# OCCURRENCE OF ANTIBODIES TO THE ETIOLOGIC AGENTS OF INFECTIOUS BOVINE RHINOTRACHEITIS, PARAINFLUENZA 3, LEPTOSPIROSIS, AND BRUCELLOSIS IN WHITE-TAILED DEER IN MINNESOTA

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# OCCURRENCE OF ANTIBODIES TO THE ETIOLOGIC AGENTS OF INFECTIOUS BOVINE RHINOTRACHEITIS, PARAINFLUENZA 3, LEPTOSPIROSIS, AND BRUCELLOSIS IN WHITE-TAILED DEER IN MINNESOTA

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ABSTRACT: A serologic survey was conducted on 628 white-tailed deer (*Odocoileus virginianus*) in 1976 and 1979–1980. Tests for antibodies to the etiologic agents of infectious bovine rhinotracheitis (IBR), parainfluenza 3 (PI3), leptospirosis, and brucellosis produced positive results of 15%, 20%, 3% and 0%, respectively. Adult deer had significantly higher prevalence of antibodies to IBR virus and PI3 virus than fawns. These data provide a basis for monitoring these disease agents in Minnesota's white-tailed deer.

## INTRODUCTION

A decline in the productivity of white-tailed deer (*Odocoileus virginianus*) was observed in the farmland area of Minnesota in 1976. Disease, drought, and related stress were suspected as possible factors because adequate habitat was abundant and recent winters had been mild. In conjunction with an intensive study of bovine virus diarrhea (BVD) (Ludwig and McClurkin, unpubl. data), a serologic survey was conducted to determine the occurrence of antibodies in white-tailed deer to the etiologic agents of infectious bovine rhinotracheitis (IBR), parainfluenza 3 (PI3), leptospirosis, and brucellosis. Antibodies to these four disease agents have been reported previously in white-tailed deer in the United States (Table 1). Antibodies to IBR and PI3 viruses also have been reported in moose (*Alces alces*) in Minnesota (Johnson et al., 1972).

Infectious bovine rhinotracheitis is a herpes virus infection of cattle which primarily is a respiratory disease and is known to cause abortion (Richards, 1981). Little is known of IBR virus in deer. The PI3 virus is a paramyxovirus which has been associated with pneumonia in calves (Richards, 1981). Adult cattle may harbor the virus. Whether cattle transmit the virus to deer is unknown. Leptospirosis is generally transmitted through the urine of carrier animals. Leptospiral organisms survive in moist soil, stagnant ponds, and slow-moving streams (Roth, 1970). Drinking contaminated water is a likely means of transmittal of leptospiral organisms. Leptospirosis has been observed under experimental conditions to cause abortion in white-tailed deer (Trainer et al., 1961). Brucellosis is a widespread disease of man, cattle, goats, and swine, but is found rarely in deer in the United States. It is a cause of abortion in cattle (Witter and O'Meara, 1970). Contact between livestock and wildlife in Minnesota was indicated by the high prevalence (19%–54%) of seropositives to BVD virus in white-tailed deer (Ludwig and McClurkin, unpubl. data).

The objectives of this study were to determine the prevalence of neutralizing antibodies to the etiologic agents of IBR, PI3, leptospirosis, and brucellosis in white-tailed deer in the farmland area of Minnesota. The data would document exposure of deer to bovine diseases and suggest areas for additional research that might explain changes in deer productivity and populations.

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TABLE 1. Summary of selected references on serosurveys of infectious disease agents in white-tailed deer in the United States.

| Disease agent | No. positive/no. tested | % Positive | Reference |
|---|---|---|---|
| Infectious bovine rhinotracheitis virus | 4/198 | 2 | Friend and Halterman, 1967 |
| | 12/49 | 24 | Anonymous, 1976 |
| Parainfluenza 3 virus | 1/27 | 4 | Shah et al., 1965 |
| | 9/49 | 18 | Anonymous, 1976 |
| *Leptospira interrogans* | 30/187 | 16 | Wedman and Driver, 1957 |
| | 585/3,673 | 16 | Ferris et al., 1961 |
| | 3/261 | 1 | Friend and Halterman, 1967 |
| | 28/285 | 10 | Haugen, 1967 |
| | 3/36 | 8 | Fleming and Nusbaum, 1979 |
| *Brucella abortus* | 1/179 | <1 | Wedman and Driver, 1957 |
| | 20/12,706 | <1 | Fay, 1961 |
| | 1/70 | 1 | Corey et al., 1964 |

