March 22, 2007

Thomas Kroll, Park Manager and Arboretum Director
Saint John's University
New Science Center 108
Collegeville, MN 56321-3000

Dear Mr. Kroll,

The Minnesota Department of Health (MDH) sampled for *Ixodes scapularis* ticks at Saint John's Arboretum in 2005 as part of its effort to explain increasing rates of tick-borne diseases in Minnesota. This letter summarizes overall study findings and provides detailed results for your park.

Background

Each life stage of *I. scapularis*, known as the deer tick or black-legged tick, takes one vertebrate blood meal. Larvae and nymphs typically feed on white-footed mice (*Peromyscus leucopus*), and adults prefer white-tailed deer (*Odocoileus virginianus*). Nymphs or adults that instead feed on humans may inoculate their human hosts with one or more disease agents: *Borrelia burgdorferi*, the bacteria that cause Lyme disease; *Anaplasma phagocytophilum*, the bacteria that cause human anaplasmosis; and *Babesia microti*, the protozoan cause of babesiosis. Risk of bites from host-seeking *I. scapularis* ticks is greatest in woody or brushy habitats during late spring, early summer, and autumn months.

Historically, most cases of tick-borne disease in Minnesota resulted from exposure to infected ticks in forested portions of east-central counties or in the Saint Croix and Mississippi River valleys of eastern and southeastern Minnesota. Recent data, however, suggest that exposures are also occurring in areas of northern, west-central, central, and southeastern counties on the periphery of Minnesota's historical endemic range. This expansion of disease risk may be associated with recent establishment of infected tick populations in new areas of Minnesota.

MDH implemented a tick distribution study in the summer of 2005 to estimate *I. scapularis* abundance and infection rates at 16 forested sites at the edge of Minnesota's known tick-borne disease risk zone (Figure 1). Field staff collected host-seeking *I. scapularis* by dragging a 1-m^2 white canvas cloth along specific sampling transects and removing any attached ticks. Numbers of ticks collected by drag cloth were used for density estimation. In addition, ticks found by dragging, on field staff, or elsewhere in each site were tested by polymerase chain reaction (PCR) for evidence of disease agents.

In early November 2005, MDH staff also examined the prevalence of tick-borne disease agents in white-tailed deer during Saint John's fall deer hunt. Staff collected deer blood and *I. scapularis* ticks from hunter-killed deer and tested samples for PCR evidence of tick-borne pathogens.

Overall findings

I. scapularis ticks were identified at 13 of the 16 study sites (Figure 1). Nearly 250 adult and nymphal ticks were collected and tested for *B. burgdorferi*, *A. phagocytophilum*, and *B. microti*. Evidence of all 3 pathogens was detected. Overall, 34% of ticks from 9 study sites (range, 20%-50%) were PCR-positive for at least 1 disease agent. A smaller percentage of nymphal ticks (16%) than adult ticks (44%) were positive; however, nymphs pose a greater disease risk because they are smaller and more difficult for people to detect on themselves.

Saint John's Arboretum

Field staff sampled five transects at each of two visits to Saint John's Arboretum in September and October, 2005 (Figure 2). *I. scapularis* adults were identified at four of five transects and during both visits (Table 1). The presence of adult ticks and lack of immature ticks during this sampling period were consistent with host-seeking activities of *I. scapularis*; typically, all three stages seek hosts during the spring to early summer, but only adults quest in the autumn. The abundance of adult ticks suggests that larvae and nymphs may be present in the spring and summer, which would indicate an established *I. scapularis* population. Densities of adult *I. scapularis* averaged 0.25 ticks/100 m^2; in other words, someone walking nearly half a kilometer through the woods at Saint John's in the autumn could accumulate at least one adult tick. This density is a conservative estimate, as it excludes additional *I. scapularis* found on field staff instead of the drag cloth. Of host-seeking female *I. scapularis*, which are responsible for transmitting disease agents, 40% (2/5) were PCR-positive for *B. burgdorferi*, the cause of Lyme disease (Table 2).

