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Serologic, Parasitic and Pregnancy Survey of the Colockum Elk Herd in Washington

Abstract

This study was undertaken to determine the prevalence of selected infectious and parasitic diseases and to compare pregnancy diagnostic techniques in the Colockum elk herd. Between January 1988 and March 1990, 64 Rocky Mountain elk (*Cervus elaphus nelsoni*), less than one year old to maturity, were captured on winter range of the Colockum region in Central Washington. Serum antibody titers to bovine respiratory syncytial virus (RSV), infectious bovine rhinotracheitis (IBR), parainfluenza-3 virus (PI-3), *Hemophilus*, and *Campylobacter* from 45 elk were low or insignificant. All samples were seronegative for brucellosis and leptospirosis. Rectal palpation of cows of reproductive age (>1½ years, n = 24) was performed to detect pregnancy, and serum from those cows was tested for pregnancy specific protein B (PSPB). Twenty-two cows tested positive for pregnancy specific protein; whereas 21 of those cows tested positive on rectal palpation. No female calves (n = 3) or males (n = 13) tested positive for PSPB. Based on fecal sample analysis, 36 of 46 (78%) elk were negative for internal parasites while the remaining had low parasite egg, oocyst or larvae numbers. The significance of these results is that the Colockum elk have low prevalence of selected infectious diseases, few internal parasites, and PSPB compares favorably with rectal palpation for pregnancy diagnosis.

Introduction

The Colockum Elk Study, a five year project, was started in July 1987 to map and inventory elk habitat, determine distribution and migration patterns of elk, determine the prevalence of parasites from fecal analysis, selected infectious diseases from serologic testing, and compare pregnancy testing methods of cows. This report details the results of infectious disease, internal parasite, and pregnancy method testing. There have been no such previous studies performed on elk in the Colockum herd.

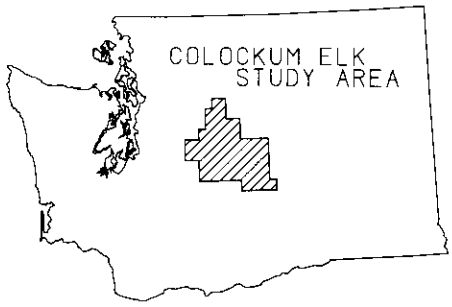
The infectious diseases and internal parasites for which the elk were tested are common pathogens in cattle which may be of clinical and economical significance (Blood *et al.* 1989). There have been no challenge inoculation studies with RSV, IBR, PI-3, or *Hemophilus* in elk. *Campylobacter*, a very ubiquitous bacterium, has been reported to cause increased fetal deaths and low fawn production in Wyoming antelope; however, this has not been noted in elk (Thorn *et al.* 1982). *Brucella*, an abortifacient, has been well documented in elk. The most prevalent signs include abortion, premature birth or birth of weak nonviable calves. Currently, brucellosis in elk is restricted to the Yellowstone ecosystem and has not been reported in elk from Washington. Clinical BVD and leptospirosis have not been reported in elk.

