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Metropolitan Mosquito Control District
***Ixodes scapularis* Distribution Study Report**

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Tick Vector Services

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1994 BLACK LEGGED TICK DISTRIBUTION STUDY

Abstract

A black legged 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. At least one *I. scapularis* was collected from 35 of these sites during 1994. A total of 543 *I. scapularis* were removed from 1672 mammals for an overall season mean of .325 *I. scapularis* per mammal. The presence of *I. scapularis* was detected through small mammal sampling for the first time at two sampling locations in 1994 (both in Andover township in Anoka county), but *I. scapularis* was detected again at only three of the six sites found newly positive in 1993. Most of the *I. scapularis* collections continue to occur north of the Mississippi River in Washington, Anoka, and Ramsey counties, and from Washington county in particular. Townships maintaining the highest 1990-1994 *I. scapularis* per mammal averages (all > .600) include New Scandia, May, and Grant townships of Washington county, as well as East Bethel and Linwood townships of Anoka county. *I. scapularis* collections in 1994 resulted in the highest total number collected since 1990, when 660 *I. scapularis* were collected from 250 sampling sites (and 70% of our efforts were concentrated in Washington and Anoka counties). We maintain that our probability of collecting *I. scapularis*, even in areas where their population levels may be low, would have been enhanced in 1994 due to the higher population levels that existed during this past season. Since we have seen no significant change in where our collections are occurring, we conclude that *I. scapularis* is not noticeably expanding its range at this time.

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 collected in the northeastern counties.

Since 1993, our distribution study has focused on the re-sampling of 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 the counties of Dakota (15 sites), Hennepin (14 sites), Scott (8 sites), and Carver (7 sites).

Sampling was initiated on April 25, 1994 and ended on October 28, 1994. As in past years, 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.

One three-hundred foot transect was established at each sampling location, and 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. All mammals were re-inspected by a separate staff member, and any additional ticks found were placed into the appropriate vial.

Results

1994 Study:

We found at least one *I. scapularis* at 35 of 100 sampling sites, with 33 positive sites found north of the Mississippi River in Washington (14 sites positive/25 sites sampled), Anoka (18 sites positive/28 sites sampled), and Ramsey (1 site positive/3 sites sampled) counties. Two positive sites were detected south of the river in Dakota county as well.

Overall, 1672 mammals (Figure 1) were inspected: 872 from north of the Mississippi River and 800 from south of the river, and a total of 543 *I. scapularis* (Figure 2) were collected from them. The data accumulated from the Washington county sampling locations accounted for 61% (329/543) of the overall season total (307 larvae; 22 nymphs). *I. scapularis* collections were greatest in Hugo (109 larvae; 9 nymphs) and May (92 larvae; 8 nymphs) townships. Anoka county collections accounted for an additional 35% (190/543) of the total (149 larvae; 41 nymphs), with the majority of the collections obtained from the townships of Linwood (59 larvae; 10 nymphs) and East Bethel (47 larvae; 27 nymphs (23 removed from one *Tamias striatus*: 4 from one other)).

The overall season mean number of *I. scapularis* collected per mammal in 1994 was .325 (larvae: .285, nymphs: .040). The mean increases to .954 (larvae: .836, nymphs: .118) when all sites that were negative for *I. scapularis* are excluded. As in past years, the highest average number of *I. scapularis* per mammal was calculated for Washington county, which had a season mean of .887, compared with Anoka county's season mean of .409 overall (see 1994 results in Figure 3). The number of larval *I. scapularis* collected per week peaked during June, coinciding with past results, while the nymphal peak occurred during the third week in May (aided by the collection of one *T. striatus* with 23 nymphs!).

The presence of *I. scapularis* was detected through small mammal sampling for the first time in 1994 at two sampling locations, both in Andover township in Anoka county. Interestingly, the remaining Andover site (found to be positive for *I. scapularis* through small mammal sampling for the first time in 1993) was negative this past season. Of the other five sampling sites first found positive in 1993, three were positive for *I. scapularis* again in 1994. These sites are located within Burns and Ham Lake townships in Anoka county, and Woodbury township in Washington county.

Quality assurance measures were conducted on random tick samples. All 178 (11.8% of the total) of the ticks had been identified correctly.

