GASTROINTESTINAL HELMINTHS IN RED FOXES (*VULPES VULPES* L.) OF SOUTHERN ILLINOIS

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ABSTRACT

Between 1959 and 1964, 183 *Vulpes vulpes* collected in southern Illinois were examined for gastrointestinal helminths; 77 (82%) males and 48 (54%) females were infected. Overall prevalence of infections was 68% and included 7 (4%) *Ancylostoma caninum*, 113 (62%) *Physaloptera rara*, 4 (2%) *Toxascaris leonina*, 1 (1%) *Toxocara canis*, 3 (2%) *Trichuris vulpis*, 4 (2%) *Mesocestoides variabilis*, 38 (21%) *Taenia pisiformis*, and 3 (2%) *Alaria marcianae*.

INTRODUCTION

While extensive studies have been conducted on gastrointestinal parasites in wild canid populations in North America, most are in reference to wolves and coyotes. Helminths of wolves (*Canis lupus* L.) have been reported from Alaska (Rausch and Williamson, 1959), Ontario (Freeman *et al.*, 1961), Alberta (Holmes and Podesta, 1968), Yukon and the Northwest Territories (Choquette *et al.*, 1973), Manitoba (Samuel *et al.*, 1978), Utah (Butler and Ameel, 1959; Hirsch and Gier, 1974), Iowa (Granson *et al.*, 1978) and Minnesota (Byman *et al.*, 1977).

Although reports on gastrointestinal parasites of foxes are numerous, few are concerned with total helminth faunas. Buechner (1964) examined 112 grey foxes (*Urocyon cinereoargenteus*) from Texas, while Dyer and Klimstra (1981) studied 543 from southern Illinois. Samuel *et al.* (1978) reported on the gastrointestinal helminths of 6 red foxes from southwestern Manitoba, Baron (1970) on 75 from southern Manitoba, Smith (1978) on 61 from New Brunswick and Nova Scotia, Rausch and Richards (1971) on 96 and 30 from northern and southern North Dakota, respectively, Erickson (1944) on 152 from Minnesota, Smith (1943) on 234 from Iowa, and Rankin (1946) on 4 from Massachusetts.

The only study of gastrointestinal parasites of red foxes from Illinois includes 12 *Vulpes vulpes* examined from counties in the northern part of the state (Leigh, 1940). The purpose of this study was to determine the helminth fauna of the gastrointestinal tracts of a large sample of *V. vulpes* from counties in southern Illinois and to compare these data with the recorded findings on similar helminths in red foxes from other areas.

MATERIALS AND METHODS

One hundred and eighty-three red foxes were either shot or trapped in

Union, Williamson and Jackson counties, southern Illinois, between February, 1959 and February, 1964. The carcasses were immediately frozen and transported to the laboratory. After thawing, the gastrointestinal tract was divided into the stomach, small and large intestine, flushed with tap water and the mucosa examined for attached parasites. The stomach and intestinal perfusates were examined under a dissecting microscope and detected helminths isolated and transferred to fixative. The remaining contents were stored in a 10% formalin solution.

Trematodes and cestodes were fixed in alcohol-formalin-acetic acid (AFA), stained with either Harris' or Delafield's hematoxylin and mounted in Canada balsam. Rostellar hooks were removed from the cestodes, mounted in aquamount, and compared with hooks from known species. Nematodes were fixed in glycerin-alcohol, cleared in glycerin, and examined from glycerin wet mounts.

RESULTS

Of 183 *V. vulpes* collected over a discontinuous 35-month period, only 1 of 3 (33%) animals from 1959, 13 of 17 (77%) animals from 1960, 83 of 108 (77%) animals from 1961, 8 of 62 (13%) animals from 1962, 18 of 38 (47%) animals from 1963, and 2 of 4 (50%) animals from 1964 were positive.

