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Helminths from the Short-tail Shrew, *Blarina brevicauda*, in Connecticut with Reference to the Histopathology of *Capillaria*

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ABSTRACT: Three species of trematodes, three species of cestodes, seven species of nematodes, and one species of acanthocephalan were collected from 143 short-tail shrews from Connecticut. Necropsy reports showed that 82.5% of the shrews were infected with some kind of helminth. These included Trematoda: *Brachylaima thompsoni* (9.7%), *B. rhomboideus* (53.1%), *Panopistus pricei* (21.6%); Cestoda: *Hymenolepis anthocephalus* (14.6%), *Pseudodiorchis reynoldsi* (0.6%), *Protogynella blarinae* (8.3%); Nematoda: *Porrocaecum americanum* (13.9%), *P. encapsulatum* (4.8%), *Capillaria* sp. (liver, 6.2%), *Capillaria* sp. (spleen, 0.6%), *Capillaria blarinae* (40.5%), *C. urinicola* (4.8%), *Spirura talpae* (0.6%); and Acanthocephala: *Prosthorhynchus formosus* (2.0%). The relationship of habitat type with specific helminth infections is presented. The histopathology associated with *Capillaria* infections is presented. A new host record is reported for *Spirura talpae*.

Blarina brevicauda, the short-tail shrew, is an abundant insectivore in Connecticut but its helminth fauna has not been documented except by Bray (1954) who studied the capillary worms from this host. Shrew helminth literature in the continental United States has dealt primarily with descriptions of new species. Surveys on short-tail shrew helminths have been reported from central Ohio by Oswald (1958), by Miller et al. (1974) in North Carolina, and by Wittrock and Hendrickson (1979) in Iowa.

Materials and Methods

This study was conducted from October 1974 to March 1975. One hundred forty-three shrews from Connecticut were examined to determine helminth species present, severity of infection, histopathology associated with such infections, correlation of infection with food habits, and correlation of infection with habitat types. The study areas encompassed four habitat types: grass monoculture, forest, freshwater swamp, and salt marshes.

Shrews were captured using small Victor snap traps and Sherman small animal live traps. Standard collection techniques for helminths were employed. Helminths were stained with Mayer's HCl carmine, dehydrated in an alcohol series to toluene and mounted in Permount for identification. Nematodes were also mounted in glycerin jelly for study.

Tissues were fixed in 10% formalin, dehydrated in an alcohol series, embedded in paraffin, sectioned at 6 μm, and stained with hematoxylin and eosin.

Specimens were deposited in the National Parasite Collection, Beltsville, Maryland.

Results

Seventy-two female and 71 male shrews were trapped. Necropsy reports showed that 82.5% of the shrews were infected with some species of helminth.

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Table 1. Helminths of *Blarina brevicauda* in Connecticut, prevalence of infection, range of intensity and anatomic location.

Parasite	Prevalence of infection (%) (n = 143)	Range of intensity	Anatomic location
Trematoda			
Brachylaima thompsoni	9.7	1–91	small intestine
Brachylaima rhomboideus	53.1	1–32	small intestine
Panopistus pricei	21.6	1–47	large intestine
Cestoda			
Hymenolepis anthocephalus	14.6	1–4	small intestine
Pseudodiorchis reynoldsi	0.6	2	small intestine
Protogynella blarinae	8.3	2–6	small intestine
Nematoda			
Porrocaecum americanum	13.9	4–8	cysts in intestinal mesentery
Porrocaecum encapsulatum	4.8	2–19	subcutaneous
Capillaria blarinae	40.5	3–6	esophageal epithelium
Capillaria urinicola	4.8	5–11	urinary bladder
Capillaria sp. (liver)	6.2	1	liver
Capillaria sp. (spleen)	0.6	1	spleen
Spirura talpae	0.6	3	stomach
Acanthocephala			
Prosthorhynchus formosus	2.0	1–4	small intestine

Three species of trematodes, three species of cestodes, seven species of nematodes, and one species of acanthocephalan were found. Table 1 lists the helminth species collected, severity of infection, and anatomic location. No seasonal variation in parasite burden was noted. Males and females were parasitized in equal intensity. Table 2 depicts the relationship of habitat type with specific helminth infections. The grass monoculture habitat yielded the greatest number of shrews for study and had the greatest variety of parasite species. The parasite variety for shrews by habitat type followed the order of grass monoculture (12), forest (10), salt marsh (8), and swamp (4).