Compiled 1990-1994 Results:

The 1990-1994 season mean number of *I. scapularis* collected per mammal was .222, 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). Compiling the five year averages by township resulted in the same six townships with the highest overall averages as calculated in 1993, but with slight variation in rank. The averages for Hugo, New Scandia, May (Washington county), and East Bethel (Anoka county) townships were found to be >1.0 *I. scapularis* per mammal, while the averages for Linwood (Anoka county) and Grant (Washington county) townships were > .600 *I. scapularis* per mammal (Figure 4).

Collections from 1994 resulted in the highest total number of *I. scapularis* collected since 1990, when 660 were collected from 250 sampling sites (Table 1).

Table 1: Number of *I. scapularis* collected by year, compared with the total number of mammals and sampling sites.

<u>Year:</u>	<u># <i>I. scapularis</i> collected:</u>	<u># of mammals collected:</u>	<u>number of sampling sites:</u>
1990	660	3651	250
1991	515	5566	270
1992	148	2544	200
1993	409	1543	100
1994	543	1672	100

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

I. scapularis status has changed at 38 of the sites since 1990 or 1991. In particular, we determined that:

- I. scapularis* was found all years (+) at 17 sites
- I. scapularis* was found most years at 15 sites
- I. scapularis* was found least (but + at least 1 year) at 23 sites
- I. scapularis* was not found any year (-) at 45 sites

Discussion

Our results seem to indicate that *I. scapularis* populations are established within northeastern Anoka and northern Washington counties, while remaining low or nonexistent south of the Mississippi River. Although our study was not designed to specifically answer the question of tick establishment, we feel that our relative *I. scapularis* density estimates are accurate enough for a general risk assessment. Given the consistency of our results over the last five years, with greater numbers of *I. scapularis* collected in the northeastern metropolitan area each year, we believe that the greatest Lyme disease risk occurs in the northeastern metropolitan area at this time.

Additionally, we do not plan on intensifying our sampling effort in 1995, as we feel that we have not detected significant range expansion of *I. scapularis*. The majority of *I. scapularis* have continued to be collected north of the Mississippi River in Washington, Anoka, and Ramsey counties, despite what appears to have been our best *I. scapularis* collection season to date. The overall season mean of .325 *I. scapularis* per mammal is

the largest computed to date. Additionally, *I. scapularis* collections in 1994 resulted in the highest total number collected since 1990, when 70% of our sampling effort was concentrated in Washington (85 sites) and Anoka (90 sites) counties, which weakens the argument that site selection alone could have reduced, or interfered with, the total number of *I. scapularis* collected. While we do realize that study design in 1992 (emphasis on locations south and west of the Mississippi River) could have impacted the total numbers of *I. scapularis* collected, we do not believe that is the case. The majority of the 148 *I. scapularis* collected in 1992 were obtained from our current Washington, Anoka, and Ramsey county sampling locations. We believe that these low numbers (148) represent the low population levels of *I. scapularis* that existed overall during 1992. Congruently, we believe that the higher total numbers of *I. scapularis* collected during 1994 (543) are representative of an above average collection season. We maintain that our probability of collecting *I. scapularis*, even in areas where their population levels may be low, would have been enhanced in 1994 due to the higher population levels that existed this past season. Since we have seen no significant change in where our collections are occurring, we conclude that *I. scapularis* is not noticeably expanding its range at this time.

Continuing studies for 1995 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. We may undertake some additional study (drawing blood samples to be analyzed elsewhere) on hantaviruses in the metropolitan area.