## MATERIALS AND METHODS

In 1976, blood samples were collected from hunter-killed deer at 36 mandatory deer registration stations in the farmland area. Blood was collected from the body cavity or visceral organs in 15-ml tubes, centrifuged, and the sera removed and frozen within 24 to 36 hr of collection. The brucellosis test was conducted at the State-Federal Brucellosis Laboratory in St. Paul, Minnesota on the sera collected in 1976 using the standard plate agglutination test (U.S. Department of Agriculture [not dated]) at dilutions of 1:25, 1:50, 1:100, and 1:200. The microscopic-agglutination microtiter test (MAMT) for leptospirosis (Galton et al., 1965) was conducted at the Veterinary Diagnostic Laboratories, University of Minnesota. Sera were tested for antibodies to *Leptospira interrogans* serovars *pomona*, *canicola*, *icterohaemorrhagiae*, *hardjo*, and *grippotyphosa*.

In 1979, a randomly selected sample ($n$ = 4,200) of antlerless deer permit recipients was sent prepaid mailers containing a 15-ml plastic syringe, 15-ga needle, centrifuge tube, and instructions on how to collect a blood sample. The hunters were asked to mail the blood to the Minnesota Department of Natural Resources (DNR) at Madelia, where it was centrifuged to obtain serum for IBR and PI3 tests.

Blood specimens were also collected by DNR personnel from deer processed at a sample of mandatory registration stations during the 1979 muzzleloader season and from deer live-trapped at Whitewater Wildlife Management Area (WWMA) during December 1979–February 1980. These sera were kept frozen and subsequently sent to the National Animal Disease Center, Ames, Iowa, for testing for antibodies to IBR and PI3 viruses. The sera were tested by microneutralization (Ross and Kiesel, 1971) using BT cells (McClurkin et al., 1974) maintained in Gibco (Grand Island Biologic Company, Grand Island, New York 14072, USA) minimum essential media with Earle's salts and 10% virus- and antibody-free bovine serum.

Neutralization endpoints for antibodies to IBR and PI3 viruses were 1:512 or greater, and titers from there to 1:4 were considered to be positive. Data were analyzed by the chi-square test using Yates' correction for the 2 × 2 tables (Yates, 1934). Correlations were used to compare densities.

## RESULTS AND DISCUSSION

Adequate amounts of suitable sera were obtained from 124 deer in 1976, 428 deer during the 1979 regular firearms and muzzleloader seasons, and 77 deer live-trapped at WWMA the following winter. The 418 returns of acceptable serum obtained from the 1979 sample represent a 10% return for the mail survey.

Seropositive results were obtained for IBR virus, PI3 virus, and *Leptospira interrogans*; however, no positive results were obtained for *Brucella abortus* (Table 2). Seropositive titers of 1:100, 1:100, and 1:200 were found for leptospiral serovars *icterohaemorrhagiae*, *pomona*, and *grippotyphosa*, respectively, in each of three deer.

Prevalence of antibodies to IBR virus

TABLE 2. Serologic results for four disease agents in white-tailed deer in the farmland area of Minnesota, 1976–1980.

| Disease agent | Years | No. positive/ no. tested | % Positive |
|---|---|---|---|
| Infectious bovine rhinotracheitis virus | 1979–1980 | 74/504 | 15 |
| Parainfluenza 3 virus | 1979–1980 | 99/504 | 20 |
| *Leptospira interrogans* | 1976 | 3/115 | 3 |
| *Brucella abortus* | 1976 | 0/124 | 0 |

($\chi^2 = 0.02$, $P = 0.90$) and PI3 virus ($\chi^2 = 0.02$, $P = 0.90$) were not different among sexes. However, adults had a significantly higher prevalence of antibody than fawns to IBR virus (18% vs. 8%, $\chi^2 = 8.28$, $P < 0.005$) and PI3 virus (24% vs. 11%, $\chi^2 = 9.78$, $P < 0.002$) (Tables 3, 4) which is probably a result of the increased chance of exposure as deer age or become more mobile. There was no significant difference between the prevalence of antibody of the hunter-killed deer and WWMA live-trapped deer for IBR virus and PI3 virus.

