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Helminths of Mink, *Mustela vison,* and Muskrats, *Ondatra zibethicus,* in Southern Illinois

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ABSTRACT: Five species of helminths were detected in 50 mink, *Mustela vison,* and 3 in 50 muskrats, *Ondatra zibethicus,* taken between fall 1993 and fall 1995 from Randolph, Monroe, Washington, and Jackson counties in southern Illinois. Although both mammals share similar habitats and some common food items, their endoparasites were dissimilar. Species and prevalences of infection for mink included *Capillaria putorii* (34%), *Dirofilaria immitis* (2%), *Filaroides martis* (62%), *Molineus* sp. (2%), and *Paragonimus kellicotti* (14%), whereas those for muskrats included *Echinostoma trivolvis* (42%), *Quinqueserialis quinqueserialis* (18%), and *Taenia taeniaeformis* cysticerci (22%). All helminths from *M. vison* and *T. taeniaeformis* cysticerci from *O. zibethicus* in Illinois constitute new geographic locality records. *Dirofilaria immitis* in *M. vison* represents a new host record.

KEY WORDS: mink, muskrat, helminths, *Capillaria putorii, Dirofilaria immitis, Filaroides martis, Molineus* sp., *Paragonimus kellicotti, Echinostoma trivolvis, Quinqueserialis quinqueserialis, Taenia taeniaeformis.*

Both the mink, *Mustela vison* Schreber, 1777, and the muskrat, *Ondatra zibethicus* Linnaeus, 1766, are widely distributed throughout most of North America. Mink occur in all parts of the contiguous United States with the exception of Arizona and inhabit most of Alaska and all of Canada south of the treeline except for the Anticosti Island and the Queen Charlotte Islands (Banfield, 1974). The geographic distribution of muskrats extends from northern Mexico to northern Alaska and northern Canada. They are, however, absent in Florida and parts of extreme northern Alaska and Canada (Doyier, 1953; Lowery, 1974).

Mink are well adapted for hunting both aquatic and terrestrial prey (Linscombe et al., 1982), whereas muskrats are chiefly herbivores (Bailey, 1937; Doyier, 1953). However, both feed on clams, crayfish, fish, frogs, and young birds, all of which may serve as intermediate hosts in parasite transmission. Because mink and muskrats are carnivores and rodents, respectively, one would not expect them to have helminths in common, except when a muskrat serves as an intermediate host for adult helminths in mink.

The purpose of the present study was 2-fold: (a) to ascertain the prevalence and intensity of helminths that infect both mink and muskrats in southern Illinois and (b) to determine whether these mammals share common helminths.

Materials and Methods

Fifty *Mustela vison* and 50 *Ondatra zibethicus* were collected in Randolph, Monroe, Washington and Jackson counties, of southern Illinois between September 1993 and January 1995. Animals were obtained by means of live trapping and from commercial hunters during the trapping season. Examinations of carcasses were performed either on the day of the capture or the next day.

The esophagus, stomach, small intestine, large intestine, liver, and lungs were separated and placed into containers of physiological saline. These organs, in addition to the body cavity, were then examined with a dissecting microscope. Digeneans and cestodes were fixed in alcohol–formalin–acetic acid solution, stained in Harris hematoxylin, dehydrated, cleared in beechwood creosote, and mounted in Canada balsam. Nematodes were fixed in warm glacial acetic acid or hot 70% ethanol, stored in a solution of 5 parts glycerine and 95 parts 70% ethanol, cleared in glycerine, and studied as temporary mounts.

The ecological terms *prevalence* and *intensity* used in this report are those of Margolis et al. (1982). Voucher specimens have been deposited in the U.S. National Parasite Collection, USDA, Beltsville, Maryland 20705, under the accession numbers listed in Tables 1 and 2.

