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Author: OLSEN, A.

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THE DEVELOPMENT OF CLINICAL SIGNS AND THE POPULATION SIGNIFICANCE OF NEUROLOGIC DISEASE IN A CAPTIVE WAPITI HERD [1]

A. OLSEN, Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado 80523, USA

A. WOOLF, Research Director, Rachelwood Wildlife Research Preserve, R.D. #1, New Florence, Pennsylvania 15944, USA

Abstract: Clinical signs attributable to meningeal worm *(Parelaphostrongylus tenuis)* were recorded in three male and three female wapiti *(Cervus elaphus canadensis)* ranging in age from 5 - 29 months. The study was conducted from September, 1976 to May, 1977 in a 2104-ha preserve. Some differences were noted in occurrence, time schedule and sequence of signs but the basic pattern was similar. The mean time between initial sign observed and death was 100 days. The effect of neurologic disease on population socialization, harvest and recruitment is discussed. A comparison of projected potential population numbers with sighting data in 1959-1977 revealed a trend of lower than expected numbers since 1968 related to suspected neo-natal mortality as well as known natural mortality in the younger age classes due to meningeal worm infection.

INTRODUCTION

Neurologic disease due to meningeal worm *(Parelaphostrongylus tenuis)* has been a limiting factor in some cervid populations.[4,5,10,12] The disease also may limit some wapiti populations but documentation has been inadequate;[2,5,6,11,13] also Kradel (unpubl. data). This may be an important consideration for future introductions of wapiti or even the welfare of some natural populations if the white-tailed deer *(Odocoileus virginianus)* continues to extend its range westward. Clinical signs associated with neurologic disease in cervids have been described; however, there is a lack of quantitative information concerning the time schedule, sequential development and occurrence in free-ranging wapiti.[1,3,5,10,12,13]

A study was begun in September, 1976 at the Rachelwood Wildlife Research Preserve in Pennsylvania to determine the occurrence, sequential development and associated time schedule of clinical signs associated with neurologic disease in wapiti; and to evaluate the impact of the disease on the population. The habitat and herd history have been described.[13]

METHODS

Clinical signs attributable to meningeal worm infection were recorded in six wapiti. Ages of the three male and three female wapiti ranged from 5-29 months when the initial sign was observed. A concurrent two-year study, beginning January, 1976 on the social organization and behavior of the herd, provided comparative observations from normal wapiti. Radio-telemetry aided in following individual and herd move-

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ments. Five of the six wapiti studied were shot in the neck and given a thorough postmortem examination when their range became limited to 20-ha or less. One was captured with immobilizing drugs and maintained in captivity for observation until death. The internal organs of all six were examined grossly and histologically.

Brains of four of the six wapiti were examined and histologic sections were taken.[13] In addition, seven sections from the spinal cord were taken from the wapiti maintained in captivity. Brain sections were not examined histological ly for two wapiti since clinical signs and internal examinations provided no evidence or reason to suspect any other cause of death. The analysis of the significance of neurologic disease to the wapiti population was based on sighting, harvest, natural mortality, natality and population projection records (unpubl. data, Rachelwood Wildlife Research Preserve).

RESULTS AND DISCUSSION

Observed Occurrence of Clinical Signs

The occurrence of signs associated with neurologic disease in the six wapiti observed are shown in Table 1. Frequent occurrence of a particular sign was not always related to its significance in diagnosis. Circling was observed in only two of the six wapiti and torticollis in only three cases but both were important in diagnosis.

