PREVALENCE OF Dictyocaulus viviparus INFECTION IN ROCKY MOUNTAIN ELK IN TETON COUNTY, WYOMING*

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PREVALENCE OF *Dictyocaulus viviparus* INFECTION IN ROCKY MOUNTAIN ELK IN TETON COUNTY, WYOMING*

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Abstract: Dictyocaulus viviparus infections in Rocky Mountain elk (*Cervus canadensis* of Teton County were surveyed by fecal analyses during spring, summer and winter and by fecal analyses and necropsies during fall hunting seasons, 1968-1973. Prevalence of the lungworms was relatively high: 32-70% during the spring; slightly lower, 30-47%, during the summer; 21-39% in the fall; and declined to the annual low of 8-19% during the winter. Conversely, elk summering on Big Game Ridge showed an increase in prevalence of *D. viviparus* from 1969 to 1973. Decreases in prevalence of lungworms were noted on the National Elk Refuge at Jackson after management changes were effected in 1971.

INTRODUCTION

Early research concerning elk of Teton County, Wyoming dealt with the condition,[7] ecology, management and migration[1,2,3,6] of the herd of 7500-10,000 on the National Elk Refuge and adjacent forested areas. Some information is available on the prevalence of internal parasites of elk in Yellowstone National Park,[4,10] New Mexico[9] and Alberta, Canada[8] but aside from a general treatise,[5] there is little informaton available concerning parasite prevalence or pathology in the elk of Teton County.

The lungworm, *D. viviparus*, is an important pathogen in elk in the Teton area of Wyoming.[5] Concern about the elk lungworm was expressed by Elk Refuge administrators in the spring of 1968 when the present study was initiated.

The objectives of this study were: (1) To determine the prevalence of lungworm infection in elk on the Refuge, in elk in Teton Park (immediately north of the Refuge and in the migratory herds of the higher elevations like Big Game Ridge (Figure 1). (2) To learn whether fecal analyses might be as useful as necropsy data in determining prevalence of lungworm infection. Fecal sampling could be carried out at any time of year and data concerning prevalence of *D. viviparus* infections gathered without sacrificing elk.

MATERIALS AND METHODS

Elk fecal material was collected during the winter, spring, summer and fall, 1968-1973, in order to count numbers of *D. viviparus* larvae per gram feces and thereby estimate the prevalence and total lungworm burden in elk. Fecal samples (20g) were collected from 1968-1971. Larger samples (60g) collected in 1972, showed a greater percentage positive for lungworm larvae and were subsequently used for the remainder of the study.

Fecal analyses were invalid if collections were made during or immediately after moderate to heavy rains, wet snow or after 20 min exposure to low temperatures (—20C or lower). Moisture allowed larvae to move off the feces and low temperatures dried and thus killed the larvae.

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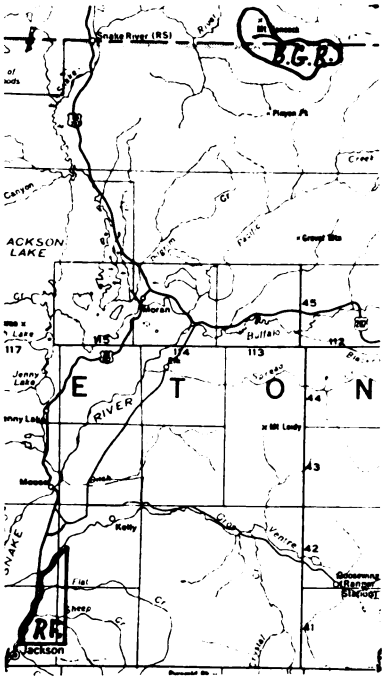

FIGURE 1. Teton County and adjacent areas. Dark outline (lower left) National Elk Refuge, Jackson; Teton National Park (light color) and Big Game Ridge (upper right, outlined).

Approximately 10% of the elk in Teton Park were sampled each spring, summer and fall by fecal examination. Samples were taken from 25-75% of small, free-ranging elk groups that were separated by 4-14 km from similar groups. Somewhat less than 10% of the elk on Big Game Ridge were sampled during July or early August. Only 1-2% of the large number of elk on the Refuge could be sampled in January-February each year.

Dictyocaulus viviparus larvae were isolated by placing elk feces in 9 cm diameter plastic Petri dishes, spraying with a jet of water (20 ml at 16 C) to dislodge the larvae from the surface of the fecal pellet, and washing the larvae to the bottom of the dishes. After 20 min, pellets were again washed with 10 ml of water, the pellets removed and the water in the dishes immediately examined for larvae. At magnification of 7.5x and 45x the larvae could easily be seen and counted.

Elk lungs from hunter-killed elk were dissected by opening the trachea near the glottis, cutting to the main bifurcation and subsequently opening all bronchioles to within 3-7 cm of the periphery of all lung lobes. Adult *D. viviparus* were removed from the lungs, sexed and counted.

Tissue from lungs with and without lungworms was fixed in 10% formalin, subsequently placed in paraffin blocks and cut at 6 μm.

RESULTS

Approximately 100 to 250 yearling elk summered on the Refuge during 1968-1971. Driving many of these elk off the Refuge in May decreased summer resident populations to 40 in 1972 and 10 in 1973.

