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Prevalence of Infectious Agents in Free-ranging White-tailed Deer in Northeastern Mexico

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ABSTRACT: The objectives of this study were to determine the prevalence of antibodies against brucellosis, leptospirosis, infectious bovine rhinotracheitis virus, and bovine viral diarrhea virus (BVDV) in white-tailed deer (*Odocoileus virginianus*) in northeastern Mexico. Deer (n=521) were captured from helicopter using a netgun on 15 ranches covering 62,114 ha in the states of Coahuila, Nuevo Leon, and Tamaulipas during spring 2004. The prevalence of antibodies against *Leptospira*, infectious bovine rhinotracheitis, BVDV, and brucellosis were 5.6, 41.1, 63.5, and 0%, respectively, indicating that white-tailed deer and cattle may share disease agents when cohabiting in northeastern Mexico.

Key words: Bovine viral diarrhea virus (BVDV), brucellosis, infectious bovine rhinotracheitis (IBR), leptospirosis, *Odocoileus virginianus*, prevalence, white-tailed deer.

Many infectious diseases of domestic animals are shared with wild animals, and transmission from wildlife to livestock, from livestock to wildlife, occasionally transmission to humans can occur (Chomel et al., 1994). There are many potential pathogens that can be shared between white-tailed deer (*Odocoileus virginianus*) and domestic ruminants, resulting in such diseases as leptospirosis, bovine viral diarrhea virus (BVDV), and infectious bovine rhinotracheitis (IBR). The prevalence of antibodies against *Leptospira* in deer populations in North America varies between 7% and 27% (Wedman and Driver, 1957; Shotts and Hayes, 1970; Fournier et al., 1986). In Minnesota, USA, a 43% antibody prevalence for *Leptospira pomona* and *L. bratislava* in white-tailed deer was reported previously (Goyal et al., 1992). A study of prevalence of *Leptospira* antibodies in white-tailed deer from Great Smoky Mountains National Park, Tennessee, USA, reported 21% deer seropositive to *Leptospira hardjo*, *L. pomona*, and *L. icterohaemorrhagiae* (New et al., 1993).

Brucellosis is a widespread human, cattle, goat, and swine disease, but it is found rarely in deer in the United States. McCorquodale and DiGiacomo (1985) concluded that wild ungulates have little significance in transmitting brucellosis to cattle in the United States. In northeastern Mexico, 350 white-tailed deer were tested for the prevalence of antibodies against *Brucella abortus* and *Brucella melitensis*; no positive animals were detected, suggesting that deer in this area are not important in the epizootiology of brucellosis (Martinez et al., 1999). Surveys of wild ruminants in North America have found a wide range in antibody prevalence estimates for BVDV (Kahrs et al., 1964; Barrett and Chalmers, 1975; Kocan et al., 1986; Aguirre et al., 1995). A type 1a BVDV was isolated from a free-ranging yearling female mule deer (*Odocoileus hemionus*) from northwestern Wyoming, USA (Van Campen et al., 2001). A noncytopathic BVDV was isolated from white-tailed deer in southeastern South Dakota (USA) in areas with high livestock concentrations (Chase et al., 2004). A study of occurrence of antibodies to infectious bovine rhinotracheitis virus (IBRV, *Bovine herpesvirus 1*), *bovine parainfluenza virus 3* (BPIV-3), *Leptospira* spp., and *B. abortus* in white-tailed deer in Minnesota reported prevalences of 15, 20, 3, and 0%, respectively (Inge-

brigtsen et al., 1986). Until now, no serologic studies of these diseases have been conducted in northeastern Mexico on white-tailed deer. The objective of the study was to determine the prevalence of antibodies in white-tailed deer sera against four common transmissible infectious diseases in northeastern Mexico.

This study was conducted on 15 ranches in northeastern Mexico (approximately 26–28°N, 99–100°W). We collected 521 blood samples from white-tailed deer during spring 2004. The deer were captured from a helicopter using a netgun in Coahuila, Nuevo Leon, and Tamaulipas states. All work was performed under a scientific collecting permit issued by the Mexican Division Animal Health Wildlife. Bleeding was done by jugular venipuncture using vacuum tubes without anticoagulant. The samples were allowed to clot, and then they were centrifuged. Finally, sera were collected and stored at 4 C until arrival at the laboratory, where the sera were stored at −20 C until tested.

