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PREVALENCE OF ANTIBODIES OF SELECTED INFECTIOUS DISEASE AGENTS IN THE PENINSULAR DESERT BIGHORN SHEEP *(OVIS CANADENSIS CREMNOBATES)* OF THE SANTA ROSA MOUNTAINS, CALIFORNIA

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California's desert bighorn sheep *(Ovis canadensis* ssp.) are sparsely distributed in isolated, disjunct populations of the Mojave and Sonoran desert habitat. The apparent predisposition of bighorn to respiratory ailments, in particular pneumonia, is well known. Less understood are the particular etiological agents. Mycoplasmas, viruses, parasites and bacteria have been implicated as primary, secondary or multiple etiological agents in the respiratory disease complex of bighorn sheep (Al-Aubaidi et al., 1972, Am. J. Vet. Res. 33: 87-90; Parks and England, 1974, J. Wildl. Dis. 10: 107-110; Post, 1971, Trans. N. Am. Wild Sheep Conf. 1: 98-102).

The purpose of this survey was to determine by serology the prevalence of para-influenza-3 (PI-3), bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), contagious ecthyma (CE), bluetongue (BT) and epizootic hemorrhagic disease (EHD) within a herd of free-ranging Peninsular bighorn sheep *(O. c. cremnobates).*

Ten free-ranging bighorn were chemically immobilized from a helicopter on the east slopes of the Santa Rosa Mountains, Riverside County, California. Immobilization was effected with 5 mg etorphine hydrochloride (M99)[1] injected with Cap-Chur equipment.[2] A single captive animal, maintained at the P.L. Boyd-Deep Canyon Desert Research Center,[3] was restrained with hobbles. Whole blood was collected into heparinized vacutainers from the external jugular vein. Whole blood and sera were refrigerated until further processing. Each animal was tagged prior to reversing the immobilization with a 10 mg intravenous injection of diprenorphine (M50-50).[1]

Antibody titers to BT, EHD and CE were determined by complement fixation and immunodiffusion at the USDA Veterinary Laboratory, Ames, Iowa. Serotypes of *Leptospira* spp. and *Brucella* spp. were determined from serum and heparinized blood samples by serum agglutination tests at the USDA Veterinary Services Laboratory, San Gabriel, California. Antibody titers for IBR, BVD and PI-3 were determined by serum neutralization tests.

Eighty percent of the free-ranging bighorn sheep examined had a titer to CE; most evidenced exposure to additional pathogens (Table 1). The two- to four-fold increased CE titer in three retested animals suggests a recent antigenic challenge. Seropositive results for

[1] D-M Pharmaceuticals, Inc., Rockville, Maryland 20850, USA.

[2] Palmer Chemical and Equipment Co., Inc., Douglasville, Georgia 30133, USA.

[3] University of California, P.L. Boyd-Deep Canyon Desert Research Center, Palm Desert, Riverside Co., California, USA.

TABLE 1. Serologic results from 10 free-ranging and one captive (Y) desert bighorn sheep, *Ovis canadensis cremnobates*, from the Santa Rosa Mountains, Riverside County, California.

Sheep no. and immobilization date	Age (yrs)	Sex	Weight (kg)	Test and Results[a]					
								Leptospira	
				BT	EHD	CE	Br[b]	pomona	hardjo
1 (1/ 3/77)	1	F	50.0	AC[c]	—	—	—	—	—
2 (1/ 3/77)	2	F	45.4	—	—	1:40	—	—	—
(6/11/77)				—	—	1:80	—	—	—
3 (1/ 3/77)	5½	F	47.7	1:20	1:20	1:20	—	—	—
(6/11/77)				1:20	1:20	1:40	—	—	—
4 (1/ 3/77)	4½	F	43.2	1:80	—	1:20	—	—	—
(6/11/77)				1:80	AC	1:80	—	—	—
5 (3/25/77)	1	F	50.0	AC	AC	—	—	—	—
6 (3/25/77)	6	F	67.2	—	—	1:10	—	—	—
7 (3/25/77)	2½	M	63.6	—	—	1:5	—	—	1:128
8 (3/25/77)	3	M	68.2	AC	AC	1:10	—	—	—
9 (3/25/77)	5	F	68.2	1:5	1:5	1:5	—	—	—
10 (6/11/77)	3	M	59.1	—	—	1:20	—	—	—
Y (1/ 3/77)	2	F	48.2	1:40	—	—	1:50	1:128	—
(3/25/77)				1:20	1:5	—	1:50	1:128	—
(6/11/77)				1:20	1:20	—	1:50	1:128	—

[a]Indicated reaction titers are shown as the highest dilution, no reaction values (—) were negative at the lowest tested dilution.