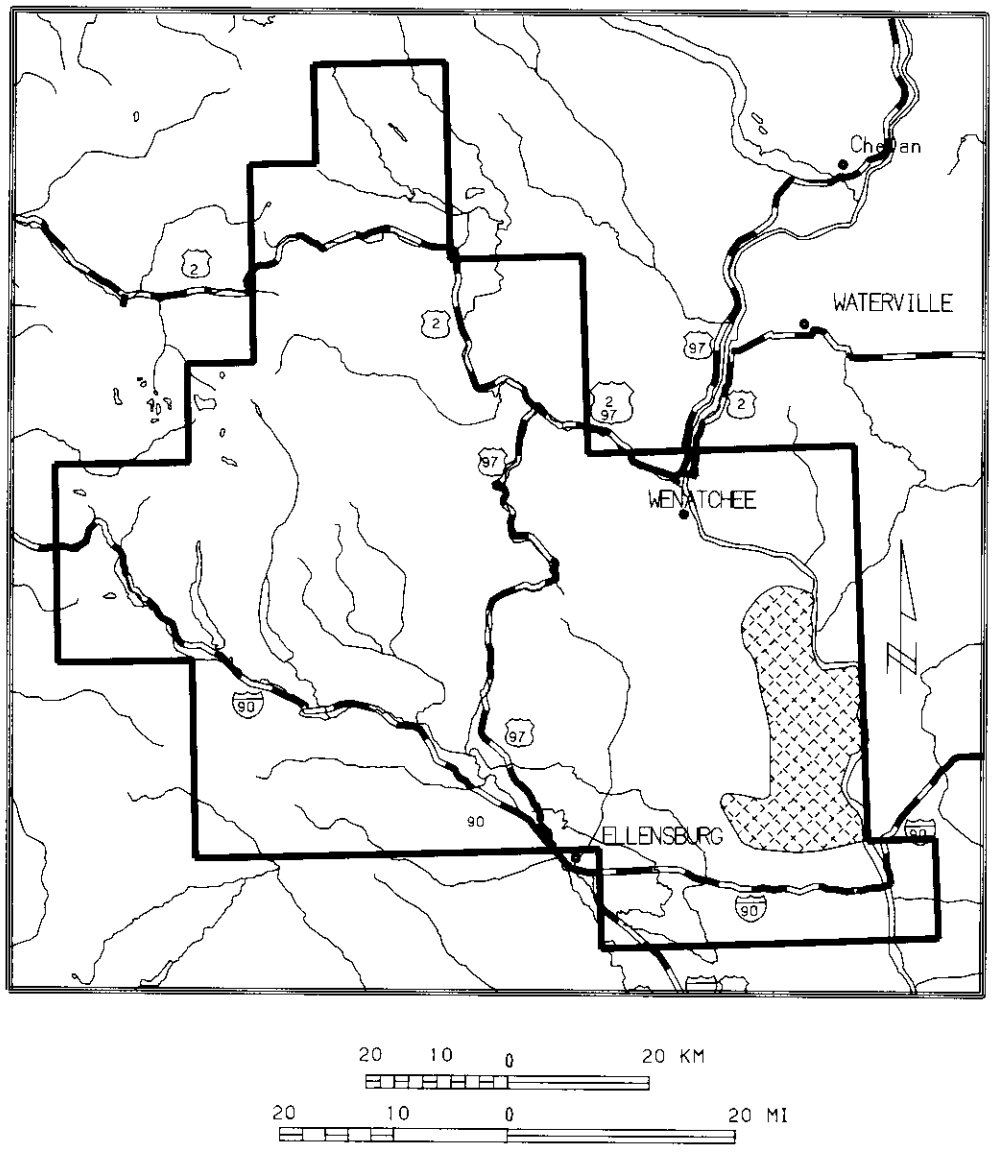
Description of Study Area

The Colockum Study area encompasses approximately 2,400 Km^2 (Figure 1) in Central Washington. The Washington Department of Wildlife Colockum Wildlife Area is centrally located in the study area. The primary study area is an eastern slope of the Cascade Mountain Range generally bordered to the east by the Columbia river and to the south and west by the Kittitas valley. Colockum rangeland varies from shrub steppe to coniferous forest with altitude ranging from 175 to 1980 m. Annual precipitation is 15-76 cm. Timber, livestock, mining, irrigation and hydroelectric watershed, winter sports and outdoor recreation are important industries and activities in the region. Elk are the primary ruminants in the area. Other ruminants include cattle, domestic sheep, mule deer, domestic and mountain goats, and a small population of captive bison.

Indian pictographs in the Colockum region suggest elk were native to the area; however, few or no elk were noted by white settlers in the mid- to late-nineteenth century (Dow 1964). Herd ancestors were transplanted in 1913 and 1916 from Yellowstone National Park. The current prehunting

Figure 1. The Colockum Elk Study area in Central Washington (right). Capture site area (shaded) within the Colockum Elk Study area (below).





season population is approximately 6,500 and accounts for 10% of the annual bull harvest for Washington.