The presence of adult *Capillaria blarinae* in the stratified squamous portion of the esophageal epithelium was noted in 40.5% of the shrews examined. The worms produced a parakeratosis in the epithelium. The dominant inflammatory cells in the basal layer of the stratum germinativum were eosinophils. Lymphocytes were occasionally found. The adults occupied wave shaped tunnels in the epithelium, usually with part of the body looped into the esophageal lumen. The *Capillaria blarinae* eggs, 60 by 20 μm, were found in the tissues and free in the lumen of the esophagus.

Eggs of *Capillaria* sp. were noted in the livers of 6.2% of the shrews. There was no consistency in the location within a liver lobule. The mean dimensions of the eggs measured 61.8 by 28.1 μm. One partial worm was removed from the liver and there was no grossly obvious reaction to the worm. Characteristic hepatic lesions were macroscopically visible in one of the shrews examined. Sec-

Table 2. Relationship of habitat type with specific helminth infections.

Parasite	Percent infected by habitat type				
	Forest	Grass monoculture	Swamp	Salt marsh	Total
Trematoda					
Brachylaima thompsoni	6.8 (2)*	9.6 (9)	—	25.0 (3)	9.7
Brachylaima rhomboideus	44.8 (13)	57.5 (57)	66.2 (2)	33.3 (4)	53.1
Panopistus pricei	3.4 (1)	22.2 (22)	—	16.6 (2)	21.6
Cestoda					
Protogynella blarinae	—	11.1 (11)	33.3 (1)	—	8.3
Hymenolepis anthocephalus	13.7 (4)	17.1 (17)	—	—	14.6
Pseudodiorchis reynoldsi	—	1.1 (1)	—	—	0.6
Nematoda					
Porrocaecum encapsulatum	10.3 (3)	2.1 (2)	33.3 (1)	8.3 (1)	4.8
Porrocaecum americanum	6.8 (2)	15.0 (14)	—	33.3 (4)	13.9
Capillaria blarinae	3.4 (1)	60.2 (56)	—	8.3 (1)	40.5
Capillaria urinicola	6.8 (2)	5.0 (5)	—	—	4.8
Capillaria sp. (liver)	10.3 (3)	5.0 (5)	—	8.3 (1)	6.2
Capillaria sp. (spleen)	3.4 (1)	—	—	—	0.6
Spirura talpae	—	—	33.3 (1)	—	0.6
Acanthocephala					
Prosthorhynchus formosus	—	1.1 (1)	—	16.2 (2)	2.0
No. of shrews examined	29	99	3	12	143

* Values in parentheses represent the number of animals infected.

tions disclosed discrete, scattered foci that were comprised of eggs. Most of the hepatic tissue was normal in appearance.

The spleen of one shrew was found to contain eggs of *Capillaria* sp. and portions of one worm. These eggs were in the white pulp of the spleen. A few eosinophils were observed in the area where the eggs were present. The mean dimensions of six bipolar operculate eggs measured in situ in the spleen were 67 by 27 μm.

Discussion

The results presented in this study emphasize the prevalence of infection with one or more helminth species in *Blarina brevicauda*. One of these helminths, *Spirura talpae*, has not been reported previously from this host in the continental United States.

