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# **Metropolitan Mosquito Control District**

## ***Ixodes scapularis* Distribution Study Report**

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**Tick Vector Services**

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## 1993 DEER TICK DISTRIBUTION STUDY

### Abstract

A deer tick (*Ixodes scapularis*) distribution study (designed to detect any changes in *I. scapularis* distribution over a many year period) was conducted in the seven county metropolitan area by the Metropolitan Mosquito Control District (MMCD). Small mammal sampling was used to collect ticks from 100 woodlots that have all been sampled since 1990 or 1991. We collected a total of 409 *I. scapularis* from 1543 mammals and found at least one *I. scapularis* at 37 sites. We detected the presence of *I. scapularis* through small mammal sampling for the first time at six sampling locations in Washington or Anoka counties, but *I. scapularis* had been found in other sampling locations within each township during previous studies. The majority of *I. scapularis* have continued to be collected north of the Mississippi River in Washington, Anoka, and Ramsey counties. Washington County alone accounted for 78% (301/388) of the *I. scapularis* larvae and 95% (20/21) of the nymphs collected in 1993. The overall season mean number of *I. scapularis*/mammal in 1993 was .264. Over the 4 year period from 1990-1993, the average was .197. Yearly season means for Washington County were consistently the highest, followed by Anoka County. Townships with the highest averages over the four year period were New Scandia, Hugo, May, and Grant townships of Washington County, as well as East Bethel and Linwood townships of Anoka County (all > .500 *I. scapularis*/mammal). Our results seem to indicate that while *I. scapularis* population levels remain low, localized, or nonexistent south of the Mississippi River, their populations are relatively established within northeastern Anoka and northern Washington counties. A pattern of intermittent distribution occurs along a band stretching from northwestern Anoka County through southeastern Washington and northern Dakota counties. Further research is needed to determine why the presence/absence status of *I. scapularis* fluctuates within this band.

### Introduction

In 1990 the MMCD initiated a Lyme Disease Tick Surveillance Program to determine the distribution and prevalence of *I. scapularis* and *Borrelia burgdorferi* within the Minneapolis- Saint Paul metropolitan area. The 1990 and 1991 studies provided baseline *I. scapularis* distribution data for our area. Most of the ticks were found in Anoka, Washington, and northern Ramsey counties, located north of the Mississippi River. The 1992 study was designed to inspect areas that had not been sampled as intensely in the past, with emphasis on locations south and west of the Mississippi River, but the majority of *I. scapularis* continued to be found in the northeastern counties.

Our 1993 distribution study focused on re-sampling 100 sites that have been sampled since 1990 or 1991. We began re-sampling seventy-five of these sites in 1991 to detect any changes in *I. scapularis* distribution over a many year period. These repeat sites were selected from the previous study based on three criteria: representative habitat of an area, locations that were unlikely to be developed, and areas where small mammal collections had been sufficient in the past. An additional twenty-five sites were selected for repeat sampling from Dakota, Hennepin, Scott, and Carver counties in 1992 to increase our data collections south of the Mississippi River. We plan to monitor these sites indefinitely, and will intensify our sampling effort in areas that have shown potential range expansion of *I. scapularis*.

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## Materials and Methods

Of the 100 repeat sites, 56 are located north of the Mississippi River in Anoka (28 sites), Washington (25 sites), and Ramsey (3 sites) counties. The 44 repeat sites located south of the Mississippi River are distributed throughout Dakota (15 sites), Hennepin (14 sites), Scott (8 sites), and Carver (7 sites) counties.

Sampling was initiated on April 26, 1993 and ended on October 28, 1993. The twenty-seven week study was divided into three nine-week sampling periods, and all sites were sampled for twenty-one trap nights (7 traps x 3 consecutive nights) per period. Weeks of site visitation were randomly selected within each sampling period.

As in past years, one three-hundred foot transect was established at each sampling location. Sherman live traps (H. B. Sherman Traps, Inc., Tallahassee, Fla.) baited with peanut butter and oats were placed along these transects at fifty foot intervals. We euthanized all small mammals caught in the traps, removed any ticks found with forceps, and stored the ticks in alcohol for later identification.

## Results

### 1993 Study:

We found at least one *I. scapularis* at 37 of 100 sampling sites, with 36 positive sites found north of the Mississippi River in Washington (18 sites positive/25 sites sampled), Anoka (17 sites positive/28 sites sampled), and Ramsey (1 site positive/3 sites sampled) counties. One positive site was detected south of the river in Dakota county as well.

We detected *I. scapularis* through small mammal sampling for the first time in 6 sampling sites (*I. scapularis* had been detected at one site previously through drag sampling), but *I. scapularis* had been found in other sample sites within each of these townships during past studies. These sites are located within one of the following townships: Cottage Grove or Woodbury in Washington County, and Andover, Burns, or Ham Lake townships in Anoka County.

Overall, 1543 mammals (Figure 1) were inspected: 880 from north of the Mississippi River and 663 from south of the river, and a total of 409 *I. scapularis* (Figure 2) were collected from them. Washington County alone accounted for 78% (301/388) of the *I. scapularis* larvae and 95% (20/21) of the nymphs collected. Further, *I. scapularis* collections were greatest in May township (172 larvae; 11 nymphs) where all five sites were positive. In comparison, we collected 21% (83/388) of the *I. scapularis* larvae and 5% (1/21) of the nymphs in Anoka County. All five sites sampled in Linwood township were positive for *I. scapularis* (54 larvae; 1 nymph collected).

