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Authors: WEINMANN, C. J., and GARCIA, R.

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COYOTES AND CANINE HEARTWORM IN CALIFORNIA

C. J. WEINMANN, Division of Entomology and Parasitology, University of California at Berkeley, California 94720, USA.
R. GARCIA, Division of Biological Control, University of California, Berkeley.

Abstract: Adult *Dirofilaria immitis* were found in the hearts of 43 of 115 coyotes *(Canis latrans)* trapped within a 50 km radius of the El Dorado County seat. Of mature coyotes, 45% were positive, with worm numbers averaging 9.0 in females and 16.2 in males. *D. immitis* microfilariae occurred in the peripheral blood and in lung smears. Microfilariae of *Dipetalonema reconditum* were present in 14 of the coyotes examined (12%). Several coyotes showed enlarged hearts with gross pathological changes.

INTRODUCTION

Although enzootic zones for canine heartworm in the United States have been expanding north and westward for many years,[11] this mosquito-borne filarial worm *(Dirofilaria immitis)* was apparently not commonly seen in dogs confined to California until the present decade.[8] The parasite now appears to be widespread among local dogs in many of the hilly and mountainous parts of northern California.[5,12,15] Although coyotes and other wild canids have been found infected with *D. immitis* in various parts of the country, most reports have indicated low prevalence rates in comparison with dogs in the area, suggesting that they do not serve significantly as reservoirs of infection.[10] However, recent reports from Louisiana[1] and Illinois[6] showing high prevalence rates in coyotes point to a need to consider the coyote as a possible reservoir host in areas where heartworms are prevalent. One such area in California occurs in El Dorado County, just east of Sacramento, where a focus of infection in local dogs has been recognized since early in this decade (Vilhaver, J.R. Pers. Commun. Placerville Veterinary Clinic). This study presents the results of a survey for *D. immitis* in coyotes in this region.

MATERIALS AND METHODS

Through the cooperation of county trappers and the El Dorado County Agricultural Commission (E.P. Delfino, Commissioner), hearts and associated lung tissues from 115 trapped coyotes were made available. In 27 instances it also was possible to obtain peripheral or heart blood from trapped animals immediately after they were shot. One to 2 ml of such blood was added to 10-12 ml of 2% formalin. Blood samples were later examined for microfilariae by a modified Knott technique.[7] Lung tissues were examined for microfilariae after preparation of wet mounts in physiological saline (0.85% NaCl). Following examination for gross pathology, hearts and attached major blood vessels were opened and examined for heartworms. Living adult female worms were gently pressed between glass plates and examined microscopically for uterine microfilariae using strong substage lighting. Recovered worms were fixed in hot AFA (ethanol-Formalin-acetic acid) or TAF (triethanolamine-Formalin) and later stored in 70% ethanol with 5% glycerin and a trace of $CuSO_4$. Six pairs of adult worms, each pair from a different coyote, were dissected and detailed body measurements made for comparison

with published descriptions of *D. immitis*.[2,3]

Coyotes were classified as juvenile or adult on the basis of physical characteristics and their general condition and sex were recorded. Animals were trapped from October to February (1975-1977) at 15 sites which ranged in elevation from 290 to 1200 m and encompassed the most populated part of this rural county.

RESULTS

The prevalence of heartworms in El Dorado County in coyotes is summarized in Table 1. Adult nematodes were found in 43 of 115 coyotes examined but 28 of these were juveniles and only 4 light infections (1 or 2 worms) were detected in these. Of mature coyotes, 44.8% were positive, with nematode numbers averaging 9.0 in females and 16.2 in males. This difference was largely due to four males that harbored 28, 43, 62 and 82 worms, respectively. Infections were unisexual in 37% of the positive animals. Parasites occurred in the right heart and frequently extended into the pulmonary artery. Grossly, visible lesions in the heart were evident only in the heavily infected male coyotes and involved enlargement of the heart, especially right ventricular dilation, severely in one animal.

Nematode body measurements were within the published range for *D. immitis* and were comparable to measurements of heartworms taken from dogs. The parasite sex ratio was 1.15, female to male. Uterine microfilariae were present in 82% of the 280 female nematodes recovered. Microfilariae were abundantly present in lung smears from all positive coyotes harboring mature male and female worms. Circulating *D. immitis* microfilariae were found in 8 of 9 adult nematode-positive coyotes from which peripheral blood also was collected. Microfilariae of *Dipetalonema reconditum* were present in at least 14 of the coyotes examined (12%), a minimal estimate since these relatively sparse parasites could easily be overlooked in preparations teeming with *D. immitis* microfilariae.

Infected coyotes were taken at 13 of 15 predator control trapping sites (Fig. 1), the negative sites involving only single animals. These sites were within a 50 km radius of the County seat in Placerville and indicate widespread coyote infection in areas of human habitation.

DISCUSSION

A survey of dogs in the Central Valley of California 10 years ago failed to reveal *D. immitis* in 515 pound dogs, nor was the parasite found in 800 beagles kept in outdoor kennels at Davis, California, and a review of clinical records at the School of Veterinary Medicine (Davis) from 1957 to 1968 revealed only 12 confirmed authochtonous cases in dogs from the surrounding counties.[8] A few years later, word-of-mouth reports from practicing veterinarians indicated that heartworms were increasingly being detected in local dogs in the foothill regions to the

TABLE 1. Prevalence of *Dirofilaria immitis* in coyotes in El Dorado County, California.