The prevalence of gastrointestinal helminths of 94 male and 89 female *V. vulpes* is summarized in Table 1. Fifty-eight of 183 (32%) red foxes were free of helminths in both stomach and intestines. Five species of nematodes, one of trematodes, and two of cestodes were found in 125 (68%) animals. Seventy-seven (82%) male and 48 (54%) female *V. vulpes* were infected with one or more helminths.

Of the 8 helminths recovered from 125 foxes, 73 harbored only a single species; 2 species were found in 44 animals, 3 in 3 and 4 in 4.

Physaloptera rara (Hall and Wigdor, 1918), was the most prevalent helminth encountered. The occurrence of this species varied significantly ($P < 0.001$) between the sexes, being encountered in 71 (76%) male and 42 (47%) female foxes (Table 1). The occurrence of other helminths did not vary significantly ($P > 0.20$) between the sexes.

DISCUSSION

Since this study was done in conjunction with a food habit study of red foxes and because of time restraints, not all animals were examined for helminths. Because helminths were not systematically recorded by month over consecutive years, data are insufficient to form convincing conclusions on the seasonal dynamics of *V. vulpes* parasites. While animals were examined each month of 1961, the sample size was too small to evaluate montly changes in prevalence and mean densities of the helminths found.

Of surveys dealing with the total gastrointestinal helminth faunas of red foxes from Canada and the continguous Unites States as listed above, only the report of Rausch and Richards (1971) provides information on the diversification of mutiple infections. These investigators reported that multiple infections of red foxes in southern North Dakota were less diversified than those from the northern part of the state. Of the 7 helminths recovered from 80 foxes from southern North Dakota, a single species was recorded in 9 foxes; 2 species were found in 11

animals, 3 in 5 and 4 in 4. Diversification of multiple infections in our survey is similar to that reported in foxes from southern North Dakota. It is of interest to note that in either survey no more than four species were found in a single fox.

As indicated in Table 1, *Physaloptera rara* was the most prevalent helminth encountered. Its greater occurrence in male foxes cannot be accounted for as it is assumed that both sexes have similar eating habits. Other reports listed above have not differentiated the incidence of this species between the sexes.

The frequency of *P. rara* in red foxes from southern Illinois is much higher than that reported from other areas. Erickson (1944) reported 20 of 152 (13%) red foxes from Minnesota and Smith (1943) 80 of 234 (34%) from Iowa infected with this parasite. The high prevalence of *P. rara* in the present study corroborates the high frequency of occurrence of grasshoppers, crickets, and beetles (39%) in the diet of red foxes from southern Illinois as reported by Knable (1970). The potential would be greater if one included the frequency of occurrence of frogs, snakes, birds and mice which may serve as paratenic hosts.

The low prevalence of *Ancylostoma caninum* (Ercolani, 1854) suggests that hookworm infections in southern Illinois do not pose a serious threat to the health of these canids. Smith (1943) reported 1 of 234 (0.4%) red foxes from Iowa and Leigh (1940) 1 of 12 (8%) from northern Illinois infected with this parasite.

Although *Toxascaris leonina* (von Linstow, 1902), *Toxocara canis* (Werner, 1782) and *Trichuris vulpis* (Froelich, 1789) have a wide distribution in canids, few were encountered in this study. Samuel *et al.* (1978) reported 6 of 6 (100%) red foxes from southwestern Manitoba infected with *T. leonina* while Baron (1970) did not find this species in 75 foxes examined from southern Manitoba. Rausch and Richards (1971) reported 93 of 96 (97%) and 28 of 30 (93%) red foxes from nothern and southern North Dakota, respectively, infected with this parasite; Erickson (1944) found 103 of 152 (68%) foxes from Minnesota and Smith (1943) 48 of 234 (68%) from Iowa infected with *T. leonina*.