The overall season mean number of *I. scapularis* collected/mammal in 1993 was .264 (larvae: .251, nymphs: .014). The mean increases to .575 (larvae: .541, nymphs: .034) when all sites that were negative for *I. scapularis* are excluded. The highest average number of *I. scapularis*/mammal was calculated for Washington County, which had a season mean of .792, compared with Anoka County's season mean of .234 overall (see 1993 results in Figure 3). The number of larval and nymphal *I. scapularis* collected/week peaked during early June, coinciding with past results.

Quality assurance measures were again conducted on random small mammal and tick samples. We rechecked 137 mammals (8.9% of the total) for any ticks missed on the first inspection and found only one additional *Dermacentor variabilis*. All 208 (11.7% of the total) of the ticks had been identified correctly.

*Compiled 1990-1993 Results:*

The 1990-1993 season mean number of *I. scapularis* collected/mammal was .197, with the highest averages occurring north of the Mississippi River. Yearly season means for Washington County have consistently been the highest, followed by Anoka County. Averages for Ramsey County have been consistently low, yet greater overall than those occurring south of the river (Figure 3). When compiling the four year averages by township, we found six townships (all in Washington or Anoka counties) with the highest averages overall. The averages for New Scandia, Hugo, and May townships in Washington County were found to be >1.0 *I. scapularis*/mammal, while the averages for East Bethel, Linwood (both Anoka County), and Grant (Washington County) townships were > .500 *I. scapularis* /mammal (Figure 4).

*I. scapularis* status at the 100 repeat sampling locations is shown on Figure 5.

*I. scapularis* status has changed at 34 (up from 26 in 1992) of the sites since 1990 or 1991. In particular, we determined that:

- I. scapularis* was found all years (+) at 19 sites
- I. scapularis* was found most years at 15 sites
- I. scapularis* was found least (but + at least 1 year) at 19 sites
- I. scapularis* was not found any year (-) at 47 sites

### Discussion

Our results seem to indicate that while *I. scapularis* population levels remain low or nonexistent south of the Mississippi River, their populations are relatively established within northeastern Anoka and northern Washington counties. The majority of *I. scapularis* have continued to be collected north of the Mississippi River in Washington, Anoka, and Ramsey counties, with the highest 1990-1993 averages of *I. scapularis* collected/mammal occurring within New Scandia, Hugo, May, and Grant townships of Washington County, and East Bethel and Linwood townships of Anoka County.

While our study was not designed to specifically answer the question of tick establishment, we feel that the consistency of our results over the last four years indicates that *I. scapularis* numbers and therefore Lyme disease risk are highest in the northeastern metropolitan area.

We realize that our *I. scapularis* density estimates assume that mammal densities are equal across all sites, which may not be the case, as unequal mammal densities could result in inaccurate relative tick density estimates. This possibility will be explored before we use the data for risk assessment purposes. However, given our multi-year experience sampling in these areas, we feel that our relative *I. scapularis* density estimates are accurate enough for a general risk assessment.

Although our 1993 sampling efforts resulted in the detection of *I. scapularis* for the first time in 5 new sampling locations, it is presently unknown whether *I. scapularis* is expanding its range, or if we have simply been able to detect low population levels for the first time. These sites are all located within townships where presence of *I. scapularis* has been obtained during past studies, and are found in a band of townships where *I. scapularis* presence/absence status continues to fluctuate at many sites.

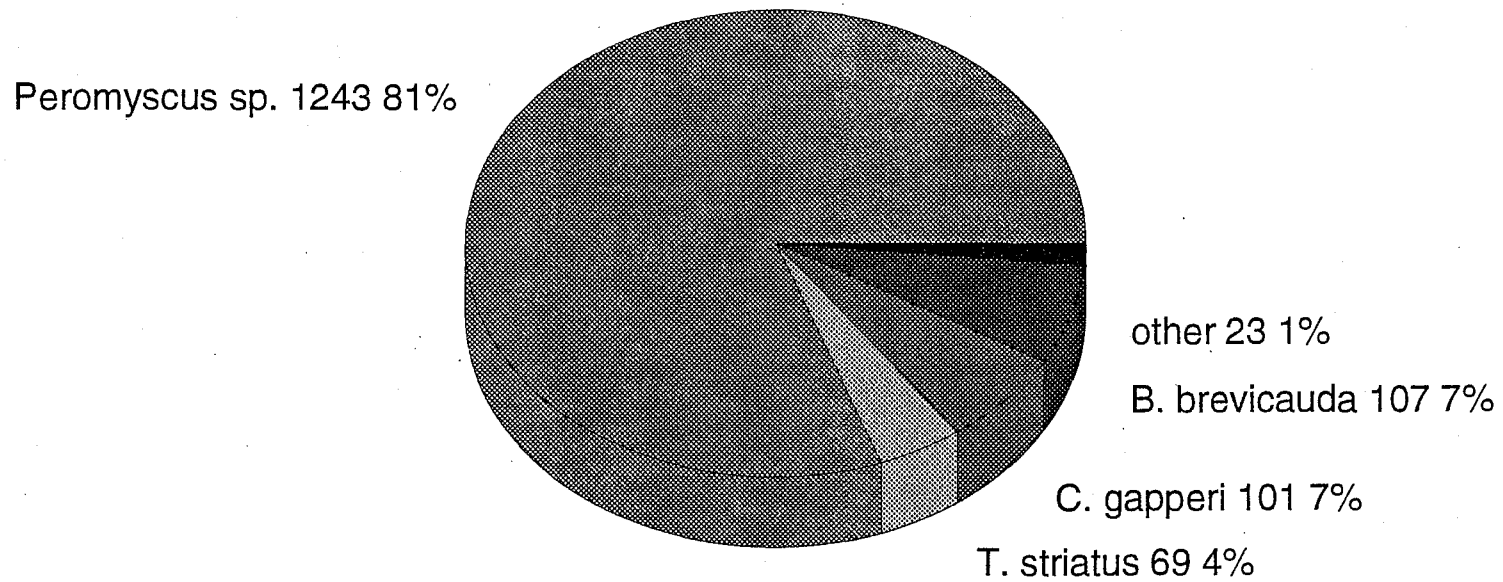
This band of intermittent distribution stretches from northwestern Anoka County through southeastern Washington and northern Dakota counties. Further research is needed to determine why this intermittent distribution pattern exists. Possible range expansion or