The microscopic-agglutination test (Faine, 1982) was used to detect antibodies to nine serovars of *L. interrogans*: *icterohaemorrhagie*, *hardjo*, *pyrogenes*, *grippotyphosa*, *canicola*, *pomona*, *wolffi*, *bratislava*, and *tarssovi*. A titer of ≥100 was regarded as positive. An enzyme-linked immunosorbent assay test/kit for IBRV and BVDV antibody detection (Cypress Diagnostics C.V. 2002 Ref. HLS, Veterinary Biological Products, Inc., Port Byron, Illinois 61275, USA [VB021]). Sera were tested for antibodies to *B. abortus* using the Rose Bengal test. Chi-square and logistic regression analyses were performed using STATA software, version 9.0 (Stata Corporation LP, College Station, Texas, USA) to measure the strength of association between antibody prevalence and management factors and to obtain odds ratios at 95% confidence intervals.

Of 521 white-tailed deer serum samples tested, 214 (41%) had antibodies against IBRV. The highest IBRV antibody prevalence was found in Nuevo Laredo, Tamaulipas municipality (61%), followed by Guerrero, Coahuila (58%). Twenty-nine (5.5%) of the samples had antibodies to *L. interrogans*; however, the antibody prevalence was low at all locations, ranging from 0% in Guerrero, Tamaulipas to 25% in Hidalgo, Coahuila. Three hundred thirty-one samples (64%) were antibody positive to BVDV, and the prevalence was high at all locations, ranging from 11% in Nuevo Laredo, Tamaulipas to 100% in Hidalgo, Coahuila. Antibodies to *B. abortus* were not detected. Of the 15 deer populations (herds) tested, seropositive animals for BVDV, *L. interrogans*, and IBRV were detected in 15 (100%), nine (60%), and 15 (100%) of herds, respectively (Table 1).

The results of chi-square ($P<0.01$) analyses indicate antibody prevalence to IBRV was higher on ranches with high fences (45%) and on ranches using rotational grazing systems (48%). Ranches that had high densities of deer (one deer/10 ha) also had a higher prevalence (51%) of IBRV antibody-positive deer than ranches with low deer density (one deer/15 ha); however, BVDV antibody prevalence was highest on ranches with low deer density (70%). Ranches with both cattle and deer had higher prevalence (66%) of BVDV antibody-positive deer than ranches where cattle were absent. Deer on ranches where brush and exotic grasses were abundant also had higher antibody prevalence estimates for both IBR and BVDV (Table 2).

The most common studies of leptospirosis in white-tailed deer have been serologic surveys. The earliest surveys were conducted in the late 1950s and 1960s. Antibodies to serovars *L. grippothyphosa* and *L. pomona* are commonly reported in white-tailed deer (Shotts, 1981). Serovar *L. hardjo* is strongly associated with cattle (Hanson, 1982). In Tamaulipas, Mexico, serovar *hardjo* has been diagnosed in cattle, with prevalences ranging from 40% to 68% (Cantu and Alvarado, 1999). In Tennessee, New et al. (1993) studied sympatric white-tailed deer

TABLE 1. Geographic distribution of prevalence of four infectious disease agents in white-tailed deer in northern Mexico.

Municipality	State[a]	n[b]	Brucellosis[c]	IBRV[c]	Leptospirosis[c]	BVDV[c]
N. Laredo	Tamp.	32a	0/0b	16/50.0	1/3.1	14/43.7
N. Laredo	Tamp.	34	0/0	21/61.7	0/0	28/82.4
N. Laredo	Tamp.	9	0/0	5/55.5	1/11.1	1/11.1
Guerrero	Tamp.	87	0/0	12/13.8	0/0	71/81.6
Hidalgo	Coah.	9	0/0	2/22.2	0/0	9/100.0
Hidalgo	Coah.	26	0/0	12/46.1	4/15.3	11/42.3
Hidalgo	Coah.	20	0/0	10/50.0	5/25.0	8/40.0
Hidalgo	Coah.	58	0/0	29/50.0	1/1.7	33/56.8
Guerreo	Coah.	22	0/0	11/50.0	0/0	18/81.8
Guerrero	Coah.	49	0/0	25/51.0	0/0	39/79.6
Guerrero	Coah.	29	0/0	17/58.6	3/11.1	5/17.2
Guerrero	Coah.	48	0/0	15/31.2	5/10.6	41/85.2
Guerrero	Coah.	65	0/0	29/44.6	7/10.9	27/41.5
Anahuac	N.L.	15	0/0	6/40.0	2/13.3	12/80.0
Anahuac	N.L.	18	0/0	4/22.2	0/0	14/77.7
Total %		521	0/0	214/41.07	29/5.56	331/63.53

[a] Tamp. = Tamaulipas; Coah. = Coahuila; N.L. = Nuevo Leon.

[b] Number tested.