Figure 1

**Small Mammals Collected 1994:
1672 total**

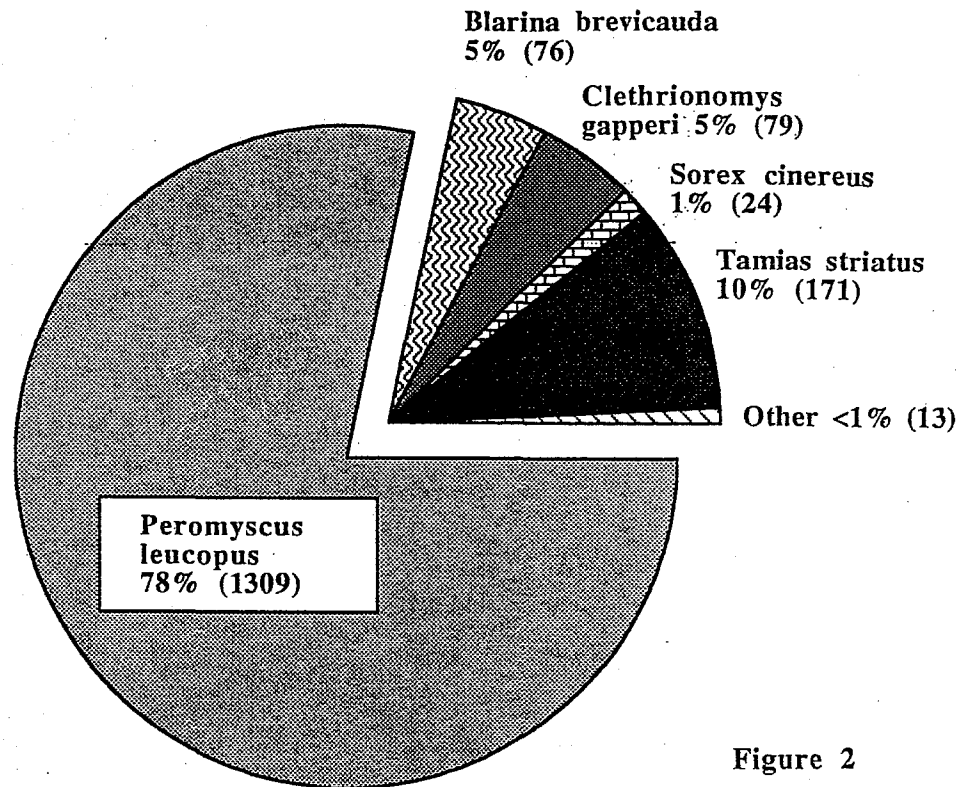


Figure 2

**Ticks Collected from Small Mammals
by Ticks Species and Stage 1994:
1514 total**

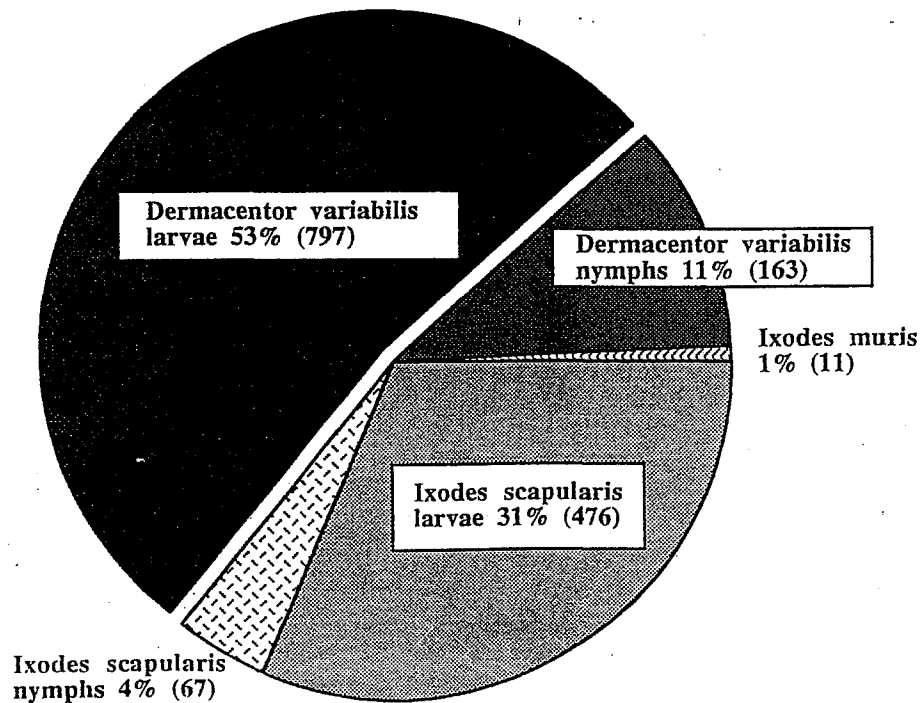


Figure 3

Average *I. scapularis* Collected/ Mammal
 in Anoka, Washington, and Ramsey Counties: 1990-1994