Materials and Methods

Elk were captured by four techniques: 1) portable panel trap, 2) permanent corral trap, 3) net gunning from a helicopter, and 4) darting with immobilizing drugs from a helicopter. Fifty-one elk were examined by a veterinarian (Hein) at the time of capture.

The portable panel trap (2.5 m high x 2.5 m wide x 5 m long) was used in January 1988 and 1989. It was baited with alfalfa hay and salt and equipped with a trip wire. The figure eight corral traps (2.5 m high x 23 m diameter and 2.5 m high x 6 m diameter), used in January 1988, were baited in a similar manner. In both the panel and corral traps, an intramuscular injection of succinycholine at a dosage of 15-20 mg per elk via darts fired from a Palmer Cap-Chur® dart gun was used for immobilization. A 3.3 x 3.3 m net fired from a Coda® net gun from a Hughes 500 helicopter was used in February 1988 and 1989. Due to trauma to the elk and possible human injury, this method of capture was discontinued.

Elk were also darted in February 1989 and 1990 with Palmer Cap-Chur® darts from the same helicopter with a combination of xylazine (Rompun®) at a dosage of 20-70 mg per elk and carfentanil (Wildnil®) at a dosage of 1.5-3.6 mg per elk. One elk was darted with 70 mg xylazine and 8.6 mg etorphine (M99®). Reversal of carfentanil and etorphine in the narcotized elk was accomplished with naloxone at dosages of 140-260 mg. One-third of the naloxone was administered subcutaneously while the remainder was given intravenously. Recycling of the narcotics was observed.

Blood was collected from the jugular vein, allowed to clot, centrifuged, and the serum was collected and frozen prior to shipment for analysis. Serum samples were analyzed by the Washington Animal Disease Diagnostic Laboratory (WADDL), Washington State University, Pullman, Washington. Antibody against bovine respiratory syncytial virus (RSV), infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), and parainfluenza-3 virus (PI-3) was tested by microtiter virus neutralization (Dunbar *et al.* 1985; Forcyt and Everman 1988). Serum antibody titers to *Hemophilus*, *Campylobacter*, and *Leptospira* were determined by microtiter agglutination, and *Brucella* was tested by latex agglutination.

Fecal samples were analyzed for parasite eggs, oocysts, and larvae at the Department of Microbiology and Pathology, College of Veterinary Medicine, Washington State University. Prior to shipment, fecal samples were stored at 4°C. Fecal flotation with a standard sugar flotation technique (sp. gr. = 1.27) was used to determine the numbers of gastrointestinal parasite eggs and coccidia oocysts. A Baerman apparatus technique was used to evaluate feces for first stage larvae of lungworms.

Serum was assayed for pregnancy specific protein B (PSPB) at the Department of Animal Science, College of Agriculture, University of Idaho, Moscow, Idaho. Forty samples (13 male; 3 calf, 2 yearling and 22 adult female) were assayed for PSPB by the radioimmunoassay procedure (Sasser *et al.* 1986). Field pregnancy determination was by rectal palpation of fetal membranes, uterine cotyledons, or fetal ballottement.

Results and Discussion

Five elk were captured in the portable panel trap, 17 in the figure eight corral trap, 18 by net gunning from a helicopter, and 24 by darting from a helicopter. Captured elk represented less than one percent of the herd population. Ideally, 10 percent of the population should have been tested, but this was not possible due to fiscal limitations. All elk were in good physical condition except one cow that was very thin. No other elk exhibited signs of clinical disease.

Neutralizing antibody titers to RSV in this study ranged 1:5 to 1:80 (median = 1:7.5) and were detected in 6 of 45 (13%) elk (Table 1). The low seroprevalence indicates RSV infection is not widespread within the elk tested. Serum titers to IBR of 1:5 to 1:10 (median = 1:5) were found in 17 of 45 (38%) elk indicating low incidence of exposure without observed clinical manifestation. All elk except a mature bull tested negative to BVD. A titer of 1:40 in the bull indicated exposure, but no clinical disease was observed when the bull was handled. Serum titers to PI-3 were found in 30 of 45 (67%) elk and ranged 1:5 to 1:160 (median = 1:15). These titers indicate widespread exposure. *Hemophilus* titers were present in 43 of 46 (96%) elk, ranging from 1:50 to 1:512 (median = 1:128). These titers reveal widespread

TABLE 1. Serologic results for assays against respiratory syncytial virus (RSV), infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), parainfluenza-3 virus (PI-3), *Hemophilus*, *Campylobacter*, *Brucella*, and *Leptospira* in the Colockum elk of Central Washington.

