvae	6	2.0	1-3

*New Host Record

†New Locality Record for Ohio

TREMATODA

Allocreadium pseudotritoni Rankin 1937
 USNM no. 76676-77

Hosts: *Gyrinophilus porphyriticus*, *Pseudotriton ruber*, *Pseudotriton montanus*

Hosts reported for this species include *P. ruber* and *P. montanus* from North Carolina (Rankin 1937a, b) and *Eurycea lucifuga* in Tennessee (Dyer and Peck 1975) and Kentucky (O'Brien 1979). Its occurrence in *Gyrinophilus porphyriticus* in Ohio represents both new host and locality records.

Allocreadium pseudotritoni was found in salamanders from 2 sites in Vinton Co., one in Adams Co., and one in Scioto Co.

Adult salamanders had a higher incidence of infestation than larvae (100% of 13 adults and 16 [50%] of 32 larvae at one site), and often carried higher numbers of parasites (1-19, avg. 5.9, N = 16 adults; 1-10, avg. 2.2, N = 15 larvae).

Yamaguti (1958, 1971) transferred this species to the genus *Cainocreadium* (Opaeoelidae). We, however, agree with Rankin (1937a), Seitner (1951), Peters (1957) and Durio and Manter (1968) that adult morphology (presence of eyespot pigment, shape of cirrus sac, posterior extent of the uterus, and flame cell pattern) clearly indicate that this species is a member of the genus *Allocreadium*.

TABLE 3
Helminth Parasites of Pseudotriton montanus and P. ruber collected in Ohio.

	Tissue Site	No. Infested	% Infested	Mean No. Per Host	Range
<i>P. montanus</i> (4 Adult, 5 Larvae)					
Trematoda:					
† <i>Allocreadium pseudotritoni</i> Rankin 1937	Sm. Intestine	5 Total	56	5.0	1-19
		3 Adult	75	7.0	1-19
		2 Larvae	40	1.5	1-2
* <i>Megalodiscus temporatus</i> Stafford 1905	Colon	2 Total	22	3.5	3-4
		0 Adult	---	---	---
		2 Larvae	40	3.5	3-4
<i>P. ruber</i> (9 Adult, 4 Larvae)					
Trematoda:					
† <i>Allocreadium pseudotritoni</i> Rankin 1937	Sm. Intestine near pylorus	1 Total	8	1.0	---
		0 Adult	---	---	---
		1 Larva	25	1.0	---
<i>Plagioporus gyrinophilii</i> Catalano & Etges 1981	Sm. Intestine near pylorus	1 Total	8	1.0	---
		1 Adult	11	1.0	---
		0 Larvae	---	---	---
<i>Brachycoelium salamandrae</i> (Froelich 1789) Luhe 1909	Sm. Intestine	1 Total	8	3.0	---
		1 Adult	11	3.0	---
		0 Larvae	---	---	---
Cestoda:					
†* <i>Bothriocephalus varus</i> Thomas 1937	Sm. Intestine	1 Total	8	1.0	---
		0 Adult	---	---	---
		1 Larva	25	1.0	---
Nematoda:					
* <i>Capillaria inequalis</i> Walton 1935	Sm. Intestine	2 Total	15	10.0	3-17
		2 Adult	22	10.0	3-17
		0 Larvae	---	---	---
* <i>Cosmoceroides dukae</i> (Holl 1938) Wilkie 1930	Lrg. Intestine	1 Total	8	5.0	---
		1 Adult	11	5.0	---
		0 Larvae	---	---	---

*New Host Record

†New Locality Record for Ohio

Plagioporus gyrinophilii Catalano and Etges 1981 USNM no. 76317

Hosts: *Gyrinophilus porphyriticus* and *Pseudotriton ruber*

Gyrinophilus porphyriticus from one Scioto County site were frequently infested (56%; 3 (75%) of 4 adults and 16 (53%) of 30 larvae) with this recently described species. Specimens were also collected from one *G. porphyriticus* from another Scioto Co. site and from *P. ruber* from Adams Co. *Plagioporus gyrinophilii* is the only species in the genus *Plagioporus* which utilizes amphibians as a definitive host (Catalano and Etges 1981) and, with proper placement of *A. pseudotritoni*, is the only species in the family Opeoelidae in non-piscine hosts.

Brachycoelium salamandrae (Froelich 1789) Luhe 1909 USNM no. 76678

Hosts: *Gyrinophilus porphyriticus* and *Pseudotriton ruber*

Trematodes of this genus are among the most frequently encountered parasites of salamanders and are cosmopolitan parasites of amphibians, reptiles, and fishes. Rankin (1938) reduced all described American species to synonymy with *B. salamandrae*; however, Parker (1941) and Cheng (1958) stated that a number of species were probably valid based on morphological differences. Using Cheng's (1958) key, the trematodes collected in the present study were identified as *B. salamandrae*.