localized die back of *I. scapularis* may in fact be the explanation. Other factors, such as insensitivity in our sampling methods, vegetative differences between sampling locations, or increased human habitation within this band compared to areas of tick establishment may be important as well. Therefore, we plan to document and analyze vegetative differences between sampling locations in 1994 to further our understanding of important variables in tick distribution.

Continuing studies for 1994 include our multi-year distribution study (unchanged from 1993), and our cooperative studies with the University of Minnesota regarding the distribution and prevalence of *B. burgdorferi* in the metropolitan area.

Figure 1

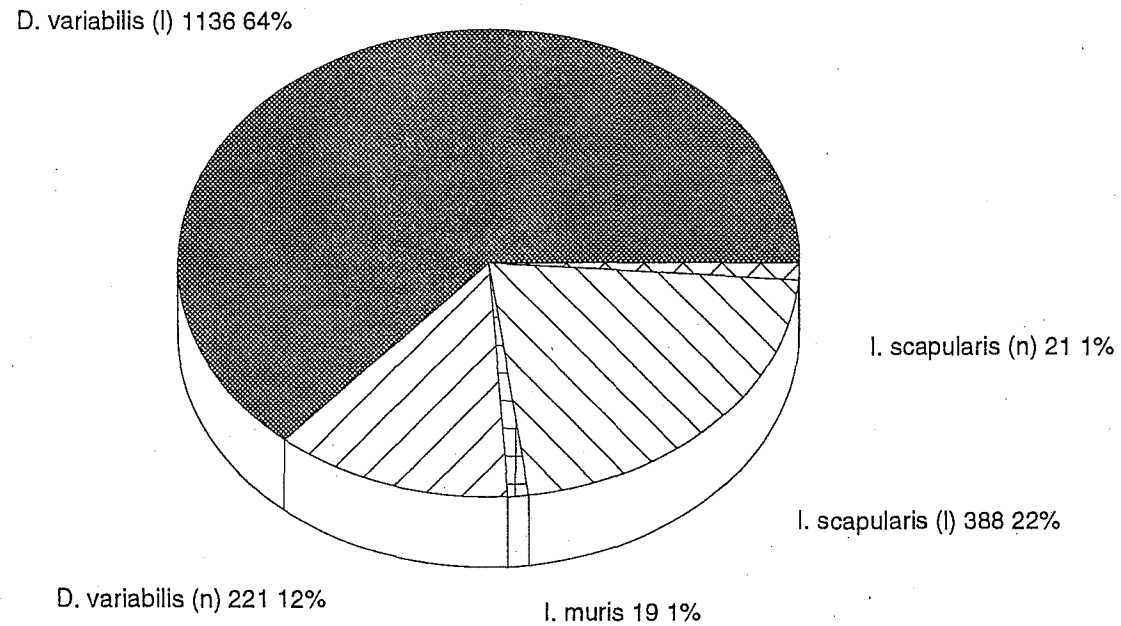