			Calves		Yearlings		Adults	
			Antibody Titers[a]					
Infectious Disease	Total Positive/ Total Tested	Percent Positive	Male (n = 4)	Female (n = 3)	Male (n = 4)	Female (n = 3)	Male (n = 8)	Female (n = 23)
RSV	6/45	13	Neg	Neg	Neg	Neg	5-40 (n = 3)	5-80 (n = 3)
IBR	17/45	38	Neg	Neg	Neg	Neg	5-10 (n = 2)	5-10 (n = 15)
BVD	1/45	2	Neg	Neg	Neg	Neg	40 (n = 1)	Neg
PI-3	30/45	67	Neg	20 (n = 1)	5-10 (n = 2)	5-40 (n = 2)	10-160 (n = 6)	5-160 (n = 19)
Hemophilus	43/45	96	64-512 (n = 4)	128-512 (n = 3)	128-512 (n = 4)	128-512 (n = 3)	50-128 (n = 8)	50-512 (n = 21)
Campylobacter	45/45	100	25-50 (n = 4)	50-100 (n = 3)	25-100 (n = 4)	50-200 (n = 3)	25-100 (n = 8)	25-100 (n = 23)
Brucella	0/45	0	Neg	Neg	Neg	Neg	Neg	Neg
Leptospira	0/45	0	Neg	Neg	Neg	Neg	Neg	Neg

[a]Numbers indicate reciprocal serum titer values from positive animals.

exposure. All elk had positive antibody titers to *Campylobacter*, ranging from 1:25 to 1:200 (median = 1:50). A titer of 1:200 in one elk reflects recent exposure; however, without additional samples the titer is difficult to interpret. Antibody tests for *Brucella* and *Leptospira* were negative. Both diseases are important diseases of livestock, but at this time it does not appear that the Colockum elk are a reservoir of infection for livestock that are sympatric.

Numbers and counts of internal parasite ova detected are listed in Table 2. *Nematodirus* sp., the thinnecked intestinal worm, was found in 7 of 46 (15%) elk. Eggs per gram of feces ranged from 2-14 (median = 5). *Trichuris* sp., the whipworm, was found in 5 of 46 (11%) elk. Egg counts were low, ranging from 1-6 (median = 4). One *Eimeria* sp. oocyst was found in one elk. Tapeworm eggs of the genus *Moniezia* were found in 3 of 46 (7%) elk. Egg counts ranged 12 to 18 (median = 15). Trichostrongyle stomachworm (*Hemonchus, Trichostrongylus, Ostertagia*) eggs were found in one elk with the count of eight eggs per gram. First stage larvae of lungworms were not present in any samples.

Rectal palpation for determination of pregnancy in 2 yearlings and 22 adult cows indicated that 21 of the adults were pregnant. Serum PSPB results (Table 3) and rectal palpation results of adult cows were in full agreement. Of the two yearling cows, one tested positive for PSPB whereas the result for the other was inconclusive. Both of the yearling cows tested negative on rectal palpation. These inconsistencies may be explained by an error on rectal palpation or persistence of PSPB in circulation after recent fetal death as seen in red deer (Haigh *et al.* 1988). Based on rectal palpation, conception rate for adult cows was 95% and for yearling and adults combined was 88%. All 13 male elk and 3 female calves tested PSPB negative. The PSPB assay has also been used in deer (Wood *et al.* 1986) and mountain goats (Houston *et al.* 1986) with reliable results.

