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HEARTWORMS (*DIROFILARIA IMMITIS*) IN COYOTES (*CANIS LATRANS*) IN NEW ENGLAND

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There have been few studies of heartworm in populations of wild canids in northeastern United States. Augustine (1938, Am. J. Hyg. 28: 390-395) reported heartworm microfilariae in 8.5% of 94 dogs (*Canis familiaris*) in Massachusetts and an absence of microfilariae in 10 red foxes (*Vulpes vulpes*) from Massachusetts and 28 dogs from New Hampshire. Hirth et al. (1966, J. Am. Vet. Med. Assoc. 148: 1508-1516) and Tritch et al. (1973, Am. J. Vet. Res. 34: 1473-1474) found that dogs in Connecticut were parasitized by heartworm. Monson et al. (1973, N.Y. Fish Game J. 20: 48-53) reported infections in coyotes (*Canis latrans*) and a gray fox (*Urocyon cinereoargenteus*) and red foxes in New York. In the present study we examined coyotes from New Hampshire, Massachusetts, and Connecticut for the presence of heartworms.

The hearts, pulmonary arteries and lungs of 259 coyotes, obtained from trappers via state game biologists, were examined for the presence of heartworms. Two hundred and thirty-four of these were from New Hampshire, 21 from

Massachusetts, and 4 from Connecticut. Ages of the coyotes were determined by tooth wear (Gier, 1968, *Coyotes in Kansas*. Agric. Exp. Sta., Kansas State Univ., Manhattan, Kansas, 117 pp), development of alveolar bone (Nellis et al., 1978, J. Wildl. Manage. 42: 680-683), suture closure and development of the postorbital processes. Representative specimens of the heartworms have been deposited in U.S. National Parasite Collection, Beltsville, Maryland (Accession No. 77031).

Worms were found in eight (3.4%) of the coyotes from New Hampshire; burdens ranged from 1 to 39 (\bar{x} = 13.6) worms per infected coyote (Table 1). Although specimens were examined from throughout the state, infected coyotes occurred only in three central and eastern counties (Merrimack, Belknap, and Strafford). Male coyotes (n = 4) averaged 25 worms, females (n = 3) only 3 (Table 1). Coyotes less than 1 yr or older than 4 yr were not infected. The highest percentage of infected individuals (40%) occurred in the 3-4 yr age class while the lowest (5.7%) occurred in the 1-2 yr class.

TABLE 1. Characteristics of coyotes infected with *Dirofilaria immitis*.

Locality	Sex	Age (yr)	No. <i>D. immitis</i>	
			Males	Females
New Hampshire, Merrimack Co.	F	1-2	1	1
New Hampshire, Strafford Co.	M	1-2	2	13
New Hampshire, Strafford Co.	M	1-2	15	17
New Hampshire, Merrimack Co.	F	2-3	0	2
New Hampshire, Merrimack Co.	M	2-3	6	8
New Hampshire, Belknap Co.	F	2-3	1	3
New Hampshire, Merrimack Co.	M	3-4	9	30
New Hampshire, Strafford Co.	F	3-4	0	1
Massachusetts, Worcester Co.	M	1-2	2	1
Connecticut, Hartford Co.	M	4-5	1	4

In one male coyote, worms were extracted from the pulmonary artery and bronchi as well as the right ventricle. In the remainder, worms occurred only in the right ventricle. Of the 109 heartworms found in the New Hampshire coyotes, 75 were females, 34 males (2.2:1). The mean length of the male worms was 130.7mm (69-190mm) and the mean length of females was 227.9mm (94-315mm).

Five heartworms were extracted from one coyote from Connecticut and three from one coyote from Massachusetts.

Our findings are comparable to the prevalence of heartworms in coyotes in New York and Iowa (Table 2). The low prevalence in coyotes in Kansas was recorded between 1947 and 1962, prior to the observed increased prevalence of heartworms in the midwestern United States (Otto, 1975, Proc. 1974 Heartworm Symp., Auburn, Alabama, pp. 1-2); Graham (1975, J. Parasit. 63: 513-516) reported a much higher frequency (8.0%) in 1975 in the same state. Custer and Pence (1981, Vet. Parasit. 8: 71-82) recorded a prevalence of 70.8% in coyotes in Texas and Louisiana which is consistent with values in other parts of the southern United States (Rothstein et al., 1961, J. Parasit. 47: 661-665). Stuht and Youatt (1972, J. Wildl. Manage. 36: 166-170) concluded that heartworms in wild canids may be confined to endemic areas. It follows that the variations observed in Table 2 may be due to the specific areas

sampled in each study. The results of our study suggest that an endemic area exists in New Hampshire. Although figures for populations of domestic dogs are not available, the three counties which yielded infected coyotes are north of the primary human population centers.

Our findings of 2.2 female heartworms for each male is consistent with Crowell et al. (1978, Proc. 1977 Heartworm Symp., Atlanta, Georgia, pp. 10-13) who reported a ratio of 2.1:1 but Custer and Pence (op. cit.) found 1.2:1. The occurrence of heartworms in the bronchi is an unusual location (Otto, 1975, Proc. 1974 Heartworm Symp., Auburn, Alabama, pp. 6-13) but Turk et al. (1956, J. Am. Vet. Med. Assoc. 129: 425) reported these worms in the bronchioles of dogs.

There was a trend for increased parasitism with age in coyotes in New Hampshire, just as there was in Colorado and Kansas (Graham, op. cit.) and Louisiana and Texas (Crowell et al., op. cit.; Custer and Pence, op. cit.). In both northern studies, New Hampshire and Colorado/Kansas, there was a sharp decline from age group 3-4 and up. Such demographics may indicate an expanding coyote population which is possible in New Hampshire, but unlikely in Kansas/Colorado. It may, however, reflect a population decrease due to a stress factor such as heartworm. Custer and Pence (op. cit.) concluded that this nematode appears to be "... an important factor in the morbidity and mortality ..." of wild

TABLE 2. Geographic prevalence of heartworms in coyotes in United States.

Area (reference)	No. Coyotes Examined	Number Positive	Percent Positive
New Hampshire (present study)	234	8	3.4
New York (Monson et al., op. cit.)	51	2	3.9
Iowa (Franson et al., 1976, J. Wildl. Dis. 12: 165-166)	220	8	3.6
Kansas (Gier, op. cit.)	1,790	10	0.6
Kansas (Graham, op. cit.)	113	9	8.0
Colorado (Graham, op. cit.)	20	2	10.0
Texas/Louisiana (Custer and Pence, op. cit.)	24	17	70.8
Louisiana (Crowell et al., op. cit.)	71	41	57.7

canids in southeastern Texas and southwestern Louisiana and Monson et al. (op. cit.) suggested that such parasitism may cause death due to loss of stamina. The winter climate of New Hampshire and Colorado/Kansas is severe and may be detrimental to coyotes weakened by heartworm infections.

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