Of the 18 hunter-killed deer tested, 7 (39%) were PCR-positive for *A. phagocytophilum*, the cause of human anaplasmosis. However, recent research has shown that the strains of *A. phagocytophilum* found in deer are not the same strains found in human human anaplasmosis patients. Two (11%) were PCR-positive for *B. microti*, the cause of babesiosis (Table 3). No deer had PCR evidence of *B. burgdorferi*, the Lyme disease agent, but deer are known to readily clear these bacteria. Compared to does, male deer were more heavily infested with *I. scapularis* ticks, likely due to greater habitat ranges. Of the 16 female *I. scapularis* collected from deer, evidence of *A. phagocytophilum* was found in 3 (19%) ticks (Table 4) from one *A. phagocytophilum*-positive deer; the remaining 13 negative ticks were collected off of negative deer. These results indicate that disease agents are circulating among adult *I. scapularis* and their white-tailed deer hosts.

The presence of adult *I. scapularis* and their pathogens demonstrates the potential for tick-borne disease transmission at Saint John's Arboretum. Hunters may be at risk for Lyme disease, human anaplasmosis, or babesiosis from tick bites in the fall. Persons who butcher deer may also have a slight risk of contracting human anaplasmosis or babesiosis, since deer blood had evidence of *A. phagocytophilum* and *B. microti* organisms. However, the greatest risk of tick-borne diseases is during the spring and early summer months from immature *I.scapularis* ticks.

While the presence of *I. scapularis* should not reduce educational and recreational use of Saint John's Arboretum, staff and visitors should be aware of tick-borne disease risks and adopt appropriate prevention measures, such as wearing long pants, using tick repellent, and performing tick-checks to remove attached ticks. These precautions are most important during the high-risk season from mid-May to mid-July. MDH has a Lyme disease brochure available on our tick-borne disease website (http://www.health.state.mn.us/divs/idepc/dtopics/tickborne).

These findings will help MDH plan future tick-borne disease prevention efforts, and we hope that you find the results helpful as well. Further MDH research goals include additional *I. scapularis* distribution and infection rate studies in various parts of Minnesota.

If you have any questions or input on these findings, please contact Dave Neitzel or me by phone (651/201-5414) or email (David.Neitzel@state.mn.us; Melissa.Kemperman@state.mn.us). Thank you for your participation in this important study! We look forward to working with you in the future to better understand and prevent tick-borne diseases in Minnesota.