Data from 1,477 fecal analyses and 307 lung dissections (Fig. 2) illustrate that there was a low prevalence of *D. viviparus* in Refuge elk in January-February (8-19% positive each year). There was a significant increase in the percent of positive samples to 32-70% each spring as the elk moved to Teton Park areas, a decrease by July-August to 30-47%, another decrease by October-November to 21-39% and a final decline to the annual low by January-February each year of the study. Fecal samples of 20 g were apparently too small to give comparable numbers of positive cases as those found at necropsy (Table 1). Fecal samples of 60 g during 1972 and 1973 were apparently sufficiently large to show a significant increase in the prevalence of lungworm infection in the spring and to show a decreasing number of positive cases throughout the remainder of the year (Fig. 2).

D. viviparus larvae per gram (l.p.g.) counts from feces from individual elk, where the number of female worms could also be counted, showed that each

female worm was producing about 0.3-0.5 l.p.g. feces. Up to 330 female worms were estimated from larval counts of some fecal samples. Conversely, no counts in excess of 150 female worms were found at necropsy. Highest numbers of larvae were encountered during the spring months when necropsy data concerning worm numbers in the lungs could not be gathered.

Data from elk feces from Big Game Ridge in July showed little change in prevalence from the summer of 1969 when 13% were positive, through 1971 when 12% were positive. With increased sample size, 33% in 1972 and 40% in 1973

TABLE 1. Comparison of **D. viviparus** prevalence by lung dissection and by fecal analyses on the same animal.

	Lung Dissection (necropsy)			Fecal Analyses		
	no. exam./	no. pos./	% pos.	no. exam./	no. pos./	% pos.
1968	11	8	73	11 (20 g samples)	6	55
1970	20	14	70	20 (20 g samples)	12	60
1972	50	18	36	50 (60 g samples)	15	30
Totals and mean % pos.	81	40	60	81	33	48

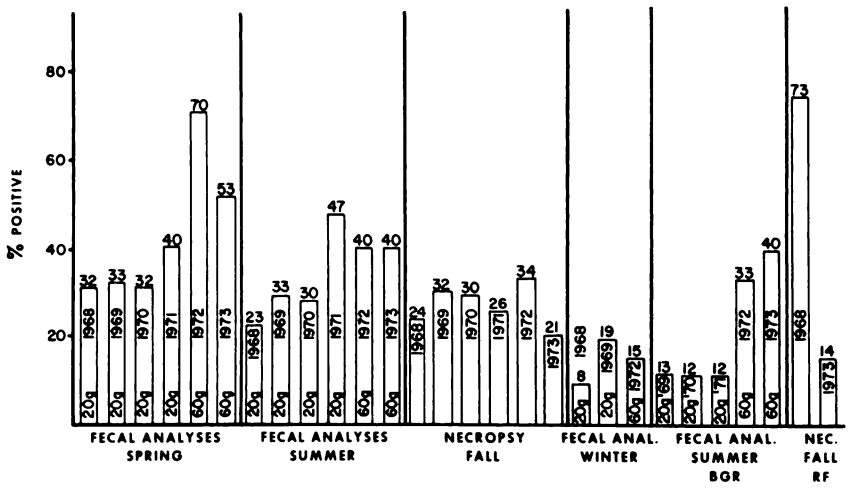

FIGURE 2. Percentage of elk feces and lungs positive for **Dictyocaulus viviparus**: Teton County, Wyoming and adjacent areas, 1968-73.

BGR—Big Game Ridge (migratory elk on summer range)

RF—National Elk Refuge, Jackson, Wyoming

were noted. In 1968, 80% of the elk on the Refuge were positive by fecal analyses in spring and summer and 73% by necropsy in the fall. However, in 1973, after two summers when the Refuge was free of elk, the percent of positive cases at necropsy in the fall on the Refuge was 14%, or similar to that of the Teton Park elk with 21% positive.

Data presented in Table 1 show comparisons of percent positive cases at necropsy (adult worms in lungs) and fecal analyses positive for larvae with small numbers of individual elk. Although total numbers of elk involved in this part of the study were low, the results were consistent in that the fecal analyses showed a bias toward the conservative with 7-18% fewer positive cases.

Pathogenesis noted in infected elk lungs ranged from a slight interstitial hyperplasia to large (4-12 cm) areas of fibrosed, non-functional tissue previously composed of alveoli. Extensive emphysema, especially on the peripheral 5-10 cm of dependent and main lobes was noted where large masses of worms blocked the bronchiolar spaces. Eosinophil and neutrophil concentrations near capillary vessels was common. A few lungs contained small to rather large (5 by 12 cm) abscesses. Small, green-grey, spherical, necrotic and calcified areas were noted in some sets of lungs where no viable worms were found but where dead worms were associated with areas of focal necrosis.

DISCUSSION

Data in Figure 2 and Table 1 indicate that wildlife researchers can gather much reliable data from a combination of fecal analyses and postmortem examinations.

The prevalence of *D. viviparus* infections in elk throughout the year can be shown by fecal analyses, if one takes adequately large fecal samples (60 g or more), avoids unfavorable sampling weather, especially in wet spring months and cold days when feces freeze and thus dry very quickly. Conservative results obtained by fecal analyses should be adjusted upward by at least 10%. The data reported in this study support those of Montana researchers[4,10] and show a pronounced increase in prevalence of elk strain *D. viviparus* during the spring months each year. Elk apparently develop little resistance to reinfection with *D. viviparus*. Elk of all ages were found infected with lungworms in this study. It appears that infection takes place at "green-up" time each spring. Arrested, immature forms of *D. viviparus* have not been found in captive elk killed in January at the Wyoming Game and Fish Sybille Research Unit northeast of Laramie. The decreasing prevalence of infection through the fall and winter must be due to a loss of "old" worms. Nutritional levels and physiological condition appear to be more important to the elk than active protection from acquired immunity. As physiological condition improves, lungworm burdens decrease.

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