[c] Number positives/percentage.

and cattle and observed that antibodies to *L. interrogans* in 106 seropositive deer (11%) had titer to *L. hardjo*. Our results show 29 (5.6%) seropositive white-tailed deer had a titer of 1:100 to *L. hardjo*; this is less than reported by New et al. (1993). Haugen (1967) reported finding serovar *L. hardjo* titers in 1.1% of 369 deer sera collected in Iowa, USA. Goyal et al. (1992) found 43% of deer seropositive at ≥1:100 for serovars *L. pomona* and *L. bratislava*, whereas none are positive for serovar *L. hardjo*. The results provide evidence of exposure of white-tailed deer to the same

TABLE 2. Association between the prevalence antibodies for *Leptospira*, IBRV, and BVDV in white-tailed deer and studied management parameters.

Parameter	Leptospira	*P*	IBRV	*P*	BVDV	*P*
High fence						
No	3.3		27.5		63.3	
Yes	3.9	0.34	45.5	0.0001	64.4	0.096
Deer density						
1/10 ha	5.9		51.8		53.3	
1/15 ha	9.3	0.73	29.3	0.0001	70.2	0.001
Grazing system						
Continuous	6.3		29.2		64.8	
Rotation	5.0	0.52	48.8	0.0001	62.5	0.58
Activity						
Cattle/deer	4.8		41.6		66.6	
Deer	9.3	0.09	38.3	0.57	47.6	0.001
Habitat						
Brush	3.8		31.4		62.5	
Brush/exotic grass	4.7	0.05	45.8	0.0001	72.6	0.002
Brush/native grass	9.9		52.8		52.8	

serovar that infects cattle and that this is the predominant serovar infecting deer in northeastern Mexico. The relatively low prevalence of antibodies across all areas in this study is similar to the 7% reported by Fournier et al. (1986) in Ohio, USA. Based on our study, leptospirosis does not seem to be a problem for deer in three northeastern states of Mexico. Only the type of grazing system had a significant strength of association between seropositive deer and leptospirosis; deer were 3.6 times more likely to be positive when they coexisted with cattle under continuous grazing rather than on rotational grazing systems. This may due to the use of the same range by cattle and deer and the persistent contamination of the grass and water sources used by both species.

No antibodies to *B. abortus* were detected in our study; similar negative results have been reported for 37 white-tailed deer from Texas (Boeer, 1980), white-tailed deer from six ranches in the northeastern Mexico (Martinez et al., 1999), and from deer sampled in Minnesota (Ingebrigtsen et al., 1986). These negative results may in part relate to *B. abortus* control measures; at present, the prevalence of brucellosis in cattle in this area is $<0.5\%$.

Experimentally, cervids are susceptible to infection with noncytopathic BVDV; they can become viremic, shed virus for a short time through nasal secretions, and seroconvert. However, deer seldom develop clinical disease (Van Campen et al., 1997). Contact between livestock and wildlife in Minnesota was suggested as an explanation for the prevalence of antibody positive white-tailed deer for BVDV (19–54%) and IBRV (15%; Ingebrigtsen et al., 1986). Our antibody prevalence estimate was slightly higher for BVDV (63%) and much higher for IBRV (41%). These higher antibody prevalence estimates may relate to management and the prevalence of these diseases in cattle. Antibody prevalence estimates in our study were highest on ranches where deer cohabited with cattle and on ranches where brush and exotic grasses were abundant. In addition, continuous grazing increased the risk for deer testing seropositive to BVDV. These factors possibly reflect increased contact, and increased animal densities. With regard to these diseases in cattle, in Tamaulipas, Mexico, IBR and BVDV have been diagnosed in cattle with prevalences of 38 and 55%, respectively (Cantu and Alvarado, 1999).

The seropositive samples detected in our study indicate that cattle and white-tailed deer are exposed to common pathogens. The high prevalences of antibodies to BVDV and IBR in deer indicate that many deer survive these infections; however, it is not clear whether these animals represent an important reservoir to cattle or whether they are persistently infected and are capable of shedding virus throughout their life.

Based on our serologic evidence, the serovar *L. hardjo* is the predominant *Leptospira* serovar infecting deer in northeastern Mexico. However, it is unknown whether these infections adversely affect deer health. Likewise, the potential impacts of BVDV infections on deer health are difficult to determine. An important question may relate to the potential for BVDV to cause reproductive problems in deer, and this question deserves further investigation. Additionally, additional research is needed to develop management strategies for disease control and prevention strategies that recognize that important pathogens can and will be shared between wildlife and domestic animal species that use the same habitats.

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