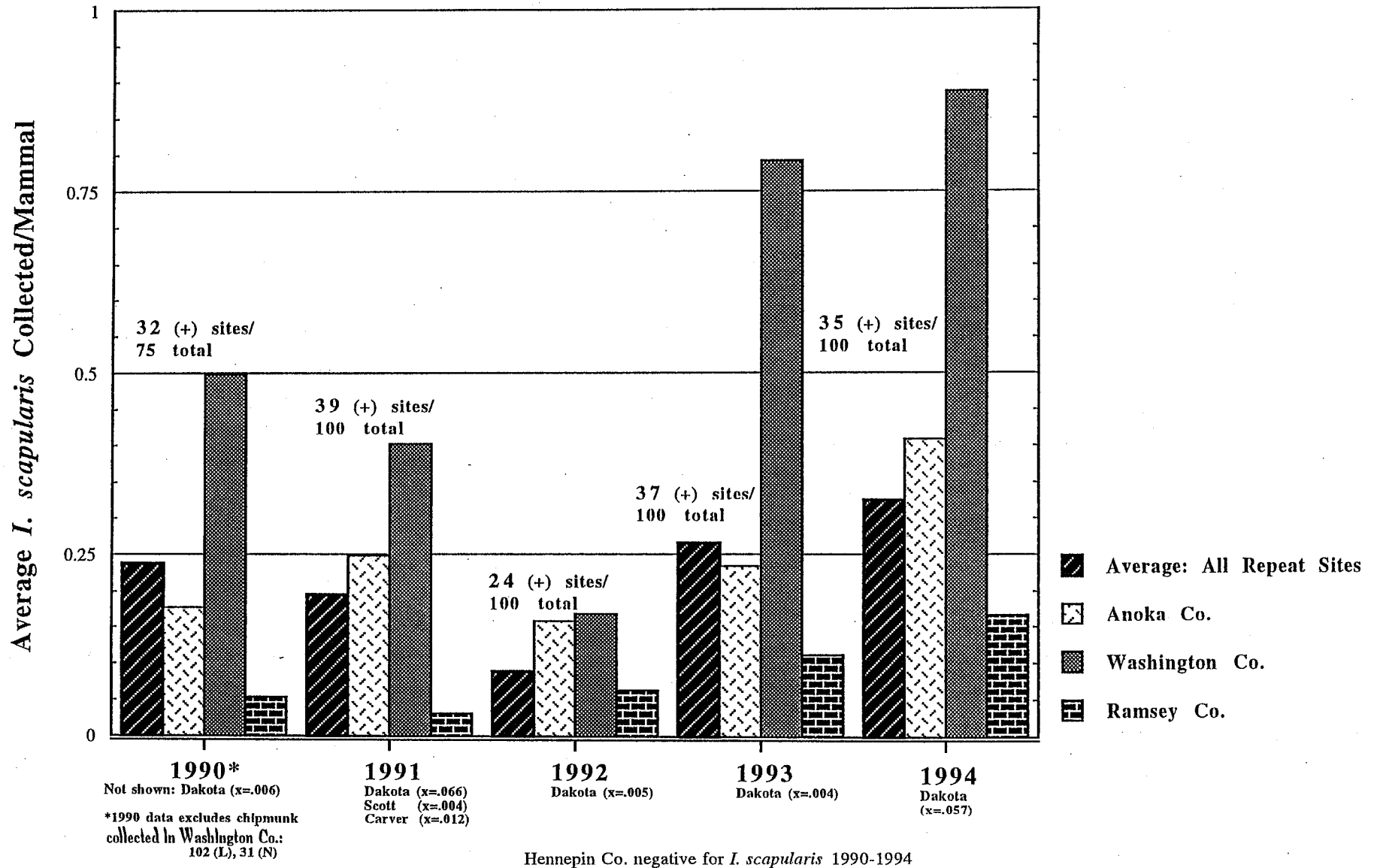
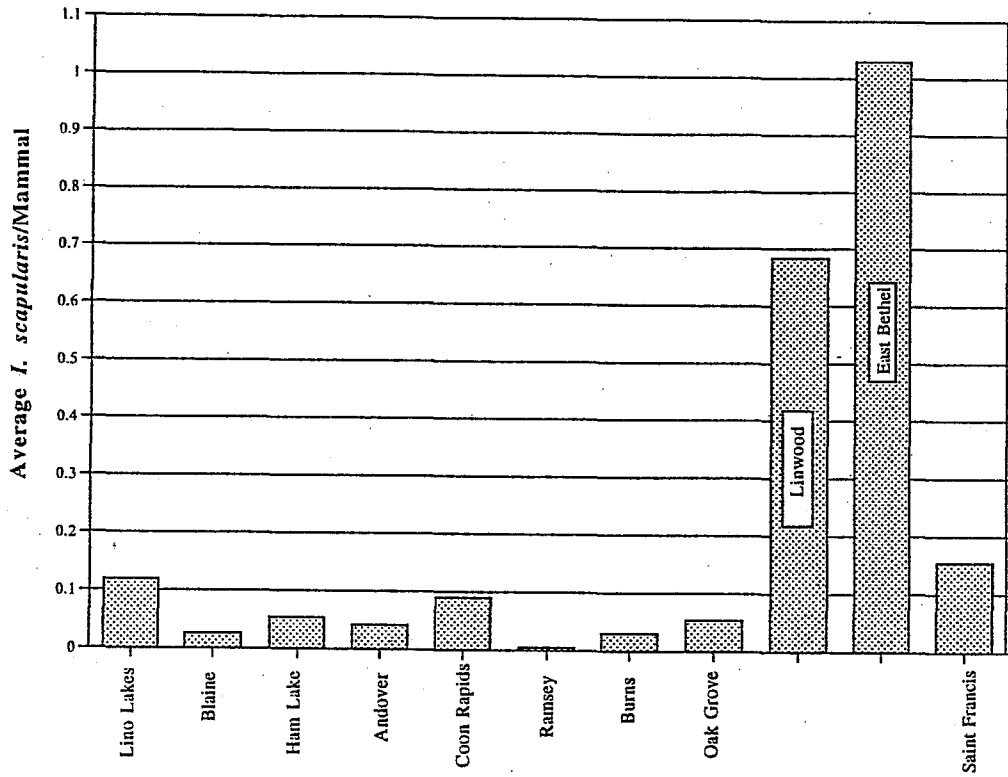