Some evidences of the disease are not included in Table 1 but are worth noting. Emaciation was observed in all six cases and whole weight at death averaged 50 kg less than healthy wapiti of the same sex and age classes (unpubl. data, Rachelwood Wildlife Research Preserve). Superficial abrasions acquired from staggering against trees and other objects were observed in two wapiti in the final days before death. The occurrence of vision and hearing impairment was difficult to evaluate. Failure to respond to visual or auditory stimuli does not necessarily imply defective vision or hearing. A clinical sign previously reported but not observed in this study was "head shaking when running".[2]

Sequential Progression of the Disease

Initial clinical signs observed were generally the same; decreased flight distance, seclusion and listlessness. The mean overall time period for disease progression from initial sign observed until death was 100 days (Table 1). Since five of the six wapiti were shot before natural death, the time period for natural disease progression would have been greater. The mean duration for the period of remission when observed was 19 days. The mean duration for deterioration after remission was only 12 days. Variations in the sequence and occurrence of signs (Table 1) may be related to different pathways taken by the meningeal worm. Some of the signs observed, such as staggering, circling, tolerance of human contact and seclusion, were not always permanent but occasionally reappeared. Final clinical signs, such as paraplegia and "head held low" are not shown in Table 1 because five of the six wapiti observed were shot before natural death.

Significance of the Disease to the Population

Neurologic disease can have several detrimental effects on wapiti populations. Wapiti with neurologic disease are more susceptible to predation, including harvest by man, because of a decreased flight distance and a propensity for trails and fields. Combining previously reported data on prevalence of histologic lesions in wapiti of Rachelwood[13] with data from this study, 61% of animals 2.5 years old or younger examined from 1973 to 1977 had lesions compared to only 25% of animals 3.5 years old or older.

TABLE 1. The development of clinical signs associated with neurologic disease in six wapiti *(Cervus elaphus canadensis)* at Rachelwood Wildlife Research Preserve, New Florence, Pennsylvania, September 1976 - May 1977.

Signs	Days from Initial Sign Observed		Occurrence (%)
	Mean	Range	
Decreased Flight Distance	0	0-2	100
Seclusion	18	0-92	100
Semi-Detached Group Following*	24	0-63	83
Listlessness	27	0-69	100
Stiff or Hackney Gait	47	0-89	67
Propensity for Trails	48	30-80	50
Circling	49	37-61	33
Tolerant of Human Contact	55	34-82	67
Aimless Wandering	61	52-103	67
General and Lumbar Weakness	63	24-120	100
Ataxia	64	24-120	100
Remission	75	18-140	67
Staggering	80	34-127	83
Excessive Salivation	88	42-128	67
Bulging Eyes	91	33-126	50
Torticollis	91	33-127	50
Range 20 ha or less	93	29-181	100
Death**	100	35-191	100

*A wapiti loosely associated with a group during bedding but unable to keep up the pace during group movements.

**Five of the six wapiti observed were shot for postmortem examination prior to natural death.

Since the younger age classes show a higher prevalence of disease, this same group would be more susceptible to harvest. Fifty-two percent of male wapiti and 68% of female wapiti examined had histologic lesions (n=17 and 19 respectively). The loss of a young female effects population recruitment much more seriously than the loss of a young male if there are enough breeding males. The quality of the hunt, which is an important consideration to many sportsmen, also is greatly reduced because of the behavior of infected wapiti.

In addition to the susceptibility to harvest of infected wapiti there is the natural mortality factor. In the years 1973 to 1977 at Rachelwood, 13 female calves and yearlings died from natural causes, 60% of which had neurologic disease. For the same period only 10 females calves and yearlings were removed from the population by harvest. This had more than an immediate effect since it generally takes three years from birth for a female wapiti to begin producing young.

Neurologic disease may have a detrimental affect on the social organization of a wapiti herd. Young males unable to assert themselves in dominance battles assume subordinate roles. Young females in seclusion are excluded from the socialization process, failing to learn traditional calving and bedding areas, or anti-predator and feeding strategies.

The time of year when clinical signs are manifested also may affect social organization. During the rut secluded young males with neurologic disease

may be unable to participate in the learning process of battling for, joining, and maintaining harems. Secluded females may not be bred by the most dominant, genetically fit, bulls. Care of young by an infected cow during the neonatal period also may be affected.