Results and Discussion

Digeneans of a single species and nematodes of 5 species were recorded from 50 mink, and digeneans of 2 species and a cestode were obtained from 50 muskrats. The species of helminth, anatomical location within the host, prevalence, mean intensity, range of intensity, and accession numbers for deposited specimens are listed in Table 1 for *M. vison* and Table 2 for *O. zibethicus.* Comparison of the data in these 2 tables reveals that mink were infected with a greater variety of helminths than muskrats.

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Table 1. Helminths recovered from 50 mink, *Mustela vison*, in southern Illinois.

Species	Anatomical location	Prevalence (%)	Mean intensity	Range of intensity	USNPC no.
Nematoda					
Capillaria putorii	Small intestine, stomach	34	5	2–11	85416
Dirofilaria immitis	Heart	2	1	1	85417
Filaroides martis	Lungs	62	70	30–120	85418
Molineus sp.	Small intestine	2	1	2	*
Trematoda					
Paragonimus kellicotti	Lungs	14	2	1–4	85419

* *Molineus* species were lost during transport.

Thirty-four (68%) of 50 mink including 10 (62.5%) of 16 females and 24 (70.5%) of 34 males were infected. Twenty-two (44%) of 50 mink were infected with a single species of helminth, whereas 12 (24%) of 50 were infected with 2 species. The data concerning the species found in mink in the present study (Table 1) reveal that nematodes and digeneans are more prevalent than cestodes and acanthocephalans.

Thirty (60%) of 50 muskrats including 11 (55%) of 20 females and 19 (63.3%) of 30 males were infected. Twenty-four (48%) of 50 muskrats were infected with a single species of helminth, whereas 6 (12%) of 50 were infected with 2 species. The data concerning the species found in muskrats in the present study (Table 2) reveal that cestodes and digeneans are more prevalent than nematodes and acanthocephalans.

Although helminths common to both mink and muskrats have been reported previously, common parasites were not found in the present study. This may be due to a couple of factors. As already stated, helminths common to both species would be expected if muskrats served as intermediate hosts for adult helminths in mink. In the present study, the helminths detected in muskrats did not include those which allow the muskrat to serve as an intermediate host for mink helminths; therefore, they are not expected to be common to both species. Second, the sample size was not very large and, because most animals were obtained in the months of December and January, the time frame of the present study did not allow for comparison of helminths during other months of the year.

Whereas most infections in either mink or muskrats were single infections, multiple infections were limited to no more than 2 species of helminths. A brief discussion of each species found is presented.

Parasites of Mink, *Mustela vison*

Nematoda

Capillaria putorii (Rudolphi, 1819) Travassos, 1915

Capillaria Zeder, 1800, is a large genus including species that parasitize nearly all organs and tissues of all classes of vertebrates. Yamaguti (1961) listed 88 species in mammals alone. Several attempts have been made to divide the genus into smaller taxa. However, Butterworth and Beverley-Burton (1980) in a study of the taxonomy of *Capillaria* spp. presented a historical

Table 2. Helminths recovered from 50 muskrats, *Ondatra zibethicus*, in southern Illinois.

Species	Anatomical location	Prevalence (%)	Mean intensity	Range of intensity	USNPC no.
Cestoda					
Taenia taeniaeformis (cysticerci)	Liver	22%	3	2–7	85420
Trematoda					
Echinostoma trivolvis	Small intestine	42%	15	2–67	85423
Quinqueserialis quinqueserialis	Small intestine, large intestine	18%	2	1–5	85421 85422

review of the genus and rejected the concept of recognizing other genera based on single characters. Their examination of specimens of *C. putorii, C. erinacei* (Rudolphi, 1819) Travassos, 1915, and *C. mustelorum* Cameron and Parnell, 1933, from type hosts lead to the conclusion that the latter 2 species are synonyms of *C. putorii.* They further demonstrated that *C. putorii* is readily distinguished by the presence of 2 lateral caudal alae, large terminal caudal ala, and 2 digitiform papillae in the male, in addition to the network of ridges on the eggshell. Moravec (1982), who proposed a new systematic arrangement of nematodes of the family Capillariidae, supported the view that the morphological features of various capillariid species, their different location, and the heterogeneity of their definitive hosts give evidence for the existence of several genera in the family.

