Metropolitan Mosquito Control District

Ixodes scapularis Distribution Study Report

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DEER TICK SURVEILLANCE PROGRAM
1991 TICK DISTRIBUTION STUDY

Abstract:

As a continuation of efforts initiated in 1990, a deer tick (Ixodes dammini) distribution study was conducted in the seven county metropolitan area by the Metropolitan Mosquito Control District. Small mammal trapping and drag cloth sampling were used to collect ticks from 270 woodlots chosen for the study (75 of these sites were also sampled in 1990). We found at least one I. dammini at 54 of these sites. A baseline I. dammini distribution map was formulated.

Introduction:

Deer ticks and human cases of Lyme disease have been reported from several counties in Minnesota (mainly north and east of the Twin Cities metropolitan area). However, confirmed human cases have occurred within the seven county metropolitan area as well.

In 1990 the Metropolitan Mosquito Control District initiated a Lyme Disease Tick Surveillance Program. The main goals of the program are to determine the distribution, and prevalence of I. dammini and the Lyme spirochete (Borrelia burgdorferi).

Prior to this study there had been no efforts to determine the deer tick distribution over the entire seven county metropolitan area. Our 1990 and 1991 studies provide baseline deer tick distribution data for the Twin Cities metropolitan area.

Methods and Materials:

Sampling site selection

In 1991, we decided to put more surveillance effort into the counties south and west of the Mississippi river, as these counties were sampled lightly in 1990. We also wanted to concentrate more effort near the river on both sides, as our 1990 data appeared to indicate that this area was near the edge of the deer tick range and has a relatively high human population compared to the fringes of the District.

We divided our sampling effort in the following way:

60% (162 sites) south of the Mississippi river
- 130 (80%) sites in townships closer to the river
- 32 (20%) sites in townships away from the river

40% (108 sites) north of the Mississippi river
- 87 (80%) sites in townships closer to the river
- 21 (20%) sites in townships away from the river

A total of 270 woodlots were chosen for the study. We sampled the following number of sites in each county:

Anoka:	50	Hennepin:	76
Washington:	44	Carver:	18
Ramsey:	14	Scott:	20
		Dakota:	48

The number of sites sampled within each township was an arbitrary number based on the size of the township (bigger townships had more sites). Within each township the sections sampled were chosen at random. Individual sites within sections were chosen nonrandomly by searching for the thickest woodlot (heaviest canopy, shrub and herb coverage) in the section to sample.

Many sites (75) from 1990 were also selected for repeat sampling to look for changes in tick status over several years. Repeat sites were selected from our 1990 site list based on three criteria:

-Representative sites of an area
-Locations not likely to be developed
-Good small mammal numbers

Deer tick collection methods

We used the same sampling methods as our 1990 study for consistency (small mammal trapping and drag sampling). At each sampling location we set up a 300 foot transect through the woods or brush of the site. Sherman live traps baited with peanut butter and oats were placed along these transects at 50 foot intervals. Any rodents caught in the traps were euthanized and searched for ticks. All ticks found were removed with forceps and stored in alcohol for later identification. Drag samples were taken along the same transect lines, or good edge habitat (trails, brushy edges, etc...), using a standard tick drag (1 square yard flannel cloth attached to a pole). The cloth was inspected for ticks after each drag was taken. Any ticks found were removed and stored for later identification.

Sampling was initiated on 4/22/91 and ended on 10/24/91. Approximately 30 sites were sampled each week during this 27 week period. Each site was sampled for three one week periods during the year. Each week consisted of 21 trap nights (7 traps x 3 nights) and three drag samples for each site (note: Drag sampling was not attempted during our second sampling period. It was only conducted when adult *I. dammini* were more likely to be questing).

Results:

During our 1991 study we collected a total of 8505 ticks of which 515 were *I. dammini*. We found at least one *I. dammini* at 54/270 sampling sites. As in 1990, most of the positive sites were in Anoka and Washington counties. Scattered positive sites were found in other District counties (Fig. 1).

Small mammal sampling gave us the vast majority of our tick data. We inspected a total of 5566 mammals (Fig. 2) and removed 8452 ticks (514 *I. dammini*) from them (Fig.3). The most prevalent tick species and stage collected were larval *Dermacentor variabilis* at a season mean of 1.22/mammal. The season mean number of *I. dammini*/mammal was .092 (larvae: .079/mammal, nymphs: .013/mammal). If all sites with 0 *I. dammini* are excluded, the means increase to .328 larval and .054 nymphal *I. dammini*/mammal. As in 1990, very low total numbers of *I. dammini* were collected at most of our sites (Fig. 4). At 16 of 54 positive sites we only collected one *I. dammini* all season.