Figure 1 illustrates a comparison of total wapiti sighted with total wapiti possible 1959/1960 to 1976/1977 based on a projection of the population from data on natural mortality, natality, harvest and introductions. Until 1967/1968, projection and sighting figures coincided. However, after this time period fewer wapiti were observed in Rachelwood than the projection showed. By 1973, harvest levels increased but an immediate decline should not have occurred since an average of only three adult cows per year were harvested from 1973 to 1976. Total calf numbers reported for the years following 1968 have never been more than 16, with a mean of only 12. This has been 20% to 40% below expected values. In our analysis of this problem several possible reasons for this discrepancy in population numbers were considered; but all seemed unlikely. No disease which might cause abortion or other pre-natal mortality has been found in the Rachelwood herd. Nutrition is not a problem since all wapiti examined during harvest were grossly healthy and a high percentage of yearling females had bred each year (minimum of 50% in 1976 determined by observation of marked animals). Field observation failed to disclose evidence that adult female wapiti are not being bred. Stray cows are always tended by subordinate bulls capable of breeding. Even when a

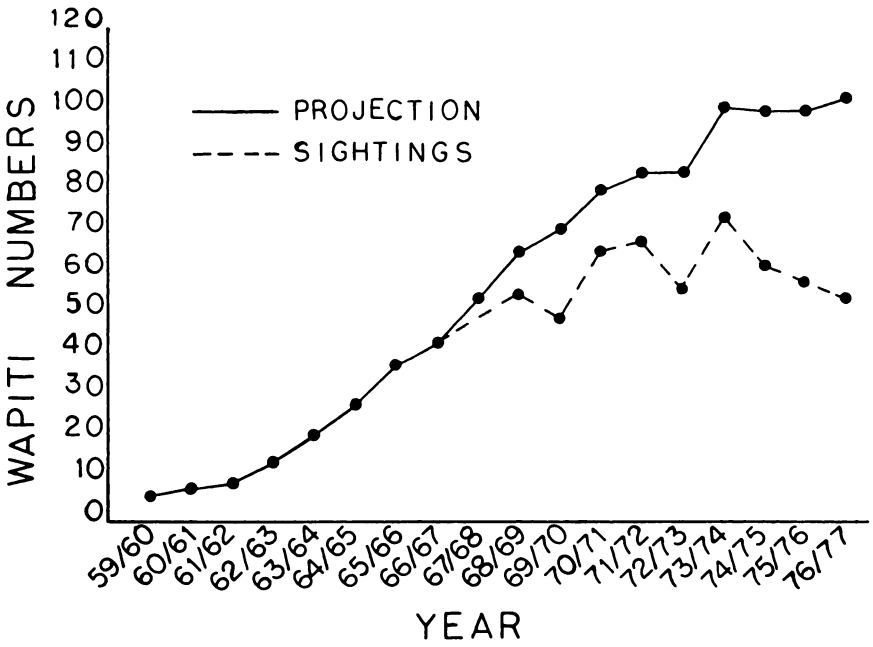

FIGURE 1. Total numbers of wapiti at Rachelwood Wildlife Research Preserve, New Florence, Pennsylvania comparing actual sighting data with maximum figures from a population projection 1959/1960 - 1976/1977.

harem bull was shot during harvest it was only a matter of hours before another bull joined the harem. The reproductive tracts from adult cows have indicated high breeding success. Only one of the 16 examined had any evidence of current or previous breeding failure. With the extensive system of roads, lack of understory, and heavy human use of the Rachelwood grounds, extensive adult mortality would have been found. Poaching also is not a factor because Rachelwood is fenced and patrolled.

Considering the above discussion, neonatal mortality seems to be the only logical source for a majority of the discrepancy in population numbers. This may be directly related to neurologic disease because of the inability of infected cows to properly care for their young. Although the combined affects of neurologic disease have not caused rapid declines in this captive wapiti herd, they have been a limiting factor to population growth. If harvest was discontinued the population growth would still be limited by neurologic disease. Between 1973 and 1975 only five clinical cases of neurologic disease were reported from 20 wapiti with histological lesions.[13] From September, 1976 - August, 1977 a minimum of nine clinical cases were observed suggesting a possible future trend of increased prevalence of neurologic disease in this population.

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