[b]Br = *Brucella* spp.

[c]Anticomplementary sera (AC) were examined by immunodiffusion; all were negative.

EHD and BT were obtained from 27% and 36% of the examined bighorn, respectively. Subsequent samples showed no significant changes. Although threshold titers to CE, BT and EHD were measured, no clinical signs were observed. The low serological reactions to *Leptospira pomona, L. hardjo* and *Brucella* spp. were static in consecutive samples. All samples were seronegative for IBR, BVD and PI-3.

Bighorn sheep sampled for this study represented individuals from two interacting herds totaling 78 individuals. Annual lamb and yearling survivorship declined precipitously in 1977 (no yearling recruitment). Depressed neonate survival has continued into the 1981 season despite an annual natality consistent with pre-1977 values (68 lambs per 100 ewes). Mortality occurred by 1 August (April - May lambing peak).

The prevalence of specific viral and bacterial pathogens in the Santa Rosa Mountain bighorn herds was demonstrated from serologic patterns,

but not from classic clinical evidence. Indeed, all animals examined during this investigation appeared clinically normal.

None of California's desert bighorn herds are subject to routine surveillance and diagnostic evaluation. The infrequent observations made are likely insufficient to detect subclinical infections.

Coincident with subclinical disease is the potential for enzootic maintenance by reservoir animals (Barrett and Chalmers, 1975, J. Wildl. Dis. 11: 157-163; Luedke et al., 1964, Am. J. Vet. Res. 25: 963-969). These diseases could become manifest during stress periods, i.e., excessive or insufficient population levels, reproductive activity, low nutrient availability and/or climatic extremes.

The low level serologic response to the contagious diseases of EHD and CE in 80% of the free-ranging bighorn implies chronic antigenic challenge. Physical contact with viremic animals may provide this challenge. Additionally, CE can be transmitted from desiccated crusts of proliferative lesions for up to 12 years in the absence of viremic hosts (Connell, 1954, Can. J. Comp. Med. 18: 59; Samuel et al., 1975, J. Wildl. Dis. 11: 26-31).

In contrast, BT is noncontagious and vectored by the biting midge, *Culicoides* spp. (Diptera: Ceratopognoidae). Thus, the disease is usually seasonal. Identification of seropositive animals during winter months attests to the aseasonality of the vector within Santa Rosa Mountain bighorn habitat. The infrequency of winter frosts in southwestern deserts and abundance of the midge presents a year-round exposure to the vector.

The unaffected natality and low prevalence of seropositive results for the abortifacient organisms, *Leptospira* spp. and *Brucella* spp., indicates they are not a serious threat to the bighorn herds at this time. The existence of a reservoir host is suggested by the 20 year absence of domestic animals from this habitat.

Absence of seropositive results for IBR, BVD and PI-3 viruses indicates lack of antigen contact. However, seropositive bighorn have been found in other desert bighorn herds where cohabitation with domestic animals occurs (Jenner, Pers. comm.). Undoubtedly, the absence of domestic animals within Santa Rosa bighorn habitat has reduced the potential for exposure to this virus.

Seropositive results for any of the diseases surveyed were obtained only from bighorns older than the yearling age class. Suckling lambs would have received antibodies, depending upon maternal exposure, by way of the colostrum. These antibody titers, waning with time, could be replaced by active immune responses as a result of antigenic challenge. If the animals lack antigenic contact during their first year's seasonal movements (Turner, 1981, Natl. Geo. Res. Repts. 13: 669-674), they succumb to otherwise low levels of infection. Yearling recruitment would be further affected in years of increased disease frequency or low herd resistance.

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