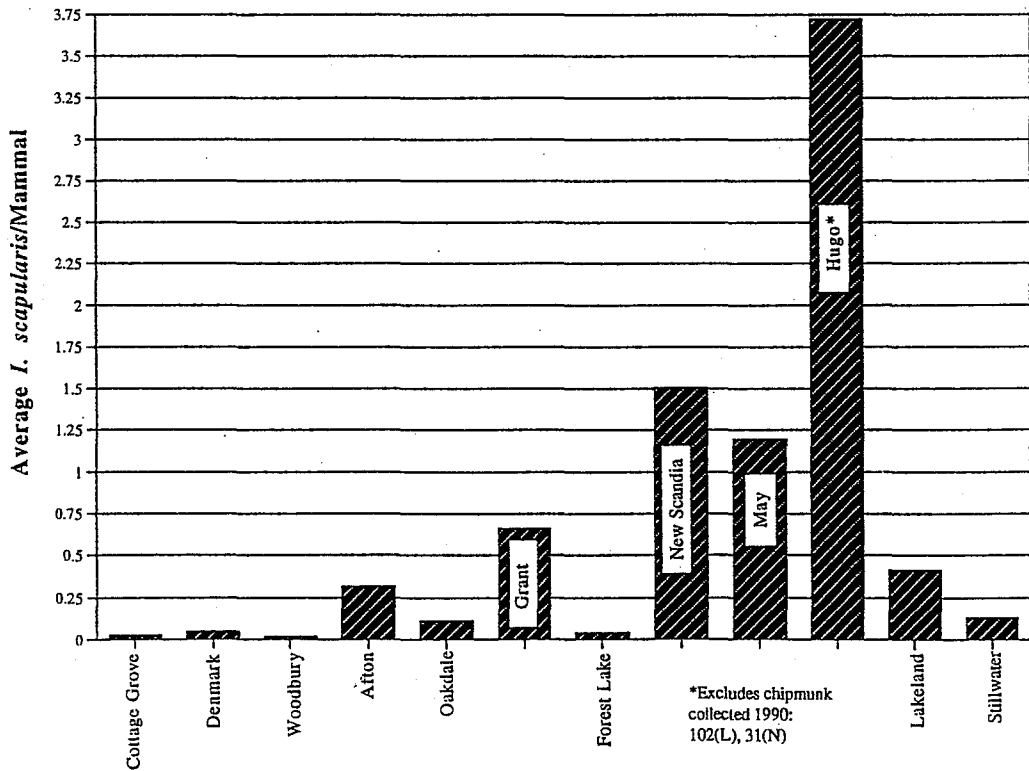