Sincerely,

Melissa Kemperman
Vector-borne Diseases

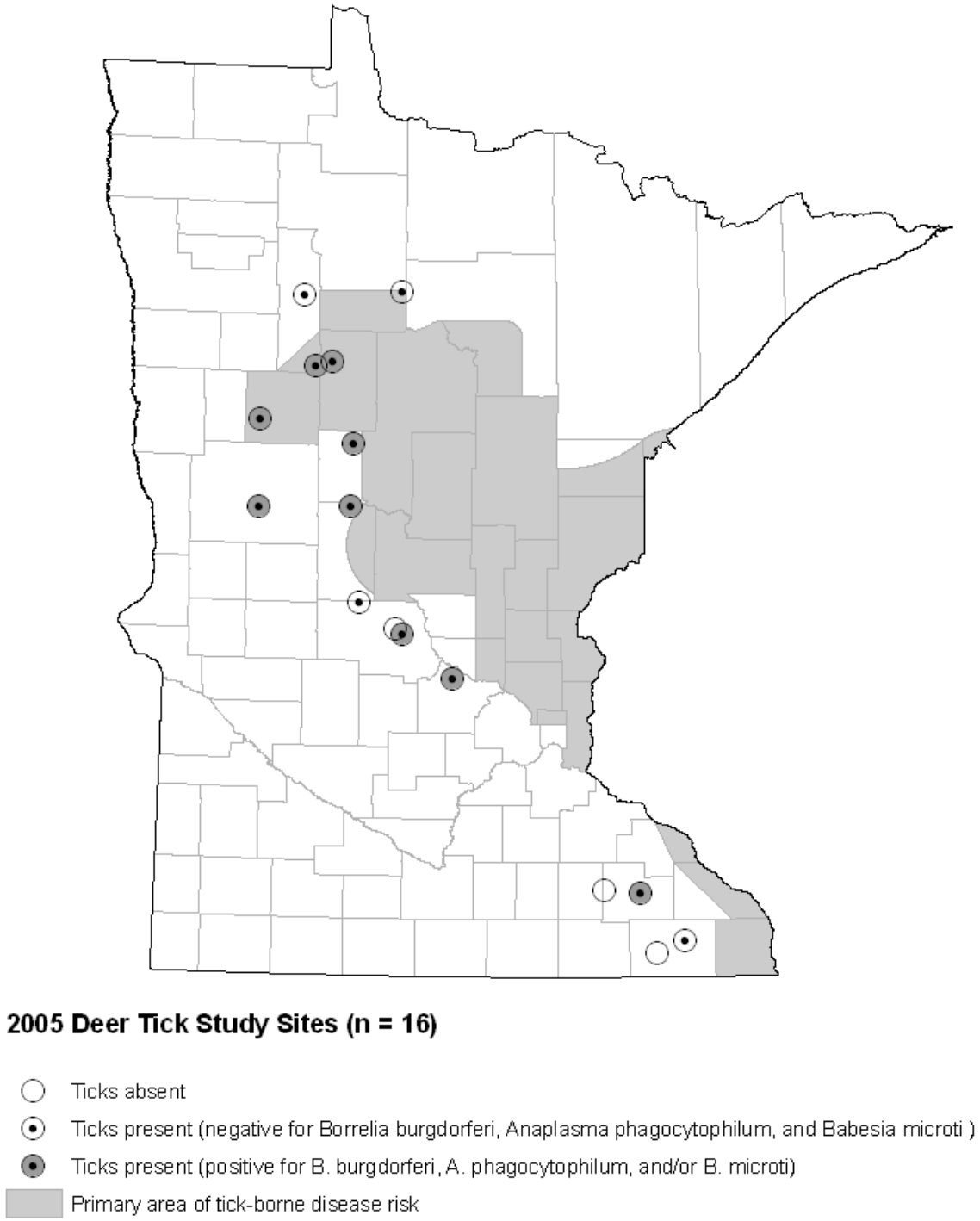
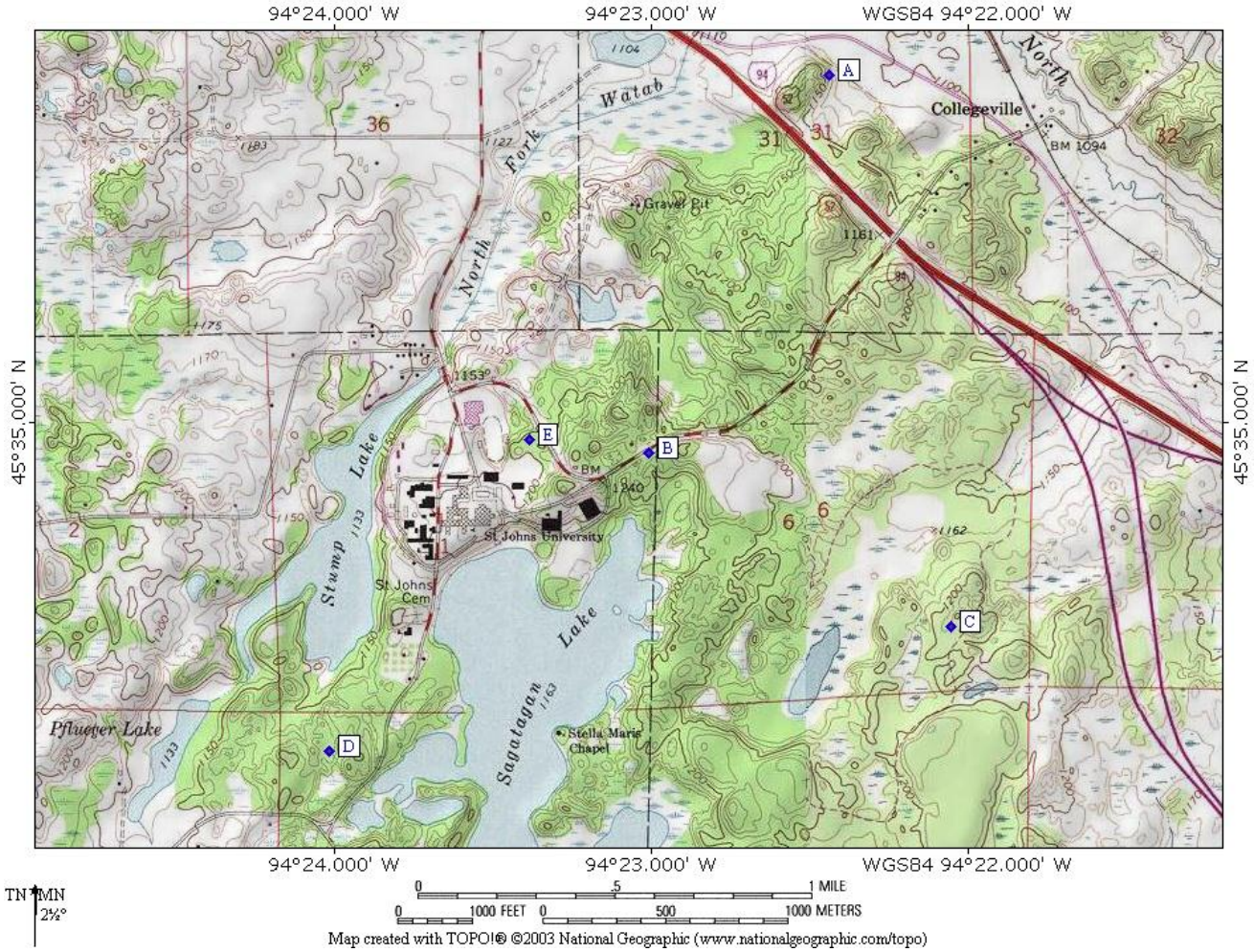


