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PROBABLE TRANSMISSION OF *Echinococcus granulosus* BETWEEN DEER AND COYOTES IN CALIFORNIA¹

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Abstract: Of 49 deer (*Odocoileus hemionus columbianus*) sampled from several California herds, from 0 to 57 percent of animals per herd were infected with cysts of *Echinococcus granulosus*. The highest prevalence rates were in deer from areas in which livestock are absent and coincided in one instance with an area in which approximately 20 percent of coyotes had been found infected with the adult parasite. It is probable that transmission of *E. granulosus* between coyotes and deer takes place, at least locally, in California.

INTRODUCTION

During recent studies by our group on the presence and epidemiology of *Echinococcus granulosus* infection in California,^{5,6} the adult parasites were found in coyotes (*Canis latrans*).³ A particularly high proportion of the coyotes trapped in 1969 in a mountainous, non-agricultural area in western Tehama County were infected. At the same time, we reported retrospectively on the prevalence of hydatid cysts in California deer which had been examined for parasites over a several-year period.¹ A high level of hydatid infection was noted in deer which had been sampled from western Tehama County herds in 1956. Tehama County is situated further north in the Central Valley of California than *Echinococcus* infection in sheep, dogs or man had been disclosed previously.

In these previous reports,^{1,3} we suggested the possibility that transmission of *E. granulosus* between coyotes and deer might occur in parts of California, facilitated, perhaps, by the actions of hunters

who discard the viscera of killed deer, or who wound deer which then become easy prey for coyotes. Approval of our request to resample the several deer herds of Tehama County 15 years after the initial finding prompted the present study.

MATERIALS AND METHODS

We were permitted to harvest and examine 38 deer from several areas of Tehama County and adjacent Glenn County. An additional 11 deer were examined in the process of herd reduction in Sequoia National Park. The collection period extended from September 1971 through April 1972.

Three herd areas, each with a different ecosystem, were selected for study in Tehama County. Area 1, approximately 16 km west of the city of Red Bluff, consisted of irrigated pasture where cattle and sheep grazed. Domestic dogs are present in this area. Area 2, in the south-western section of Tehama County, consisted of non-irrigated brush and grass-

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lands used for the grazing of cattle. Coyotes and domestic dogs are present in Area 2. Area 3 (Tom Head Mountain) consisted of the mountainous, non-agricultural region in the western section of Tehama County from which approximately 20 percent of coyotes examined earlier were found infected.³

In Glenn County, collections were made in and around the Black Butte Reservoir (Area 4), located just south of Area 2 in Tehama County. Area 4 was a lowland area harboring one of the main deer herds in Glenn County and Area 5 was situated in the southwestern section of Glenn County in a mountainous section called Black Butte Mountain.

The deer harvested and examined in Sequoia Park came from two separate but adjacent deer herds. Both of these herds reside year-round in the park. These two areas of collection were designated as Giant Forest (GF) and Dorst (D).

Each animal was autopsied in the field and the lungs, kidneys and liver were examined grossly for hydatid cysts. All suspected cysts were preserved and transported to our laboratory at the University of California, Davis, for positive identification and for determination of the presence of brood capsules and viable protoscolices.

RESULTS AND DISCUSSIONS

All hydatid cysts detected (Table 1) were in the lungs, particularly the right lung. Only three cysts were found in the left lung and these were all small caseous cysts. No hydatid cysts were found in the liver or kidneys. The brains were not examined. Most cysts were fertile and 2.0 to 4.0 cm in diameter, with the exception of one cyst which was only 0.5 cm in diameter. Infected deer usually harbored more than one cyst.

The biology and migration patterns of the deer herds we sampled are known to the State Department of Fish and Game. Tehama and Glenn counties both contain many sheep ranches. During the winter, most deer in these counties migrate from the mountainous areas to the same pastures used by the grazing sheep. There is a possibility that these migrating deer acquire their hydatid infections either from domestic dogs used to herd sheep or from hunting dogs in these areas. However, in Area 1 where sheep, cattle and domestic dogs all are plentiful, none of the seven deer sampled were found to be infected. Although 10 percent of ewes examined at the abattoir from one ranch in Area 1 were found (by M. N. R.) to harbor hydatid cysts, no other sheep from Tehama or Glenn counties have been found infected. Also, extensive,

TABLE 1. Prevalence of Hydatid Cysts in Deer (*Odcoileus hemionus columbianus*) in California Herds.

	Area	No. of deer examined	No. of positive deer	Percent of positive deer
Tehama County	1	7	0	0
	2	5	1	20
	3	8	3	37.5
Glenn County	4	14	1	7
	5	4	0	0
Sequoia National Park	GF	7	4	57
	D	4	2	50

systematic testing of sheep dogs from this area has not, as yet, revealed a positive animal (Heron, Swan and Schwabe, unpublished data).

The sample of deer taken in west Tehama County (Area 3) yielded the highest percentage of positive animals from the Tehama County-Glenn County area. This is the same location from which approximately 20 percent of coyotes had been reported infected.⁸ Although goats grazed in Area 3 until about 10 years ago, this section of Tehama County is now devoid of livestock and agriculture. It seems probable, therefore, that transmission of *E. granulosus* between deer and coyotes is taking place there.

The results of the sampling from the two deer herds in Sequoia National Park demonstrated a relatively large increase in the prevalence of hydatid infection from that noted in 1956.¹ At that time only one of 52 deer examined was found to be infected. It seems highly probable that transmission of *E. granulosus* between coyotes and deer also occurs there since these two deer herds are resident

in the Park year-round and coyotes are prevalent. No domestic dogs are allowed in this park and no sheep are grazed in the vicinity of either of these deer herds.

Extensive surveys of past records of California hospitals have revealed that human infections with *E. granulosus* have been acquired in this state as early as 1928,⁴ and records exist of hydatid cysts from California deer examined as early as 1951.¹ Infections in sheep and dogs have not been known until quite recently, however,^{4,5} and it is not yet clear whether hydatid infection is spreading or intensifying in California. Traceback of infected sheep from California to Idaho and Utah¹ and subsequent disclosures of active transmission of *E. granulosus* in Utah² suggest the possibility of a large area of hydatid endemicity in the western United States. The presence of hydatid infection in wildlife, and the likelihood of at least local sylvatic or campestrial transmission, would immeasurably complicate the future possibilities for the control of *E. granulosus* in the western United States.⁷

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