Figure 4

Average # *I. scapularis* Collected/Mammal
in Anoka County (by Twp): 1990-1994

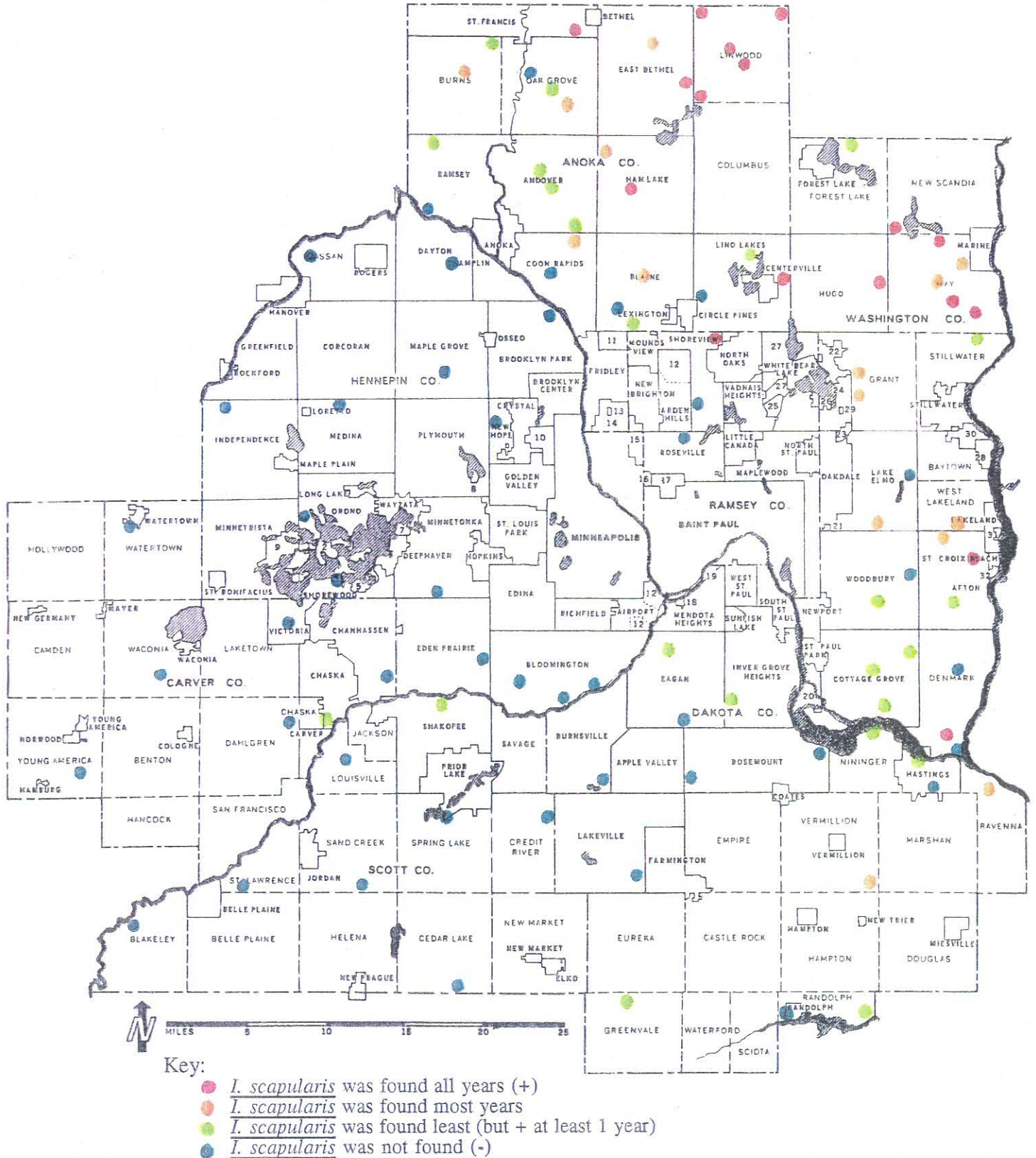


Average # *I. scapularis* Collected/Mammal
in Washington County (by Twp): 1990-1994



REPEAT SAMPLING LOCATIONS: 1990-1994

Figure 5



METROPOLITAN MOSQUITO CONTROL DISTRICT: ADDITIONAL UPDATES

1994 VEGETATION SURVEY:

The 1993 report had stated that a "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."