Figure 1. Areas of highest risk for tick-borne disease in Minnesota and MDH *I. scapularis* study sites, 2005



	A	B	C	D	E
Latitidude	45° 35.766' N	45° 34.930' N	45° 34.548' N	45° 34.272' N	45° 34.962' N
Longitude	094° 22.438' W	094° 23.007' W	094° 22.052' W	094° 24.015' W	094° 23.383' W
Bearing	NW	ENE	SW	SW	NW

Figure 2. Locations of *I. scapularis* sampling transects at Saint John's Arboretum, 2005. Transect choice was based on *I. scapularis* habitat suitability and representativeness of Saint John's Arboretum's plant communities. Transects were sampled two times during September and October. Coordinates indicate the beginning of each transect (waypoints averaged over visits); bearing indicates direction of transect. Field staff sampled each 100-m transect with a 1-m^2 canvas cloth twice for a total of 200 m^2/transect/visit.

Transect	9/29/2005		10/7/2005		Total	
	Ticks (number)	Density (ticks/100 m^2)	Ticks (number)	Density (ticks/100 m^2)	Ticks (number)	Density (ticks/100 m^2)
A[1]	0	0.0	1	0.5	**1**	**0.25**
B	0	0.0	0	0.0	**0**	**0.00**
C[2]	0	0.0	2	1.0	**2**	**0.50**
D	0	0.0	1	0.5	**1**	**0.25**
E	0	0.0	1	0.5	**1**	**0.25**
Total	**0**	**0.0**	**5**	**0.5**	**5**	**0.25**

[1] One additional adult *I. scapularis* was found on field staff while performing drag sampling during second visit to Transect A (included in infection rate but not density estimate).

[2] While performing drag sampling at Transect C, field staff found 3 additional *I. scapularis* adults on themselves during the first visit and 6 additional adults during the second visit (included in infection rate but not density estimate).

Table 1. Densities of host-seeking *I. scapularis* at Saint John's Arboretum, Fall 2005. Adults included male and female ticks. Each transect totaled 200 m^2 in length.

Pathogen(s)	**Adult Males** number (%) PCR positive (n = 10)	**Adult Females** number (%) PCR positive (n = 5)	**Total Adults** number (%) PCR positive (n = 15)
At least one infection	3 (30.0)	2 (40.0)	5 (33.3)
Single infections			
B. burgdorferi	1 (10.0)	2 (40.0)	3 (20.0)
A. phagocytophilum	2 (20.0)	0 (0.0)	2 (13.3)
B. microti	0 (0.0)	0 (0.0)	0 (0.0)
Coinfections			
B. burgdorferi + A. phagocytophilum	0 (0.0)	0 (0.0)	0 (0.0)
B. burgdorferi + B. microti	0 (0.0)	0 (0.0)	0 (0.0)
A. phagocytophilum + B. microti	0 (0.0)	0 (0.0)	0 (0.0)

Table 2. Infection rates of host-seeking adult *I. scapularis* ticks at Saint John's Arboretum, Fall 2005.

Pathogen(s)	**Adult Males** number (%) PCR positive (n = 20)	**Adult Females** number (%) PCR positive (n = 16)
At least one infection	14 (70.0)	4 (25.0)
Single infections		
B. burgdorferi	3 (15.0)	3 (18.8)
A. phagocytophilum	11 (55.0)	3 (18.8)
B. microti	1 (5.0)	1 (6.3)
Coinfections		
B. burgdorferi + A. phagocytophilum	1 (5.0)	2 (12.5)
B. burgdorferi + B. microti	0 (0.0)	0 (0.0)
A. phagocytophilum + B. microti	0 (0.0)	1 (6.3)

Table 3. Infection rates of adult *I. scapularis* attached to white-tailed deer at Saint John's Arboretum, Fall 2005. Female *I. scapularis* adults feed on deer, but male ticks attach only to mate with females. All female ticks positive for any disease agent were collected from an adult male deer that was positive for *Anaplasma phagocytophilum*. All female ticks negative for disease agents were collected from deer that were also negative.

Pathogen(s)	**Buck** [1] number (%) PCR positive (n = 8)	**Doe** [2] number (%) PCR positive (n = 10)	**TOTAL** number (%) PCR positive (n = 18)
At least one infection	4 (50.0)	4 (40.0)	8 (44.4)
Single infections			
B. burgdorferi	0 (0.0)	0 (0.0)	0 (0.0)
A. phagocytophilum	4 (50.0)	3 (30.0)	7 (38.9)
B. microti	0 (0.0)	2 (20.0)	2 (11.1)
Coinfections			
B. burgdorferi + A. phagocytophilum	0 (0.0)	0 (0.0)	0 (0.0)
B. burgdorferi + B. microti	0 (0.0)	0 (0.0)	0 (0.0)
A. phagocytophilum + B. microti	0 (0.0)	1 (10.0)	1 (5.6)

[1] All but one of the male deer were immature bucks.

[2] All but one of the female deer were adult does.

Table 4. Infection rates of white-tailed deer (*Odocoileus virginianus*) at Saint John's Arboretum, November 2005.