# Small Mammals Collected 1993



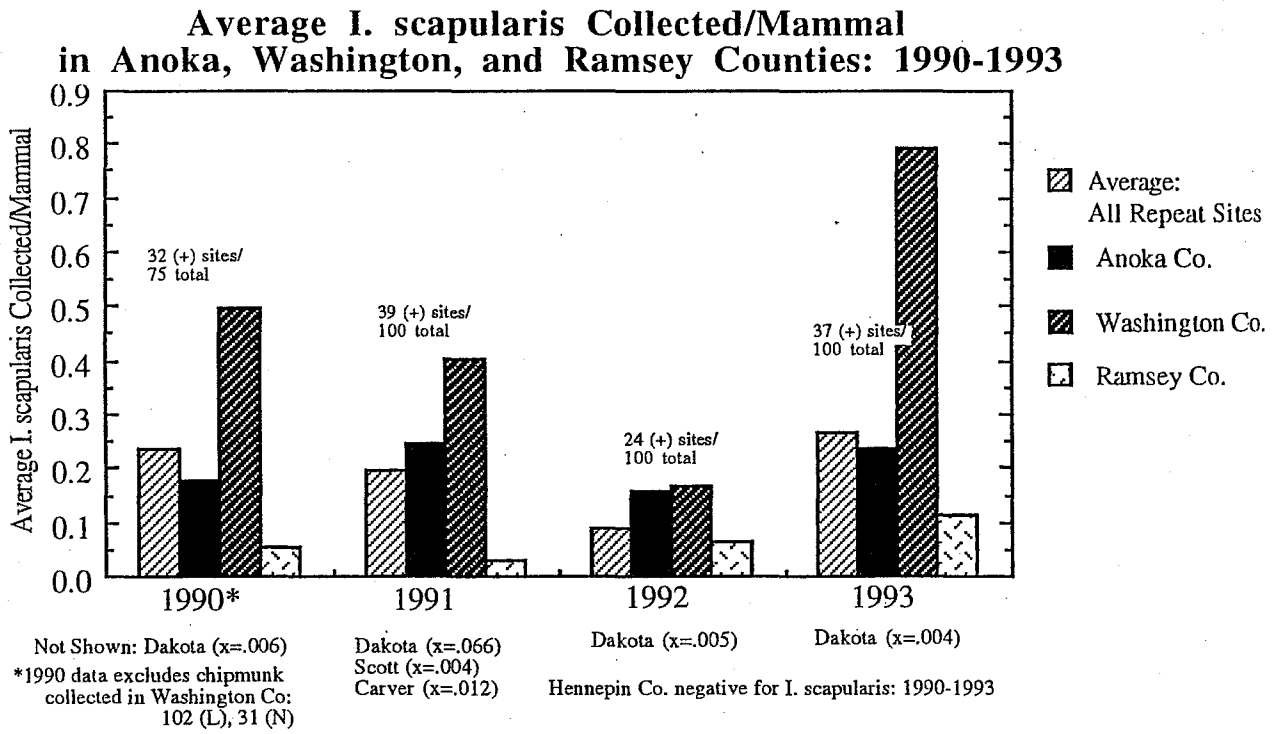
n=1543 mammals

Figure 2

# Total Ticks Collected From Small Mammals By Tick Species and Stage: 1993

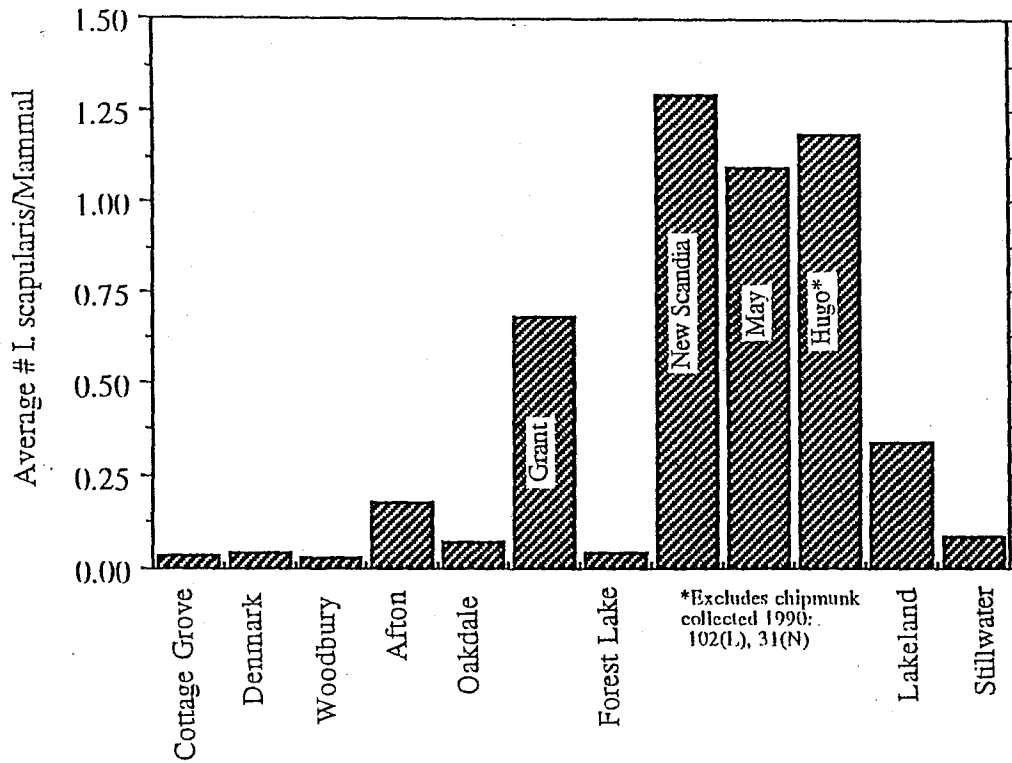


n=1785 Ticks

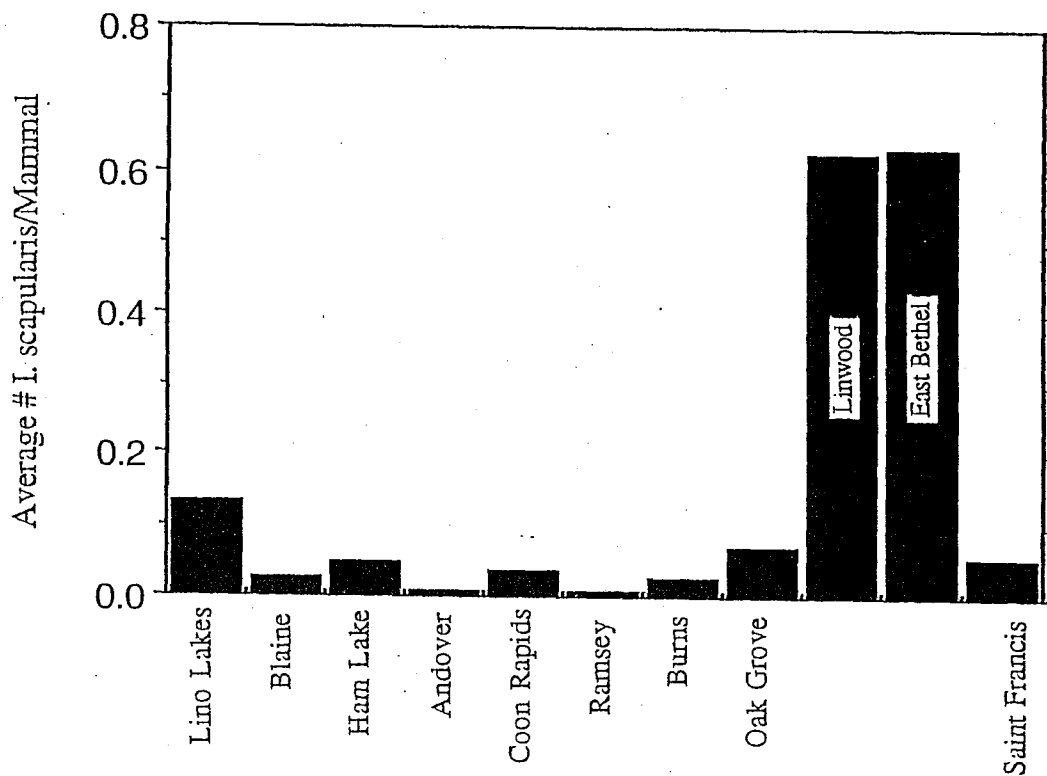




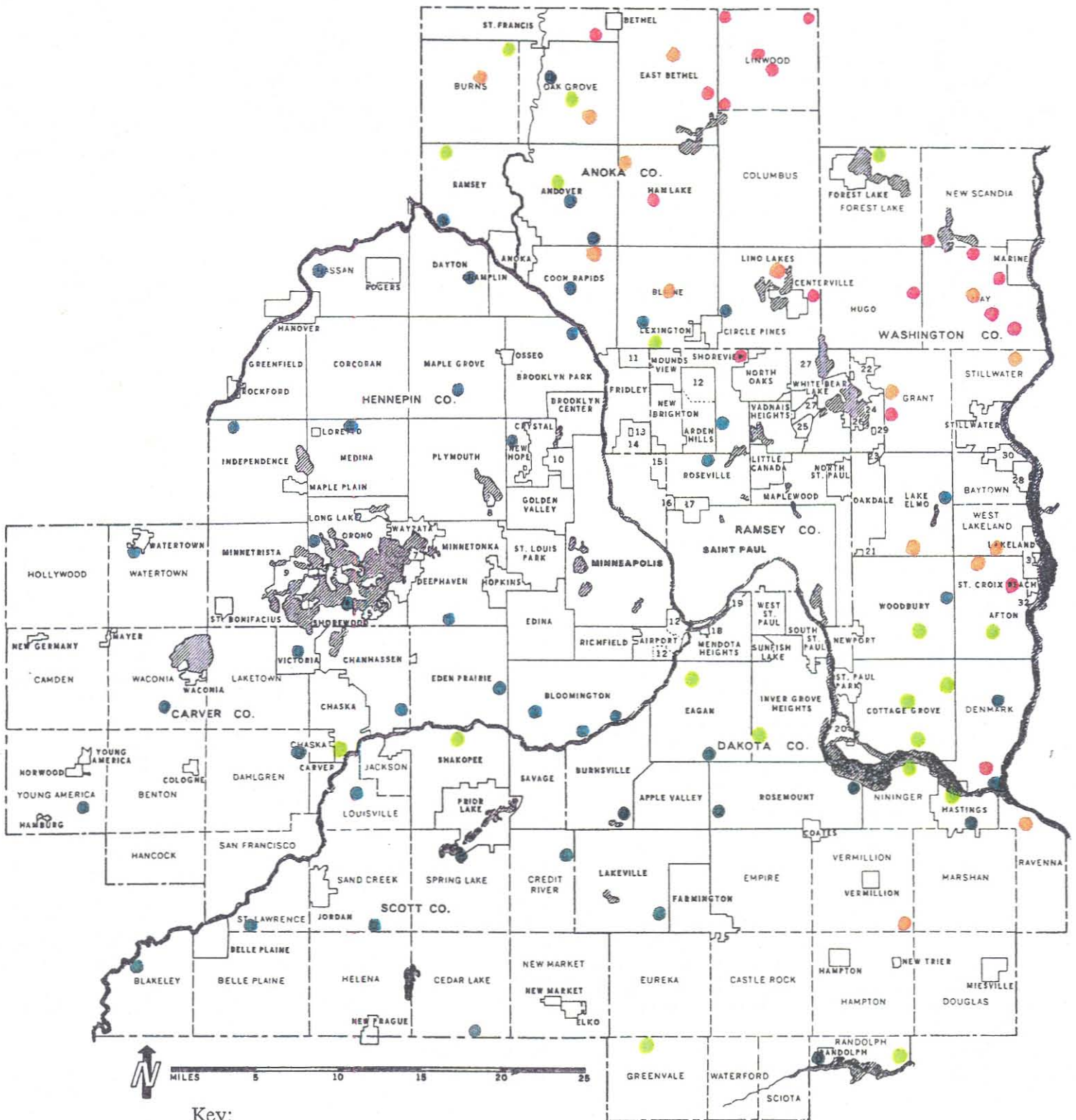
Average # *I. scapularis* Collected/Mammal  
in Washington County (by Twp): 1990-1993