Coyotes	No. Positive		Parasites/Infection		
Age-Sex	No. Examined	(% positive)	Mean	Range	Total
Juvenile ♂	1/10	(10%)	2.0	—	2
Juvenile ♀	3/18	(17%)	1.0	—	3
Adult ♂	19/43	(44%)	16.3	1-82	309
Adult ♀	20/44	(45%)	9.0	1-23	180

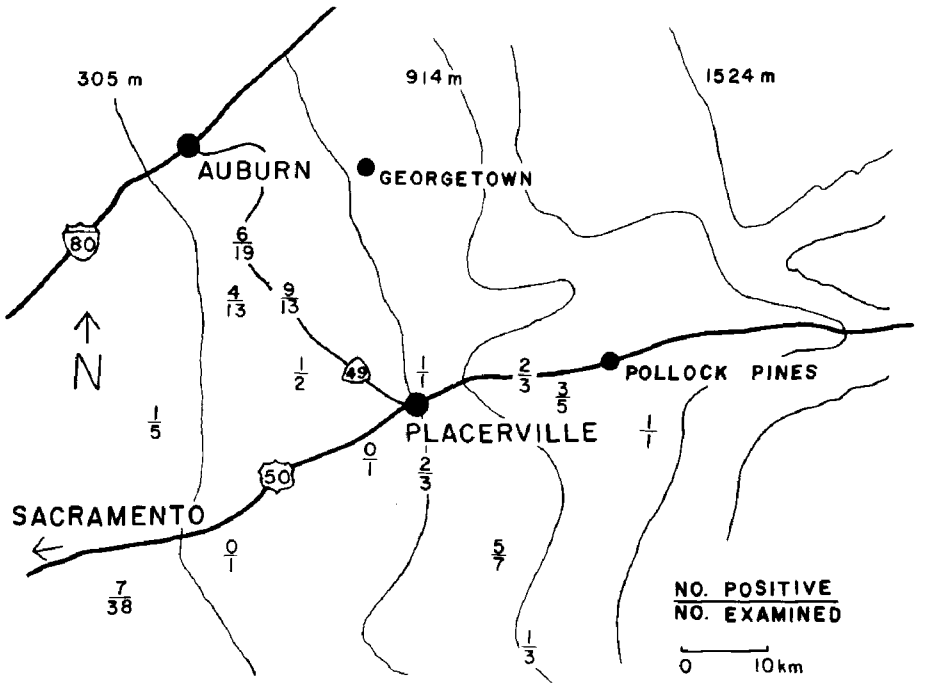

FIGURE 1. Coyote trapping sites and number of infected coyotes per site.

east, from El Dorado County northward to Shasta County. In the area covered in this report, one clinic found 119 infected dogs of 1,035 examined in 1976 and for several years recorded a consistent incidence of 11-12% in local adult, outdoor dogs (Vilhaver, J.R. Pers. Commun., Placerville Veterinary Clinic). But it is not clear how much of the sharp rise in prevalence rates seen here and elsewhere in northern and central California in recent years is really due to increased transmission and how much reflects increased surveillance for *D. immitis* by practitioners.

Judging from the prevalence rate, mean worm burden, size of adult nematodes, proportion of gravid females, and level of microfilaremia, the coyote would appear to be as suitable a host for *D. immitis* as the dog and, if so, is likely to be a reservoir of infection for the latter in areas such as El Dorado County with a large coyote population in close proximity to human habitation and an abundance of outdoor dogs. Coyotes readily adapt to urbanization[14] and are present in substantial numbers in many areas in California, especially in the foothills and mountains of the Sierra Nevada and the Pacific Coast Range[9] where heartworms are increasingly being detected in dogs. We also have found *D. immitis* in a small number of coyotes taken from the vicinity of Clear Lake and Lake Berryessa, north of the San Francisco Bay Region. A feature common to these regions in the state is the prominent presence of the tree-hole mosquito, *Aedes sierrensis,* a feeder on large mammals and a primary vector suspect in California.[15]

Several of the heavily infected coyote hearts examined showed gross pathology reminiscent of changes seen in severely infected dogs and it seems probable that some of these animals had been debilitated by the infection. Observations of *D. immitis* in coyotes in

Louisiana[1] and Kansas[4] revealed mainly light or apparently well-tolerated heavier infections. To account for the prevalence of minimal heartworm infections in coyotes in areas of Kansas where coyotes were regularly chased by dogs, it was suggested that even light infections might make a difference between survival and death in a chase.[4] In California and much of the West the coyote has a well-established reputation as a marauder of livestock. Although many issues are still in contention, there is evidence that crippled coyotes are more likely to attack domestic livestock than normal coyotes[13] and animals debilitated by heartworm may well find vulnerable domestic animals easier to obtain than wild prey in many areas. Thus, canine heartworm disease in western coyotes may not only present a wild reservoir host problem but it might, in places, have some influence on the livestock predation problem.

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