



Department of Comparative Medicine
P. O. Box 1071
Knoxville, TN 37901-1071
Phone 423/974-5576
FAX 423/974-5640

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Mr. Kim Delozier
Mr. Bill Stiver
Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738

Dear Kim and Bill,

Enclosed is a final report on the survey of deer for Lyme disease. Please let me know if you would like me to consider changing any of the recommendations and feel free to share this report with whomever you like.

Once again, it was a pleasure working with you on this project and I hope we can do so again in the future.

Sincerely,

A handwritten signature in dark ink, appearing to be 'JCN' or similar, written over a horizontal line.

John C. New, Jr., DVM, MPH
Dipl., ACVPM

c: Dr. Kania
Dr. Schaeffer

**A Report on a Survey of White-tailed Deer (*Odocoileus virginianus*)
from Cades Cove, Great Smoky Mountains National Park
for the Presence of Antibody to *Borrelia burgdorferi* (Lyme Disease)**

Dr. John C. New, Jr., DVM, MPH
Dr. Stephen Kania, PhD
Dr. Dorcas Schaeffer, DVM
Department of Comparative Medicine
College of Veterinary Medicine
University of Tennessee

INTRODUCTION: Lyme Disease (borreliosis) has emerged as the leading human tick-borne infection in the United States (Spach et al., 1993). While the number of human cases of Lyme Disease in the southeastern states has risen steadily in recent years, knowledge of the distribution of the organism is still limited (Luckhart et al., 1992). White-tailed deer are important in the epidemiology of the disease because they serve as the preferred host of the adult stage of the tick vector (Anderson, 1988; Bosler et al., 1984; Anderson and Magnarelli, 1984). Even though deer are incompetent reservoirs of *Borrelia burgdorferi*, the cause of Lyme Disease, they do produce antibodies and are a useful indicator species to identify potential foci of infection for humans (Telford et al., 1988; Luttrell et al., 1994). The Cades Cove area of the Great Smoky Mountains National Park (GSMNP) has a dense deer population (Wathen and New, 1989) as well as the most important tick vector of the disease. Deer as indicator species for the presence of *B. burgdorferi* are relatively easy to sample, compared to the other mammalian species and vectors important to the maintenance of borreliosis. If the organism is also present, it could represent an important health risk to visitors and GSMNP staff.

OBJECTIVE: To investigate the presence of *Borrelia burgdorferi* in the white-tailed deer population of Cades Cove, GSMNP using stored sera from previous studies and supplemented with samples collected from the current population of deer.

JUSTIFICATION: GSMNP is the most visited park in the national park system, and Cades Cove is the most visited part of the Park. There have been two reported cases of human Lyme Disease associated with possible exposure in the Park. Data on these cases are incomplete and definitive diagnosis of Lyme Disease is very difficult. It is important to know if diseases that represent a risk to human health (i.e. Lyme Disease) are present in this ecosystem so that visitors and staff can be informed and take precautions.

METHODOLOGY: In order to collect samples from the current deer population, the Park provided darting crews including personnel, vehicles, darting rifles, darts and immobilizing drugs. The UT College of Veterinary Medicine (UTCVM) provided veterinary representatives to collect the blood sample and all supplies necessary for blood collection and the reagents needed to conduct the serologic tests.

Blood samples were collected from 48 deer from October 25 through November 1, 1996. Deer were immobilized throughout the Cove. A blood sample (20 mls.) was collected from the jugular vein and allowed to clot. Serum was decanted and frozen until tested.

These samples were added to 617 samples collected from the Cades Cove deer population from 1980-1985 and sporadically thereafter. These samples had been stored since collection at -60°C. In addition, we accepted 8 deer sera samples from staff of the Ft. Loudon State Historic Area (FLSHA) in Monroe County, TN.

An enzyme linked immunosorbent assay (ELISA) using anti-deer IgG was used as an initial screening test for evidence of antibody to *Borrelia burgdorferi* (May et al., 1991). The serum samples that responded most strongly to the ELISA were tested further using Western blot analysis (Towbin et al., 1979). Western blot analysis separates the proteins found in a serum sample and allows scientists to look for unique patterns of proteins. For example, protein patterns from an unknown serum sample can be compared to patterns from control samples known to have antibodies to *B. burgdorferi* and samples known to be free of such antibodies. Sera from experimentally infected deer were used as positive controls and sera from known negative deer as negative controls.

RESULTS: Of the 673 samples tested in duplicate by ELISA, 24 were considered suspect. These samples were retested in triplicate on a single ELISA plate. The 15 samples with the highest reactivity by ELISA were tested by Western blot. Six of 15 samples were positive by Western blot. In addition, 1 sample was suspect but the banding pattern was difficult to interpret.

Two of the 6 Western blot positive deer came from FLSHA and the other 4 plus the one suspect came from Cades Cove. No additional data were available for the FLSHA deer. Table 1 and Figure 1 display data on the Cades Cove positive deer.