Conclusions

Based on this study, elk in the Colockum herd were physically healthy. Only one adult cow appeared in poor physical condition and on rectal palpation a large abdominal mass which may have been a tumor was detected. None of the other captured elk exhibited signs of disease. Evaluation of serum

TABLE 2. Results of fecal analysis *Nematodirus* (thinnecked intestinal worm), *Trichuris* (whipworm), *Eimeria* (coccidia), *Moniezia* (tapeworm), trichostrongyles (stomach worms), and lungworms in the Colockum elk herd in Central Washington.

		Calves		Yearlings		Adults	
Parasite	Total Positive/ Total Tested	Male (n = 4)	Female (n = 3)	Male (n = 4)	Female (n = 3)	Male (n = 8)	Female (n = 24)
Nematodirus	7/46	2-8* (n = 3)	10-14 (n = 2)	4 (n = 1)	0	0	3 (n = 1)
Trichuris	5/46	1-6 (n = 2)	4 (n = 1)	1-4 (n = 2)	0	0	0
Eimeria	1/46	1 (n = 1)	0	0	0	0	0
Moniezia	3/46	18 (n = 1)	12-25 (n = 2)	0	0	0	0
Trichostrongyles	1/46	0	0	0	0	0	8 (n = 1)
Lungworms	0/46	0	0	0	0	0	0

*Values expressed are ranges of numbers of eggs, oocysts, or larvae per gram feces in positive elk.

TABLE 3. Comparison of pregnancy specific protein B (PSPB) and rectal palpation results for pregnancy determination in the Colockum elk herd in Central Washington.

Age	Sex	No. of Animals	PSPB+	PSPB−	Rectal+	Rectal−
All ages	Male	13	0	13	ND[a]	
Calves	Female	3	0	3	ND	
Yearlings	Female	2	1	In[b]	0	2
Adult	Female	22	21	1	21	1

[a]ND = Not done

[b]In = Inconclusive

titers indicated low values or low rates of infection for ruminant respiratory, intestinal or reproductive pathogens. All elk tested negative for *Leptospira* and *Brucella*. Analysis of feces revealed low level infestation with parasites found commonly in ruminants. The PSPB serum assay appears to be an excellent test for mid-term gestation determination in elk. It correlated well with pregnancy results by rectal palpation.

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Literature Cited

Blood, D. C., and O. M. Radostits. 1989. Veterinary medicine: a textbook of the diseases of cattle, sheep, pigs, goats and horses. 7th ed., Bailliere Tindall. London, England. 1502 pp.

Dow, Edson. 1964. Adventures in the Northwest. Outdoor Publishing Company. Wenatchee. WA.

Dunbar, M. R., D. A. Jessup, J. F. Everman, and W. J. Foreyt. 1985. Seroprevalence of respiratory syncytial virus in free-ranging bighorn sheep. J. Amer. Vet. Med. Assoc. 187:1173-1174.

Foreyt, W. J., and J. F. Everman. 1988. Response of vaccinated and unvaccinated bighorn sheep (*Ovis canadensis canadensis*) to experimental respiratory syncytial virus challenge. J. Wildl. Dis. 24:356-359.

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Haigh, J. C., M. Cranfield, and R. G. Sasser. Estrus synchronization and pregnancy diagnosis in red deer. J. Zoo An. Med. 19(4):202-207.

Houston, D. B., C. T. Robbins, C. A. Ruder, and R. G. Sasser. 1986. Pregnancy detection in mountain goats by assay for pregnancy-specific protein B. J. Wildl. Manage. 50:740-742.

Sasser, R. G., C. A. Ruder, K. A. Ivani, J. E. Butler, and W. C. Hamilton. 1986. Detection of pregnancy by radioimmunoassay of a novel pregnancy-specific protein in serum of cows and a profile of serum concentrations during gestation. Bio. Repro. 35:936-942.

Thorne, E. T., N. Kingston, W. R. Jolley, and R. C. Bergstrom. 1982. Diseases of wildlife in Wyoming. 2nd Edition. Wyoming Game and Fish Department. Cheyenne, Wyoming. 353 pp.

Wood, A. K., R. E. Short, A. E. Darling, G. L. Dusek, R. G. Sasser, and C. A. Ruder. 1986. Serum assays for detecting pregnancy in mule and white-tailed deer. J. Wildl. Manage. 50:684-687.