Average # *I. scapularis* Collected/Mammal  
in Anoka County (by Twp): 1990-1993



# REPEAT SAMPLING LOCATIONS: 1990-1993



Key:

- *I. scapularis* was found all years (+)
- *I. scapularis* was found most years
- *I. scapularis* was found least (but + at least 1 year)
- *I. scapularis* was not found (-)

(Note: 1993 results were used to categorize between "most years" and "least" as needed.)

## DEER TICK DISTRIBUTION STUDY ROADKILLED MAMMAL SAMPLING & TICKS TURNED IN BY STAFF 1993

### Abstract:

As a part of our Deer Tick Distribution Study, roadkilled mammals were examined for *Ixodes scapularis*. In addition, MMCD employees were requested to turn in any ticks found on themselves while conducting field operations. Of only five ticks (4 species) collected from 47 mammals, we found one probable *I. scapularis* from an Anoka county red fox. Field staff turned in 48 *I. scapularis* during the year. Most of the ticks came from known infested areas (Anoka, Washington, northern Ramsey, and northern Dakota counties). Employee deer tick exposure rates varied from 0-1.06 ticks/employee/season.

### Introduction:

In 1990 the Metropolitan Mosquito Control District initiated a study to determine the distribution of deer ticks (*I. scapularis*) within the seven county metropolitan area. The majority of the sampling effort has been directed towards collecting the ticks from their small mammal hosts at several hundred area woodlots.

As a supplement to this work, we decided to collect ticks from medium to large sized roadkilled mammals. These mammals have larger home ranges than most small mammals, thus increasing their opportunities to come into contact with deer ticks. Roadkill sampling has been used successfully in New York to collect deer ticks (MDNR Jay McAninch pers. commun.).

In an attempt to understand the exposure potential to deer ticks that MMCD staff experience, field staff were requested to turn in any ticks that they found on themselves. The MMCD has 100-200 people in the field during most of the tick season.

### Materials and Methods:

Roadkilled mammals were collected during the process of traveling to conduct other job functions. When a roadkilled mammal was found, it was checked to make sure it was relatively fresh and then promptly inspected for ticks.

MMCD employees collected any ticks found on themselves during field operations. They were instructed to turn in all ticks unless they knew the ticks were wood ticks (*Dermacentor variabilis*). Wood ticks are often so abundant, that to request the staff to turn them all in would not be feasible.

### Results:

A total of 47 mammals representing 10 species were inspected for ticks in 1993 (Table 1). Of the five ticks collected, only one was an *I. scapularis* (probable I.D.: mouthparts and one first coxa were missing, however scutum shape and the remaining first coxa were consistent with *I. scapularis*). The tick came from a red fox in Anoka county (St. Francis twp., sec. 34).

MMCD employees turned in a total of 48 *I. scapularis* in 1993. Most of the ticks were collected in the same counties where they were found in the small mammal studies (Anoka, Washington, northern Ramsey, and northern Dakota)(Table 2). These areas also had the highest employee tick exposure rates (Fig. 1).

### **Discussion:**

As in past years, we had a difficult time collecting *I. scapularis* from roadkilled mammals. Forty-one (87%) of the mammals inspected came from townships where deer ticks have been found on small mammals, yet only one deer tick was collected. From 1990-1993 we were able to collect 63 deer ticks from 16/89 roadkilled deer, however we found only one deer tick on 237 other mammals (of 20 species) inspected for ticks. In addition, while sampling roadkilled mammals is relatively inexpensive, the irregular timing and placement of the roadkills makes thorough sampling difficult. We believe any future roadkill sampling efforts should be focused on white-tailed deer.

We were pleased that our employees are finding *I. scapularis* in the same general areas we have seen in our other studies. However, we are probably under-reporting tick exposure rates in many instances. Not all employees turned in the ticks found on themselves. For example, in May we were informed that one of our Anoka county employees had found 15 deer ticks on himself at a site in Ham Lake township, but did not save any specimens. While the employee's description of the ticks sounded like deer ticks, we could not add them to our data. Incomplete record keeping by employees was another problem during the study. The *I. scapularis* found in southern Hennepin county had no specific collection point information, which limits the usefulness of the record.