The occurrence of seropositive deer was widespread in the state. Twenty-one of 64 counties with at least one deer tested had IBR virus positives, and 30 of 64 counties had PI3 virus positives. In 1976, antibodies to *Leptospira interrogans* were less prevalent (3%) than in a 1957 survey where 16% of white-tailed deer in Minnesota were found to be seropositive (Wedman and Driver, 1957).

TABLE 3. Serologic results for white-tailed deer older than 1 yr by titer against infectious bovine rhinotracheitis virus and parainfluenza 3 virus in Minnesota, 1979–1980.

| | Infectious bovine rhinotracheitis ($n$ = 339) | | Parainfluenza 3 ($n$ = 338) | |
|---|---|---|---|---|
| Titer | No. positive | Percent positive | No. positive | Percent positive |
| 1:4 | 26 | 8 | 25 | 7 |
| 1:8 | 17 | 5 | 16 | 5 |
| 1:16 | 7 | 2 | 7 | 2 |
| 1:32 | 7 | 2 | 8 | 2 |
| 1:64 | 2 | 1 | 5 | 1 |
| 1:128 | 1 | <1 | 6 | 2 |
| 1:256 | 0 | 0 | 8 | 2 |
| 1:512 or > | 1 | <1 | 5 | 1 |
| Total | 61 | 18 | 80 | 24 |

TABLE 4. Serologic results for white-tailed deer younger than 1 yr by titer against infectious bovine rhinotracheitis virus and parainfluenza 3 virus in Minnesota, 1979–1980.

| | Infectious bovine rhinotracheitis ($n$ = 165) | | Parainfluenza 3 ($n$ = 166) | |
|---|---|---|---|---|
| Titer | No. positive | Percent positive | No. positive | Percent positive |
| 1:4 | 6 | 4 | 4 | 2 |
| 1:8 | 3 | 2 | 3 | 2 |
| 1:16 | 2 | 1 | 3 | 2 |
| 1:32 | 1 | 1 | 1 | 1 |
| 1:64 | 1 | 1 | 0 | 0 |
| 1:128 | 0 | 0 | 0 | 0 |
| 1:256 | 0 | 0 | 6 | 4 |
| 1:512 or > | 0 | 0 | 2 | 1 |
| Total | 13 | 8 | 19 | 11 |

Brucellosis is very rare in white-tailed deer. Studies in the United States have documented seropositive results of less than 2% (Wedman and Driver, 1957; Fay, 1961; Corey et al., 1964). Wedman and Driver (1957) found only one positive sample for antibodies to *Brucellosis abortus* in Minnesota.

The present study was conducted to document exposure of white-tailed deer to bovine diseases. Historically, cattle have been prevalent in areas of Minnesota where cash-grain agriculture is not feasible and these areas provide suitable deer habitat. In 1979, deer densities estimated for Minnesota's nine farmland deer management subunits (Schultz, 1984) were correlated ($r = 0.80$, $t = 3.47$, df = 7, $P = 0.01$) with cattle densities (U.S. Department of Agriculture, 1980). This suggests that ample opportunity has existed for cattle–deer contact. However, we cannot rule out a density dependent effect among

deer until it is known if these bovine diseases are capable of maintaining themselves within a deer population without exposure of bovine origin.

The positive reactors provide documentation of exposure of white-tailed deer to three bovine pathogens or closely related pathogens specific to white-tailed deer. Even though it has been shown that white-tailed deer have apparently been exposed to these bovine pathogens, very little is known about their actual response to them or their role in transmittal to other species or back to cattle. This study indicated that livestock and wildlife may be exposed to common pathogens and provided baseline data for future studies of diseases of white-tailed deer.

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