The number of ticks collected each week showed definite seasonal trends. The average number of *I. dammini* larvae and nymphs collected/week peaked at the same time in mid-June. Lower numbers of larvae and nymphs were collected during the rest of the season (Fig. 5). In 1990, both peaks were also synchronous, but occurred one week earlier in the season.

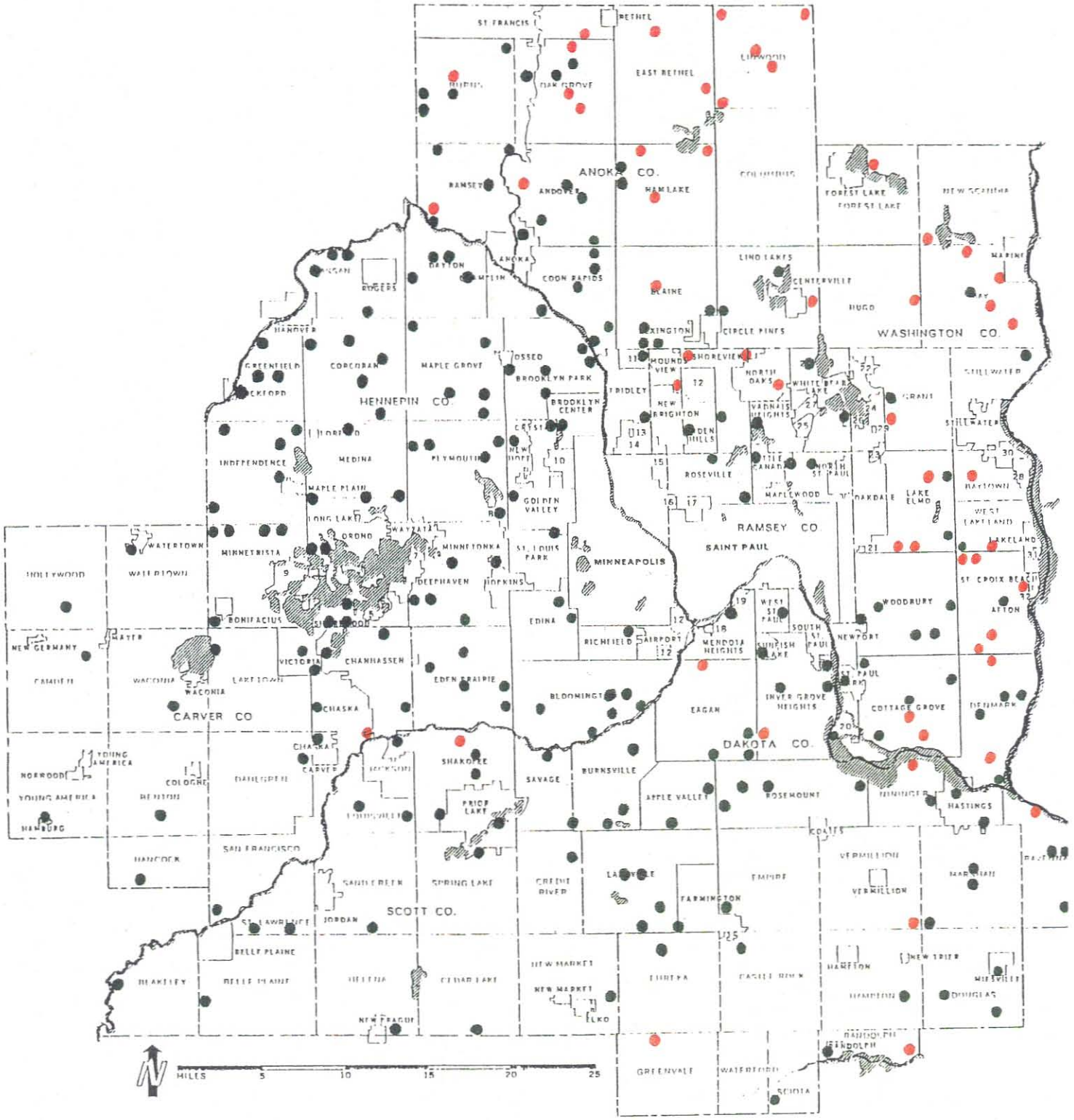
Drag sampling was much less successful at sampling *I. dammini* populations. Of 1620 drag samples, 1020 (63%) samples were negative for all tick species. Another 564 (35%) samples could not be taken because of rain. Of the 36 (2%) samples taken that had ticks, only one had a single *I. dammini*. The remaining ticks were *D. variabilis* (n=50), and *Haemaphysalis leporispalustris* (n=2).

The tick status at our 75 repeat sampling locations is shown on Figure 6. The *I. dammini* presence/absence status changed at 17 (22.6%) of the sites. In particular, we found the following:

# sites	1990 status	1991 status
8	+	-
9	-	+
23	+	+
35	-	-

Figure 1.