Our current study is mainly a measure of Spring adult *I. scapularis* exposure. Only one of the ticks collected from employees in 1993 was a nymphal *I. scapularis* (0 nymphs collected in 1992). It is likely that many nymphs are left undetected on our staff. In future years we will make our employees better aware of when the nymphs are active, so that we increase the exposure rate accuracy and better protect our employees from Lyme disease.

Table 1.

**Roadkilled Mammals And Associated Ticks 1993**

Species	# Sampled	# Positive For Ticks	# Ticks Found And Species
Gray Squirrel	17	0	
Raccoon	15	1	1 <i>D. variabilis</i>
Red Squirrel	5	0	
Fox Squirrel	3	0	
White-tailed Deer	2	0	
Red Fox	1	1	1 <i>I. scapularis</i>
Badger	1	1	2 <i>I. cookei</i>
Cottontail Rabbit	1	1	1 <i>H. leporispalustris</i>
Opossum	1	0	
Thirteen-lined Ground Squirrel	1	0	

*Ixodes scapularis* Turned in by Field Staff 1993

TOTAL # TICKS: 48

Washington County: Lake Elmo: 11  
(19 Total) New Scandia: 3  
Forest Lake: 2  
Afton: 1  
Stillwater: 1  
N. Washington Co: 1

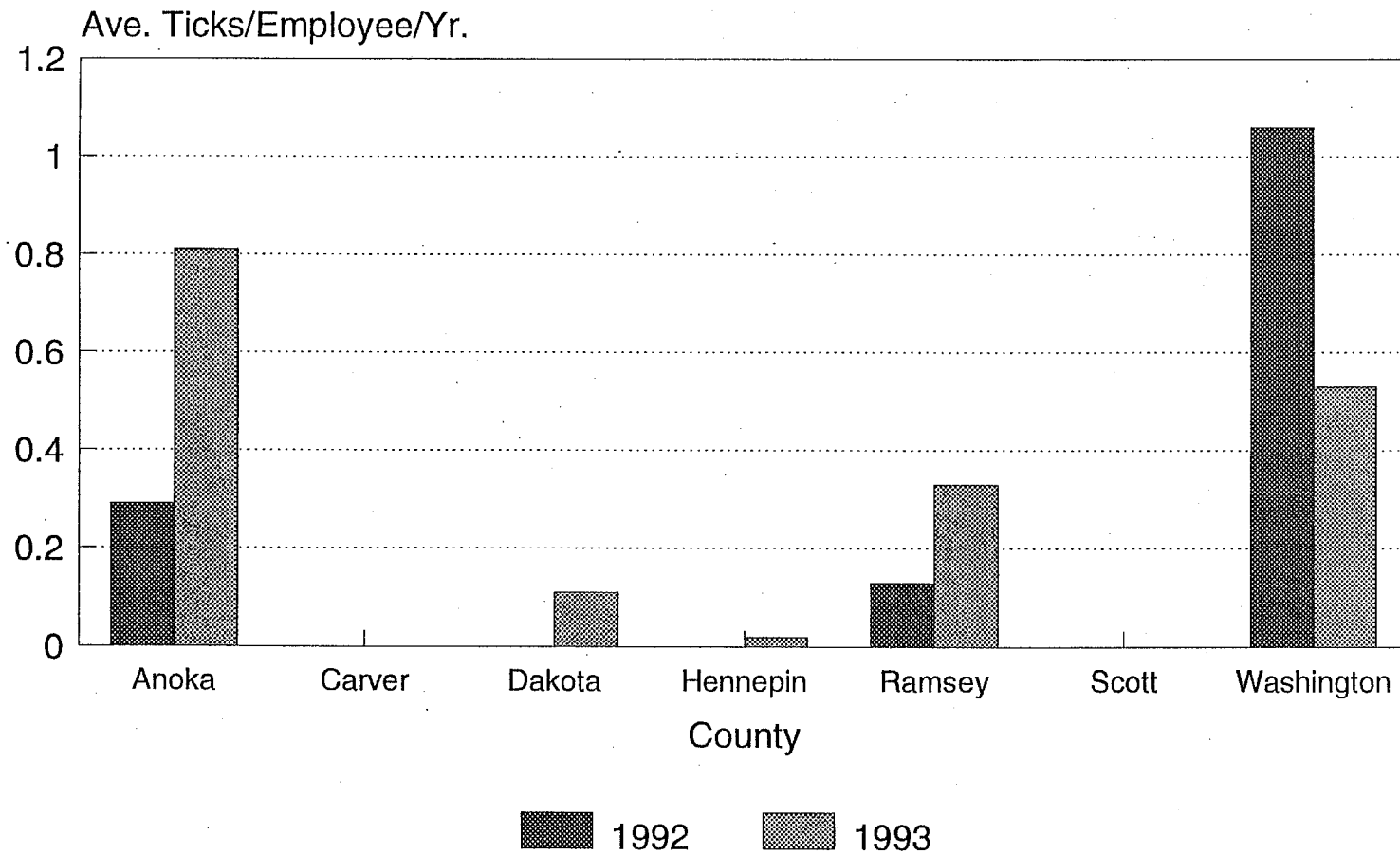
Anoka County: Ham Lake: 11  
(21 Total) Burns: 3  
E. St. Francis: 5  
Coon Rapids: 1  
Linwood: 1