Toxocara canis has been reported in 71 of 75 (95%) red foxes from southern Manitoba; 43 of 61 (71%) from New Brunswick and Nova Scotia (Smith, 1978), 5 of 152 (3%) from Minnesota (Errington, 1935), 21 of 234 (9%) from Iowa (Smith, 1943), and 1 of 4 (25%) from Massachusetts (Rankin, 1946). None were found in 6 foxes examined from southwestern Manitoba (Samuel *et al.*, 1978) as well as 96 and 30 examined from northern and southern North Dakota (Rausch and Richards, 1971). According to Sprent (1958), *T. canis* is more frequent in juvenile canids which may become infected by ingesting either embryonated eggs or infected rodents or by prenatal trasplacental migration of larvae. The single host infected in our study was a juvenile. *Trichuris vulpis* was not reported in the other studies mentioned above.

Taenia pisiformis (Bloch, 1780) had the second highest frequency of occurrence. While the prevalence of this species in *V. vulpes* from other geographic areas has been low or negative, that in *U. cinereoargenteus* from southern Illinois and other areas has been high (Dyer and Klimstra, 1981). *Taenia pisiformis* is also a prevalent cestode in *C. latrans* from certain geographic areas. It has been reported in 1758 of 1850 (95%) coyotes from Kansas (Hirsch and Gier, 1974), 41 of 75 (55%) from Utah (Butler and Grundmann, 1954), 66 of 339 (20%) from Ontario (Freeman *et al.*, 1961), 29 of 43 (67%) from southwestern Manitoba (Samuel *et al.*, 1978), and 23 of 75 (31%) from Alberta (Holmes and Podesta, 1968). The

high prevalence of *T. pisformis* in the present study corroborates the high percent frequency of occurrence of rabbits (32%) in the diet of Illinois red foxes as reported by Knable (1970).

Mesocestoides variabilis (Mueller, 1927), the only other tapeworm encountered, has not been reported in the aforementioned surveys. However, *Mesocesotides kirbyi* (Chandler, 1944) was reported in 11 of 95 (11%) and 6 of 30 (20%) red foxes from nothern and southern North Dakota, respectively (Rausch and Richards, 1971).

Alaira marcianae (LaRue, 1971), the only fluke encountered, has been reported from several canids in North America. It was reported in 6 of 6 (100%) red foxes from southwestern Manitoba (Samuel *et al.*, 1978), 15 of 61 (25%) from new Brunswick and Nova Scotia (Smith, 1978), 40 of 96 (42%) and 5 of 30 (17%) from northern and southern North Dakota (Rausch and Richards, 1971), respectively and 1 of 152 (1%) from Minnesota (Erickson, 1944).

Food habit studies of the red fox (Cook and Hamilton, 1944; Errington 1935, 1937; Murie, 1936; Scott, 1943, 1947; Scott and Klimstra, 1955) reveal that this canid is highly omnivorous and differences in food items from different areas reflect their seasonal availability. As pointed out by Scott (1955) red foxes tend to take foods which are most readily available and "foods may occur in the diet in an almost endless number of qualitative and quantitative combinations, which differ with such environmental properties as emergencies, season, year, and the general ecological character of the specific area." It is not surprising then that variation in the helminth fauna of red foxes which undergo an indirect life cycle reflects regional differences in the availability of intermediate hosts during the period of the survey in question.

TABLE 1. Prevalence of helminths in relation to sex of 183 *Vulpes vulpes* from southern Illinois.

	Prevalence—(number) Percent			
Parasite	Sexes combined (183)	Male (94)	Female (89)	P*
Nematodes				
Ancylostoma caninum	(7) 3.8	(3) 3.2	(4) 4.5	>0.20
Physaloptera rara	(113)61.8	(71)75.5	(42)47.2	<0.001
Toxascaris leonina	(4) 2.2	(3) 3.2	(1) 1.1	>0.20
Toxocara canis	(1) 0.6		(1) 1.1	
Trichuris vulpis	(3) 1.6	(3) 3.2		
Cestodes				
Mesocestoides variabilis	(4) 2.2	(3) 3.2	(1) 1.1	>0.20
Taenia pisiformis	(38)20.8	(22)23.4	(16)18.0	>0.20
Trematodes				
Alaria marcianae	(3) 1.6	(2) 2.1	(1) 1.1	>0.20

*Probability that observed difference is due to chance.

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