In the present study, *C. putorii* was found in the stomach or small intestine or both in the same individual of 17 (34%) of 50 mink (Table 1) representing 5 (31.2%) of 16 females and 12 (35%) of 34 males. Of the 4 species of nematodes found in mink, *C. putorii* was the second most common roundworm. The finding of *C. putorii* in mink from Illinois represents a new geographic locality record.

Dirofilaria immitis (Leidy, 1856) Railliet and Henry, 1911

A single female found in the right side of the heart of a male mink was identical to the description of *Dirofilaria immitis* as given by Orihel (1961). This represents the first report of this nematode in *Mustela vison.*

D. immitis has been reported in a variety of mammals from various localities in North America. Although dogs are the major definitive hosts, *D. immitis* has also been reported in raccoons by Snyder et al. (1989), coyotes by Kick et al. (1984), wolverines by Williams and Dade (1976), red foxes by Kazacos (1977), muskrats by Goble and Cook (1942), and black bears by Davidson and Nettles (1988). Because only a single specimen was detected in a sample size of 50 mink, further studies involving a larger population of mink need to be conducted in order to ascertain the status of *D. immitis* in this mammal.

Filaroides martis (Werner, 1782) Dougherty, 1943

This metastrongyle was the most common nematode. It occurred in 31 (62%) of 50 mink including 11 (68.7%) of 16 females and 20 (58.8%) of 34 males. The prevalence of *F. martis* reported here is somewhat higher than that given in comprehensive surveys. Miller and Harkema (1964) found 58 (48%) of 120 mink in North Carolina infected with this helminth, whereas Dorney and Lauerman (1969) reported 18 (43%) of 42 mink from Wisconsin infected. Anderson (1962) detected this helminth in 316 of 657 males and 121 of 319 female mink from Ontario, resulting in an overall prevalence of 45%.

Examination of specimens was difficult because the worms occur in nodules in the bronchi and brochioles and are enclosed in tough, fibrous connective tissue. Worms were compacted into closely interwined knots and frequently only fragments of the nematodes could be obtained for study. Females are ovoviviparous. Eggs hatched and larvae were active upon thawing of worms in tissue that had been frozen at −20°C for 2 days. Anderson (1962) demonstrated a sigmoidal relationship between temperature and activity of first-stage larvae of *Perostrongylus pridhami* encapsulated in the liver of mice. This helminth is also a viviparous metastrongyle in mink. The finding of *F. martis* in *M. vison* in Illinois constitutes a new geographic locality record.

Molineus sp.

Two females of the genus *Molineus* were found in the small intestine of a single male *M. vison.* In the absence of male worms, this nematode could not be identified to the species level. *Molineus patens* (Dujardin, 1845) Petrow, 1928, is the only species of this genus recorded from mink. Miller and Harkema (1964) reported 34 (28%) of 120 mink infected with *M. patens* in North Carolina, whereas Dorney and Lauerman (1968) found 1 (2%) infection from 47 *M. vison* in Wisconsin. The finding of specimens of *Molineus* in mink from Illinois constitutes a new geographic locality record.

Trematoda

Paragonimus kellicotti Ward, 1908

This digenean was detected in the lungs of 7 (14%) of 50 mink including 3 (18%) of 16 females and 4 (11.7%) of 34 males. *Paragonimus kellicotti* has been reported from several vertebrate hosts in North America including skunks, red foxes, coyotes, least weasels, raccoons, and muskrats (Ramsden and Presidente, 1975). Dogs, cats, and humans may also become infected. On

the basis of the frequency of natural infections, mink are believed to be the natural hosts (Olsen, 1974).