1991 Ixodes dammini Presence/Absence Study
Map of Sampling Locations (n=270)

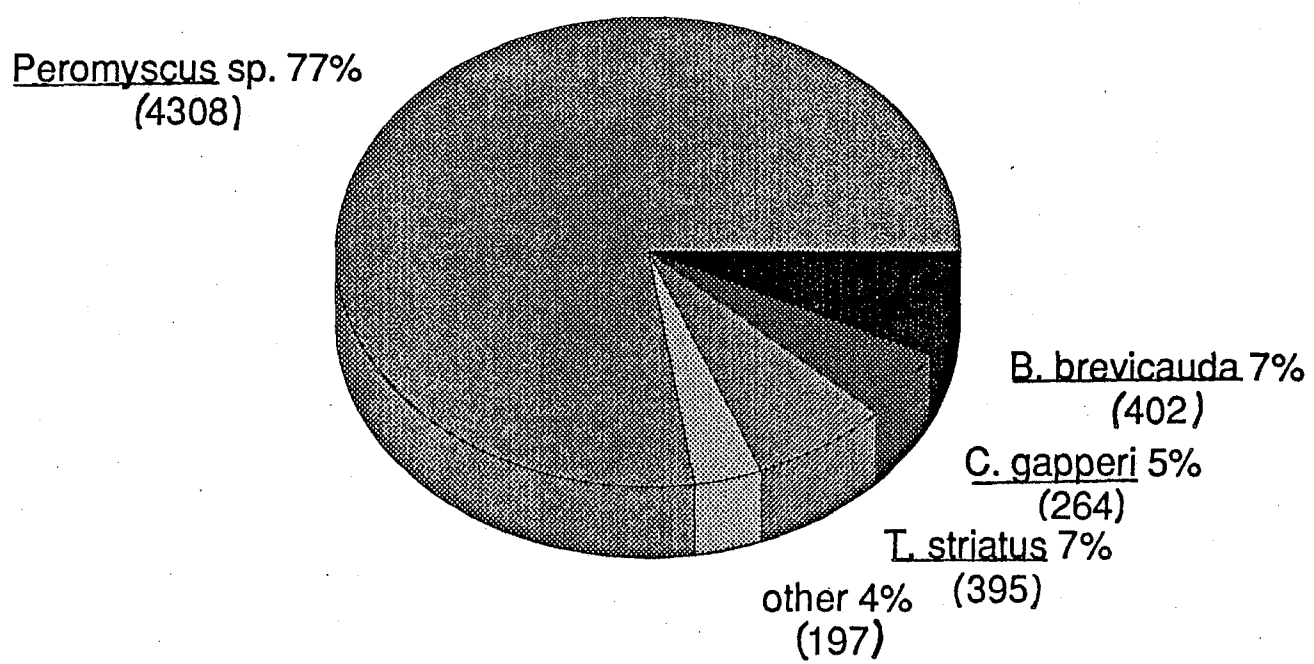


Key:

- Ixodes dammini found at the site
- Ixodes dammini not found at the site

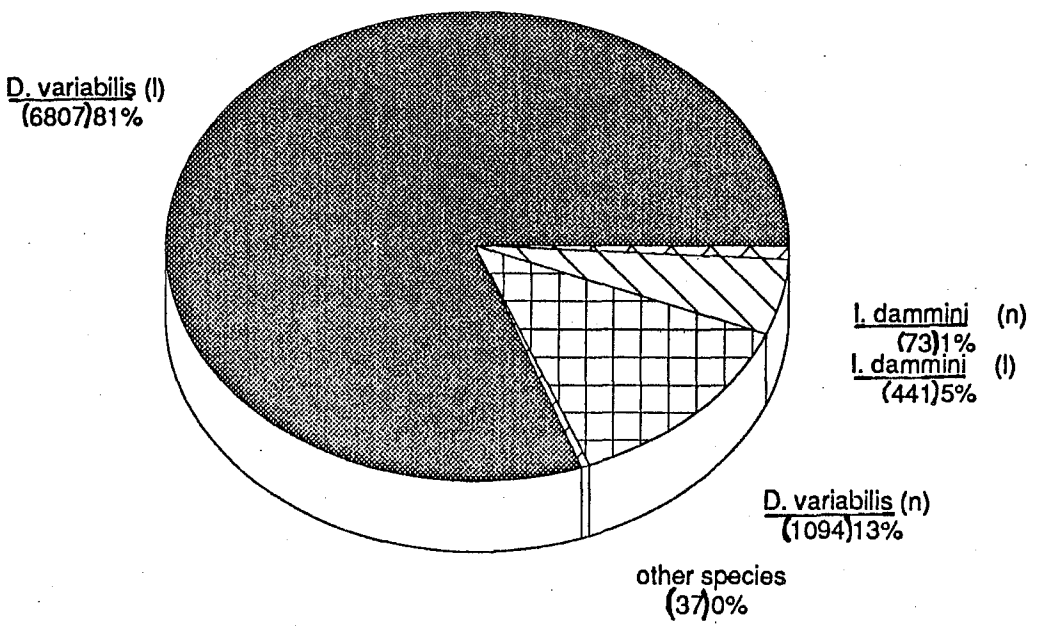
Figure 2.