Table 1. White-tailed deer from Cades Cove, GSMNP positive for <i>Borrelia burgdorferi</i>				
Sample ID #	Date collected	Age	Sex	Field number
1	9-2-97	2.5 yrs	female	85
5	9-2-97	5 yrs	female	66
134	6-15-84	2.5 yrs	male	12
312	5-6-80	not available	female	16
001 (suspect)	7-1-80	2.5 yrs	male	75

CONCLUSIONS AND RECOMMENDATIONS: The agent of Lyme Disease, *Borrelia burgdorferi*, exists in the Great Smoky Mountains National Park. Consequently, informational material should be available to visitors and staff on how to prevent infection. Infection can be prevented by preventing tick bites through the use of protective clothing and/or tick repellents and

insecticides. If repellents and/or insecticides are to be used, visitors and staff should be urged to read the product label carefully and use the product as directed. Infection can also be prevented by removing ticks as soon after they attach as possible. Visitors and staff should check themselves, children and pets at least once a day for ticks. Ticks should be removed carefully since a tick's body fluids may contain the organism and, if crushed, may contaminated fingers and hands. If such contamination comes in contact with mucous membranes (e.g., mouth, nose, eyes), infection can potentially occur.

The Park could distribute their own educational materials or use those already available from sources like the Southeastern Cooperative Wildlife Disease Study.. These should be available at all places in the Park where visitors are numerous, but especially in the Cades Cove area.

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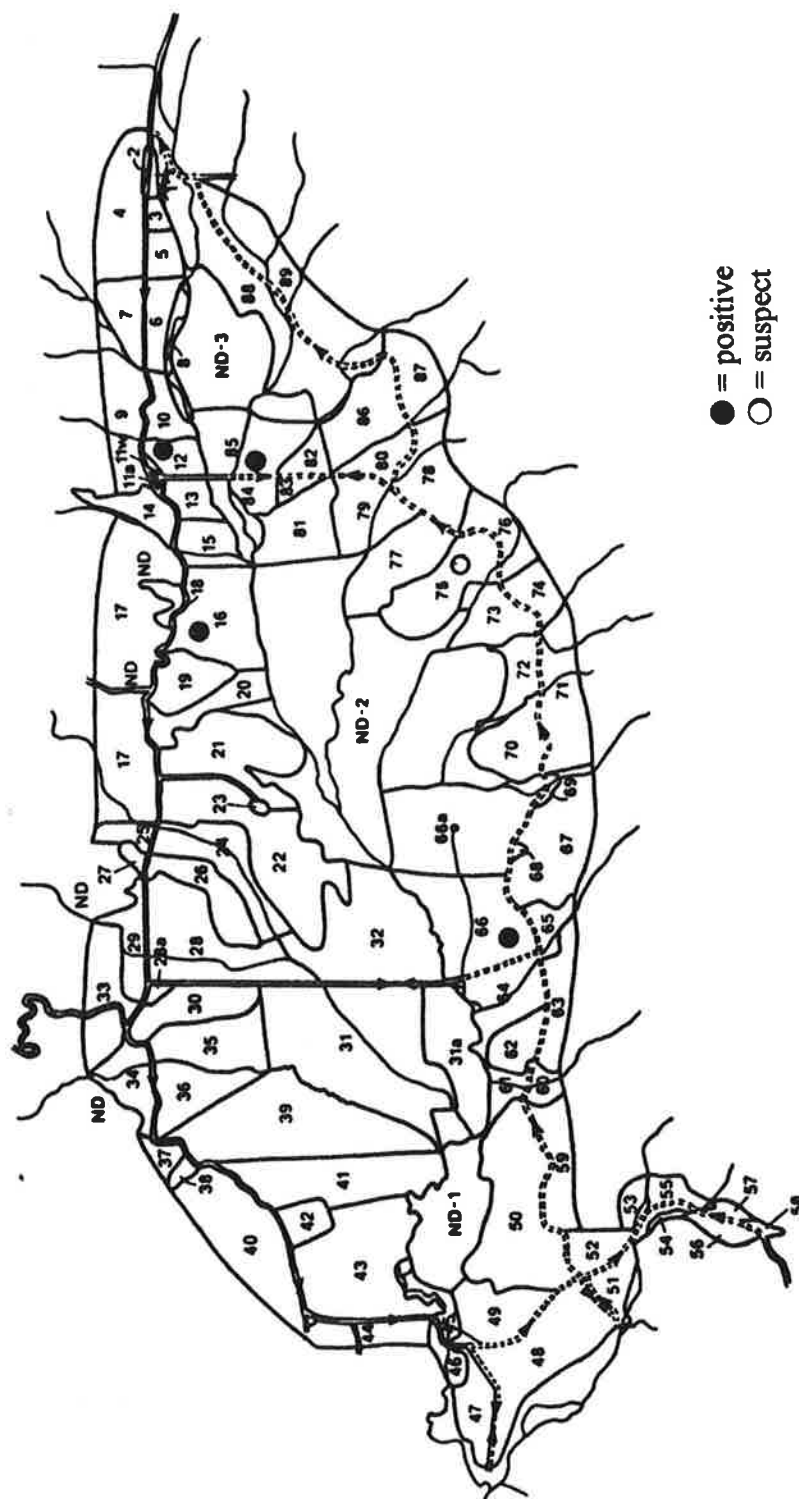


Figure 1. Field numbers and capture locations of deer seropositive for *Borrelia burgdorferi* (Lyme disease).