The taxonomy of the genus in North America remains unsettled. Some workers recognize *P. kellicotti,* whereas others consider this species a synonym of *P. westermani* (Kerbert, 1878) Braun, 1899. *P. rudis* (Diesing, 1850) Stiles and Hassall, 1900, detected by Miller and Harkema (1964) from North Carolina mink, is considered by most authors to be a synonym of *P. kellicotti.*

Ward and Hirsch (1915) differentiated *P. westermani* from *P. kellicotti* on the basis of the arrangement of tegumental spines. Ameel (1934) published an account of the life history, taxonomy, and distribution of *Paragonimus* in North America. He did not agree that the 2 species could be differentiated on the basis of arrangement of spines. Miyazaki (1949) noted that the ovary in *P. westermani* is less branched than in *P. kellicotti.* More recently, Ishii (1966) stressed the nature of the tegumental spines, egg morphology, and the morphology of the testes and ovaries. Ishii concluded that adults of *P. westermani* and *P. kellicotti* may be differentiated on the basis of the morphology of the ovary. Branching of the ovary in *P. kellicotti* is more distinct and extensive than that of *P. westermani,* which is less branched.

Specimens in the present study are tentatively assigned to *P. kellicotti* based on the morphology of the ovary until more valid criteria for differentiation are established. The finding of this species in mink in Illinois represents a new geographic locality record.

Parasites of Muskrats, *Ondatra zibethicus*

Cestoda

Taenia taeniaeformis (Batsch, 1786) Wolffhuegel, 1911

Cysticerci of *T. taeniaformis* were found encysted in nodules on the surface of the liver of 11 (22%) of 50 muskrats including 2 (10%) of 20 females and 9 (30%) of 30 males.

T. taeniaeformis is commonly parasitic in the small intestine of domestic cats and other felines (Gallati, 1956), which are the main source of eggs for infection of muskrats and voles. The only report of this parasite in muskrats from Illinois is by Gilford (1954), who reported cysticerci in 2.2% of 250 muskrats from north-central Illinois. This report constitutes a new geographic locality record for this tapeworm in muskrats of southern Illinois.

Trematoda

Echinostoma trivolvis Cort, 1914

Echinostoma trivolvis was the most abundant digenean in muskrats in the present study. It was found in the small intestine of 21 (42%) of 50 muskrats, including 8 (40%) of 20 females and 8 (26.6%) of 30 males. Ulceration and bleeding of the intestinal mucosa were evident when 30 or more specimens were present.

It is one of the most common and abundant of all trematodes of warm-blooded semiaquatic vertebrates showing little host specificity (Schmidt and Roberts, 1989). The high prevalence of this parasite in many surveys may reflect the presence of numerous hosts, which may serve as part of the reservoir for this digenean (Beaver, 1937).

Adult *Echinostoma trivolvis* exhibit considerable morphological variation in response to the physiology of a particular definitive host. This has resulted in the description of numerous new species. As a result of Beaver's (1937) extensive experimental studies, about 15 species were declared synonyms of *E. revolutum.* More recently, Huffman and Fried (1990) conducted an extensive study concerning the biology, infectivity, immunology, pathology, and epidemiology of *Echinostoma* species and demonstrated that *E. trivolvis* and not *E. revolutum* is the correct name for the North American form.

Quinqueserialis quinqueserialis (Barker and Laughlin, 1911) Harwood, 1939

This monostome was found in the intestines of 9 (18%) of 50 muskrats including 4 (20%) of 20 females and 5 (16.6%) of 30 males. It is a ubiquitous parasite over the muskrat's range in North America. In addition, it also occurs in meadow voles and jumping mice in the United States and Canada (Olsen, 1974). Although *Q. quinqueserialis* has been reported in almost all surveys of muskrat parasites, the intensity of infection is usually low and it does not appear to present a serious threat to the health of the host.

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