From the four areas sampled, similar parasite fauna was collected so that a variation in the parasite burden as the result of habitat type was not detected. The parasite burdens in the shrew reflect the food habits of this animal. Shull (1907) found that many beetles and their larvae, other insects and their pupae, earthworms and sowbugs, snails of the genus *Polygyra* and meadow mice are taken as food. Snails in the genus *Lymnaea* when available are taken by the short-tail shrew. The metacercariae of the flukes recovered from shrews in this study occur in a number of land snails and slugs. Consequently, infections were probably contracted by eating infected mollusks. Nineteen double infections with

brachylaimid trematodes were noted in this study. Multiple infections of brachylaimids are quite common in land snails according to Villella (1954), who observed *Panopistus pricei* associated with other species of brachylaimids within the same snail host.

The snail hosts *Ventridens ligera* and *V. suppressus* which have been listed for *Brachylaima rhomboideus* (Yamaguti, 1971) are not reported from Connecticut (Burch, 1962). The prevalence of *B. rhomboideus* was 53.1% which indicates that either the snail host has a new distribution or that another intermediate host is present in sufficient numbers to allow for such a high prevalence of infection.

Since 68.5% of the shrews examined were infected with trematodes, it appears that snails and slugs are a preferred food source for the shrew.

No life cycles are known for cestodes which parasitize *Blarina brevicauda*, although van Gundy (1935) found very immature specimens of *Hymenolepis anthocephalus* associated with larval elaterid beetles in the stomach of shrews. The hymenolepidids very frequently utilize an arthropod as an intermediate host which probably explains the large number of species of hymenolepidids which are found in insectivorous animals such as shrews. *Hymenolepis anthocephalus* was not found in shrews from the swamp habitat, an environment which may be unsuitable for the beetle intermediate host.

The method by which the host becomes infected with *Porrocaecum encapsulatum* is not known. Oswald (1958) suggested that the eggs are picked up first by some invertebrate such as an earthworm and that the shrew becomes infected by ingesting the eggs or very early developmental stages in the invertebrate animal.

The life cycle of *Capillaria blarinae* is not known. Some species in this genus require an earthworm as an intermediate host (Hyman, 1951). In view of the high prevalence 40.5% of infection of shrews in this study and the low reported (Hamilton, 1930) prevalence of earthworm consumption, two alternative hypotheses may be proposed: (1) Earthworms consituted a greater portion of the diet of shrews in this study than that of Hamilton (1930); and (2) *Capillaria blarinae* may utilize an intermediate host other than the earthworm. The histopathology in the shrew esophagus agrees with the description by Ogren (1953). Ogren (1953) observed no abnormal tissue proliferation as was the case for the shrews from Connecticut.

Capillaria urinicola was collected from the urinary bladder of 4.8% of the shrews examined, no reactions were noted to the presence of the parasite. It has been reported only once before by Bray (1954). *Capillaria plica* has been reported by Miller et al. (1974) from shrews in North Carolina.

The mean dimensions of 50 formalin-fixed eggs collected from the liver of the shrews in this study measured 61.8 by 28.1 μm which is longer and not as wide as the measurements given by Bancroft (1893) for live *Capillaria hepatica* eggs (55 by 30 μm). The discrepancy may be due to the fixation process.

The dimensions (67 by 27 μm) of the eggs of *Capillaria* sp. collected from the spleen of one shrew were comparable to those (64 by 26 μm) of unidentified eggs recovered from the spleen of a rat (*Rattus rattus*) by Mackerras (1957).

Spirura talpae was collected from the stomach in one shrew from a swamp habitat. Larvae encyst in the abdomen of *Blatta orientalis* according to Seurat (1911). Sprehn (1932) reported this parasite in *Talpa europea* in Europe. The

report of *Spirura talpae* from the short-tail shrew in Connecticut is a new host record.

Juvenile acanthocephalans of *Prosthorhynchus formosus* which were collected from two shrews suggests that the short-tail shrew can serve as a paratenic host of this acanthocephalan if these parasites become encysted viscerally. Nickol and Oetinger (1968) recovered 45 cystacanths of *P. formosus* from the mesenteries of a short-tail shrew in New York. The shrews in this study probably acquired the parasites by eating infected isopods. Although *P. formosus* has not been reported from a bird of prey, it is possible that parasitizations do occur, since shrews are consumed by these predators.

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