The taxonomic problem was reviewed and the distribution of *Brachycoelium* from various salamander hosts from the contiguous United States was summarized by Dyer and Brandon (1973). Records from Ohio caudates include *B. salamandrae* from *Desmognathus fuscus* (Allison 1950, Odlaug 1954), *Plethodon cinereus*, *P. glutinosus* and *Notophthalmus viridescens* (Allison 1950) and *B. trituri* from *N. viridescens* (Kelley 1934). The present collections were obtained from Adams and Scioto Counties.

The following are host and locality records not included in Dyer and Brandon (1973): *B. salamandrae* - *Notophthalmus viridescens*, Pennsylvania (Jackson and Beaudoin 1967), Louisiana (Rabalais 1970); *Plethodon glutinosus*, Louisiana (Rabalais 1970), Mississippi (Brooks 1979); *P. vehiculum*, Oregon (Panitz 1969); *Ambystoma maculatum*, *A. opacum*, *Desmognathus fuscus*, and *Eurycea bislineata*, Louisiana (Rabalais 1970); and *Typhlotriton spelaeus*, Mississippi (Dyer 1975). *B. ambystomae* - *Ambystoma maculatum* and *A. texanum*, Arkansas (Rosen and Mannis 1975). *B. elongatum* - *Ambystoma opacum*, West Virginia (Joy and Mills 1975); *Desmognathus fuscus*, Arkansas (Rosen and Mannis 1976). *B. obesum* - *Ambystoma opacum*, West Virginia (Joy and Mills 1975); and *Desmognathus fuscus*, Illinois (Dyer, et al. 1980). *Brachycoelium* sp. - *Plethodon glutinosus* and *P. jordani*, Tennessee (Powders 1968); *Eurycea lucifuga*, Alabama and Tennessee (Dyer and Peck 1975); and *Ambystoma texanum*, Illinois (Price and St. John 1980).

The life history studies of *B. obesum* (Cheng 1960) and *B. mesorchium* (Denton 1962, Jordon and Byrd 1967) indicate that members of this genus utilize terrestrial snails as their molluscan host. Less than 6% of adult *G. porphyriticus*, 11% of adult *P. ruber*, and no larval salamanders we examined were infested with *B. salamandrae*. It is probable that the totally aquatic larvae of these salamanders have no access to infective stages of the parasite in terrestrial mollusks and that the semi-aquatic adults

have only limited access to these intermediate hosts.

Megalodiscus temperatus (Stafford 1905)
Harwood 1932 USNM no. 76679

Host: *Pseudotriton montanus*

Metamorphosing larvae of *P. montanus* collected in leaf litter along the banks of a small pond in Adams County were infested with *Megalodiscus temperatus*. This species is most often reported from anurans (Yamaguti 1958, 1971) but has been reported from various species of caudates including, in Ohio, *Notophthalmus viridescens* (Kelley 1934, Allison 1950) and *Desmognathus fuscus* (Allison 1950). Elsewhere it has been reported from *N. viridescens*, North Carolina (Holl 1928, 1932, Mann 1932, Rankin 1937b), Florida (Parker 1941), Massachusetts (Rankin 1945), New York (Fischthal 1955), and Pennsylvania (Jackson & Beaudoin 1967); *Ambystoma opacum* and *D. fuscus*, Massachusetts (Rankin 1945); and *Amphiuma means tridactylum*, Tennessee (Parker, 1941). The present report is the first record of *M. temperatus* from *P. montanus*, with 22% (2 of 9) salamanders infested.

The life history of *M. temperatus* was reported by Krull and Price (1932) to include aquatic snails (*Helisoma*) as the molluscan host. Cercaria encyst on the skin of the amphibian and cysts are ingested with the shed skin or when the host is eaten by another amphibian.

CESTODA

Bothriocephalus varus Thomas 1937
USNM no. 76680

Hosts: *Gyrinophilus porphyriticus* and *Pseudotriton ruber*

This species is one of the few adult tapeworms reported from salamanders. *Bothriocephalus varus* was described from the newt, *Notophthalmus viridescens* from Michigan (Thomas 1937a). It has since been reported from this same host in Pennsylvania (Kelley 1934, Thomas 1937b, Jackson and Beaudoin 1967), South Carolina (Kelley 1934, Thomas 1937b), Massachusetts (Rankin 1945), New York

(Fischthal 1955), and Kentucky (Delfosse and Whittaker 1971); in *Taricha torosa* from California (Lehmann 1960); and *Eurycea lucifuga* from Kentucky (O'Brien 1979). The present report is the first record of this tapeworm from both *G. porphyriticus* and *P. ruber* and is also a new locality record.

Thomas (1937b) describes the development of procercooids of *B. varus* in copepods and plerocercoids in larval newts. His experiments also indicate that direct infestation of adult newts by ingestion of copepods is possible. In the present case infestation is probably the result of the ingestion of copepods or, occasionally, larval newts by the aquatic larvae of *G. porphyriticus* and *P. ruber*. Incidence of this parasite is low in both salamanders, 13% in *G. porphyriticus* and 8% in *P. ruber*. This tapeworm was present in hosts from Scioto and Adams Counties.