Ramsey County: North Oaks: 3  
(5 Total) Shoreview: 2

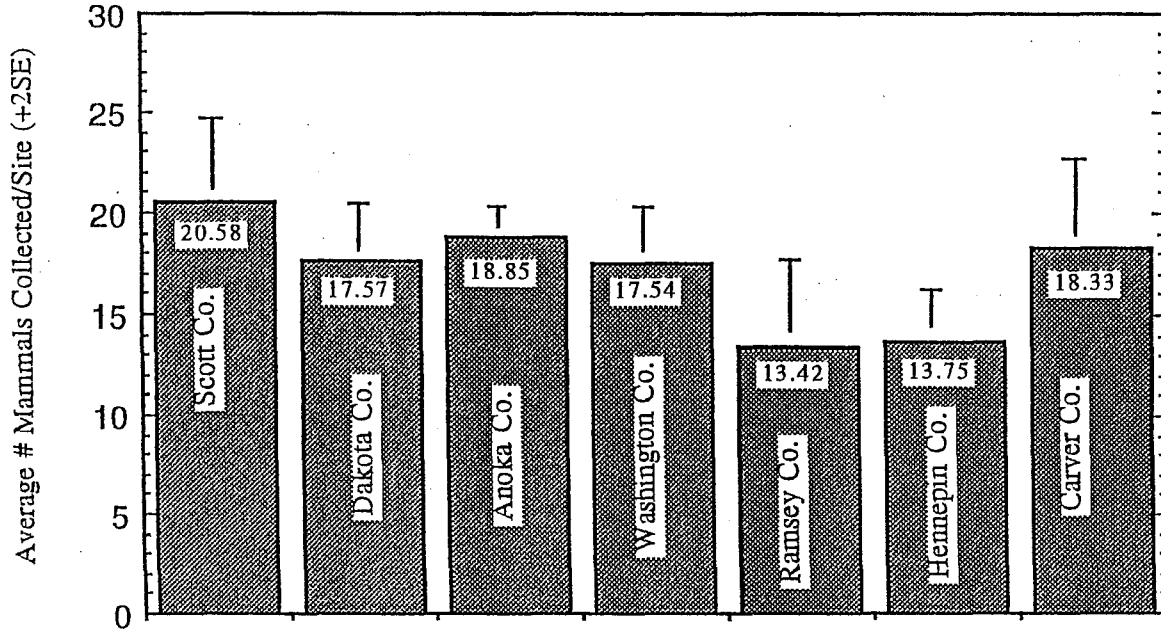
Dakota County: Rosemount: 1  
(2 Total) Hastings: 1

Hennepin County: S. Hennepin Co: 1  
(1 Total)

# MMCD Employee Deer Tick Exposure 1992-1993



Average Number of Mammals Collected/Site  
from 100 Repeat Sampling Locations: 1990-1993



\*No data from 1990 for Carver Co.



## 1994 LYME PROGRAM OUTLINE OF PROPOSED STUDIES

### Introduction:

In 1990 the Metropolitan Mosquito Control District initiated a Lyme Disease Tick Surveillance Program. In 1990-1991, we conducted a study to determine the current distribution of *Ixodes scapularis* within the seven county metropolitan area. *I. scapularis* were found primarily in the northeastern counties of the area (Anoka, Washington, and northern Ramsey). We continued the study in 1992-1993 to look for changes in *I. scapularis* distribution. We also initiated cooperative studies with Dr. Russell Johnson (University of Minnesota) to determine the distribution and prevalence of *Borrelia burgdorferi* within the metropolitan area. To date we have found infection rates in small mammals of 0-30% depending on the location.

### Summary of 1994 Program Elements

#### 1. *I. scapularis* Distribution Study

We will sample the 100 repeat sampling locations chosen in 1990 and 1991. This work is part of a multi-year effort to look for changes in *I. scapularis* distribution. In particular, want to determine when *I. scapularis* becomes established in new areas south and west of the Mississippi River. Small mammal populations will be sampled at each site using the same methods as in the previous years of the study. The work will begin in mid-April, and end in mid-October. Each site will be sampled for three one-week periods during the year.

#### 2. *B. burgdorferi* Distribution and Prevalence Study

The cooperative study with Dr. Johnson will be continued in North Oaks (Ramsey County) and several other locations in the northern part of the District. Small mammals will be collected weekly from each site and brought to Dr. Johnson's laboratory to be cultured (heart, spleen, bladder, and blood samples) for the spirochete. We hope to detect any increases in spirochete prevalence and distribution over time.

#### 3. Roadkilled Mammal Study

As in 1990-1993, freshly roadkilled mammals found while conducting other parts of our studies, will be examined for ticks. This effort will focus on roadkilled deer, as we have had greater success finding *I. scapularis* on them.

#### 4. Ticks Submitted By Employees

Employees will again be encouraged to turn in any ticks they find on themselves that cannot be readily identified as wood ticks. We will add any new *I. scapularis* records to our deer tick distribution data base, and to our calculation of deer tick exposure potential by our field staff.