For this reason, a survey of each of the 100 sampling locations was conducted during July and August of 1994. At each site, a subjective observation and subsequent determination was made as to the area type (residential versus rural), woodlot size (large, medium, small), and the dominant vegetation occurring in the canopy, shrub, and herb layers. An estimate of the percentage of shade (25%, 50%, 75%, 100%) provided by each of the three layers was also recorded. (Two photographs, one outside the woods and one inside, were taken as well, to provide a pictorial history for the future.) The results of this vegetative survey were indeterminate.

We are aware that many factors, including the subjectiveness of the survey itself, the classifications we used (or that we did not consider for documentation), and the basic assumption that each site would have equal chances for tick establishment, could have impacted our conclusion. A more technical analysis such as could be performed using geographical information system (GIS) databases may prove more useful. The MMCD is currently in the process of obtaining such a system, but it will probably not be fully functional for several years.

EMPLOYEE SURVEY UPDATE:

Miscellaneous Ticks Turned in by MMCD Field Staff: 1994 24 total

County:	Township: (# of ticks)	Species identification:
Washington (16 total)	Lake Elmo (16)	<i>Ixodes scapularis</i>
Ramsey (3 total)	Arden Hills (1)	<i>Ixodes scapularis</i>
	North Oaks (1)	<i>Ixodes scapularis</i>
	unknown (1)	<i>Ixodes scapularis</i>
Anoka (3 total)	Ramsey (2)	<i>Ixodes scapularis</i>
	Coon Rapids (1)	<i>Dermacentor variabilis</i>
Dakota (1 total)	Hastings or Inver	<i>Ixodes scapularis</i>
	Grove Heights (1)	
Carver (1 total)	unknown (1)	<i>Ixodes cookei</i> (nymph)
Overall	(22)	<i>Ixodes scapularis</i>
	(1)	<i>Dermacentor variabilis</i>
	(1)	<i>Ixodes cookei</i> (nymph)

Minnesota Hantavirus Testing Summary 1994

Here is a summary of the entire "Minnesota" data set tested by Dr. Tom Ksiazek (Chief, Diagnostic and Immunochemistry Section, Centers for Disease Control, Atlanta) in 1994:

MMCD and Dr. Russell Johnson (University of Minnesota)

239 mammals (6 species) were tested from North Oaks (Ramsey county):

- 182 *Peromyscus leucopus*
- 28 *Tamias striatus*
- 25 *Clethrionomys gapperi*
- 2 *Microtus pennsylvanicus*
- 1 *Sorex cinereus*
- 1 *Blarina brevicauda*

*note that no *Peromyscus maniculatus* were sampled

Eleven of those mammals (4.6%) tested positive to the Seoul strain of hantavirus. This is the strain that has been found at many locations around the world, but has not been associated with human illness in the United States. All of the positive mammals were *Peromyscus leucopus* (white-footed mouse), the most commonly collected mammal in our *Ixodes scapularis* studies (6% infection rate with Seoul hantavirus in that species).

No evidence of the Sin Nombre strain of hantavirus was found. This is the strain that has caused fatalities in other parts of the country. We will continue testing small mammals in 1995 to gather further information on hantavirus status within the District (assuming that testing is still available).

Science Museum of Minnesota

Much of the data that were sent to me from the Minnesota Department of Health were samples collected by the Science Museum of Minnesota. Four of the several hundred mammals they submitted for testing were positive for the Sin Nombre strain of hantavirus. However, it appears that all of the mammals were collected outside Minnesota in the Rocky Mountain states. There are site references to "Univ. N.M.", and "GTNP", which I believe to be University of New Mexico and Grand Teton National Park respectively. Most of the mammals tested (including 3/4 positive voles (*Microtus montanus*)) were of species native to the Rocky Mountains, not Minnesota.