NEMATODA

Capillaria inequalis Walton 1935
USNM no. 76685

Hosts: *Gyrinophilus porphyriticus* and *Pseudotriton ruber*

This trichiurid nematode was the most frequently encountered helminth in this study, infesting 38% of the salamanders examined. *Capillaria inequalis* was usually embedded in the small intestinal mucosa, often in numbers approaching 50. This is the first report from either *G. porphyriticus* or *P. ruber*. *Capillaria inequalis* has been reported from the following caudates: *Notophthalmus viridescens* from Ohio (Allison 1950), North Carolina (Mann 1932, Holl 1932, Rankin 1937b), and Pennsylvania (Jackson and Beaudoin 1967); *Ambystoma opacum* – North Carolina (Mann 1932, Walton 1935, Rankin 1937b); *Desmognathus fuscus*, *D. ochrophaeus*, *D. quadramaculatus*, and *Plethodon glutinosus* – North Carolina (Rankin 1937b); *Eurycea lucifuga* – Alabama, Georgia, Tennessee (Dyer and Peck 1975) and Kentucky (Dyer and Peck 1975, O'Brien 1979); and *Typhlotriton spelaeus* – Missouri (Dyer

1975). Kelley (1934) reported *Capillaria* sp. from *N. viridescens* from Ohio, Massachusetts, Michigan, Pennsylvania, and South Carolina.

The life cycle of this species is probably monoxenous and is confined to aquatic habitats (Rankin 1937b). The higher worm loads (avg., 12 vs. 6) and higher prevalence (56% vs. 34%) found in adult salamanders probably result from continuous reexposure and infestation as aquatic larvae. *Capillaria inequalis* was present in hosts from Adams, Geauga, and Scioto Counties.

Cosmocercoides dukae (Holl 1938) Wilkie
1930 USNM no. 76681

Hosts: *Gyrinophilus porphyriticus* and *Pseudotriton ruber*

This nematode, like the trematode *Brachycoelium*, has been reported by numerous authors from many species of amphibians and reptiles. The distribution of *C. dukae* from salamanders from the contiguous United States was summarized by Dyer and Brandon (1973). In Ohio it has been reported from *Desmognathus fuscus* (Odlaug 1954, McGraw 1968); *Ambystoma tigrinum* (Allison 1950); and *Ambystoma opacum*, *Eurycea bislineata*, and *Plethodon glutinosus* (McGraw 1968). Its occurrence in *G. porphyriticus* and *P. ruber* constitute new host records. The following are records for *C. dukae* in caudata not included in Dyer and Brandon (1973): *A. tigrinum* – Utah (Parry and Grundmann 1965); *Plethodon vehiculum* – Oregon (Panitz 1969); *Eurycea lucifuga* – Alabama and Tennessee (Dyer and Peck 1975) and Kentucky (O'Brien 1979); *Desmognathus fuscus* – Illinois (Dyer, et al. 1980); and *Ambystoma texanum* – Illinois (Price and St. John 1980).

The monoxenous life cycle of *C. dukae* in salamanders was reported by Harwood (1930) and its ability to infect terrestrial molluscs was discussed by Anderson (1960), Ogren (1953), McGraw (1968) and Dyer and Brandon (1973). Salamanders apparently acquire the parasite by ingesting infective eggs or by eating land snails or

slugs which contain infective eggs. *Cosmocercoides dukae* was considered by Rankin (1937b, 1945) to occur chiefly in terrestrial habitats. The slightly more terrestrial habits of adult *G. porphyriticus* and *P. ruber* probably account for the higher prevalence in them (22%, 6 of 27) than in larvae (3%, 2 of 65). Infested hosts were obtained from single sites in Adams and Scioto Counties.

Omeia papillocauda Rankin 1937 USNM no. 76684

Host: *Gyrinophilus porphyriticus*

This is the only nematode species collected during this survey which had been previously reported from *G. porphyriticus*. Rankin (1937b) reported *Omeia papillocauda* from *G. porphyriticus*, *Desmognathus fuscus*, *D. phoca*, and *D. quadramaculatus* in North Carolina. This species was also reported from *Eurycea lucifuga* from Alabama (Dyer and Peck 1975) and Kentucky (O'Brien 1979). The present collection was obtained from a single host collected in Ross County and represents a new locality record for *O. papillocauda*.

ACANTHOCEPHALA

Fessissentis necturorum Nickol 1967 USNM no. 76682-83

Host: *Gyrinophilus porphyriticus*

This thorny-headed worm was reported from several species of salamander by Nickol (1967, 1972) and Nickol and Heard (1973), including *Necturus beyeri* from Louisiana and *Ambystoma opacum* larvae, *Pseudotriton montanus* larvae, *Notophthalmus viridescens* larvae, and larval *Eurycea* sp. from Georgia. The present report of this species in *G. porphyriticus* represents new host and locality records.

Nickol and Heard (1973) reported that *F. necturorum* utilizes aquatic isopods (*Asellus*) as an intermediate host and is more common in aquatic adult or larval salamanders. Only larval *G. porphyriticus* obtained from sites in Scioto and Adams Counties were infested with these adult acanthocephalans, and at low rates (5%).

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