Small Mammals Collected 1991



n=5566 mammals

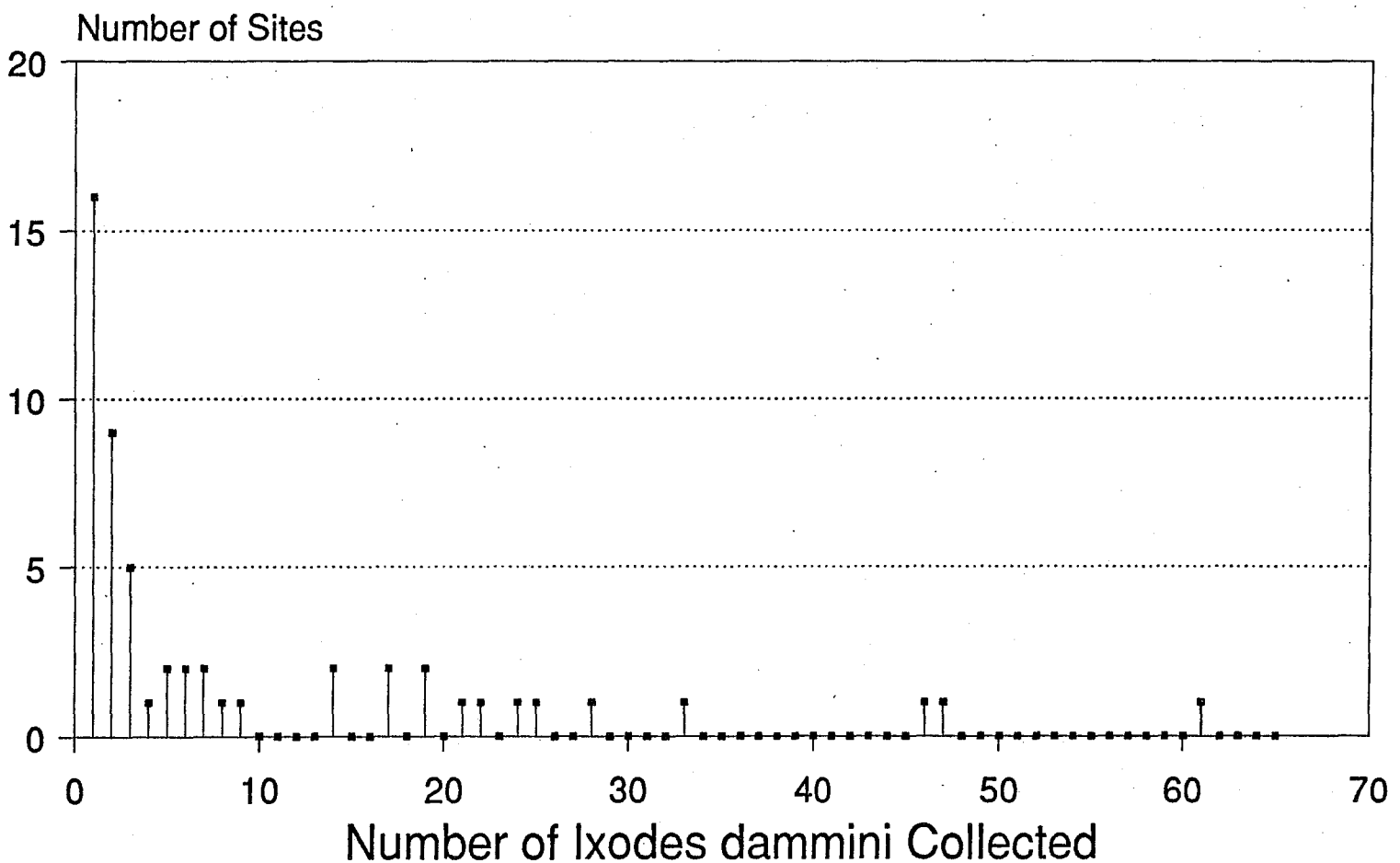
Total Ticks Collected From Small Mammals By Tick Species and Stage: 1991



n=8452 ticks

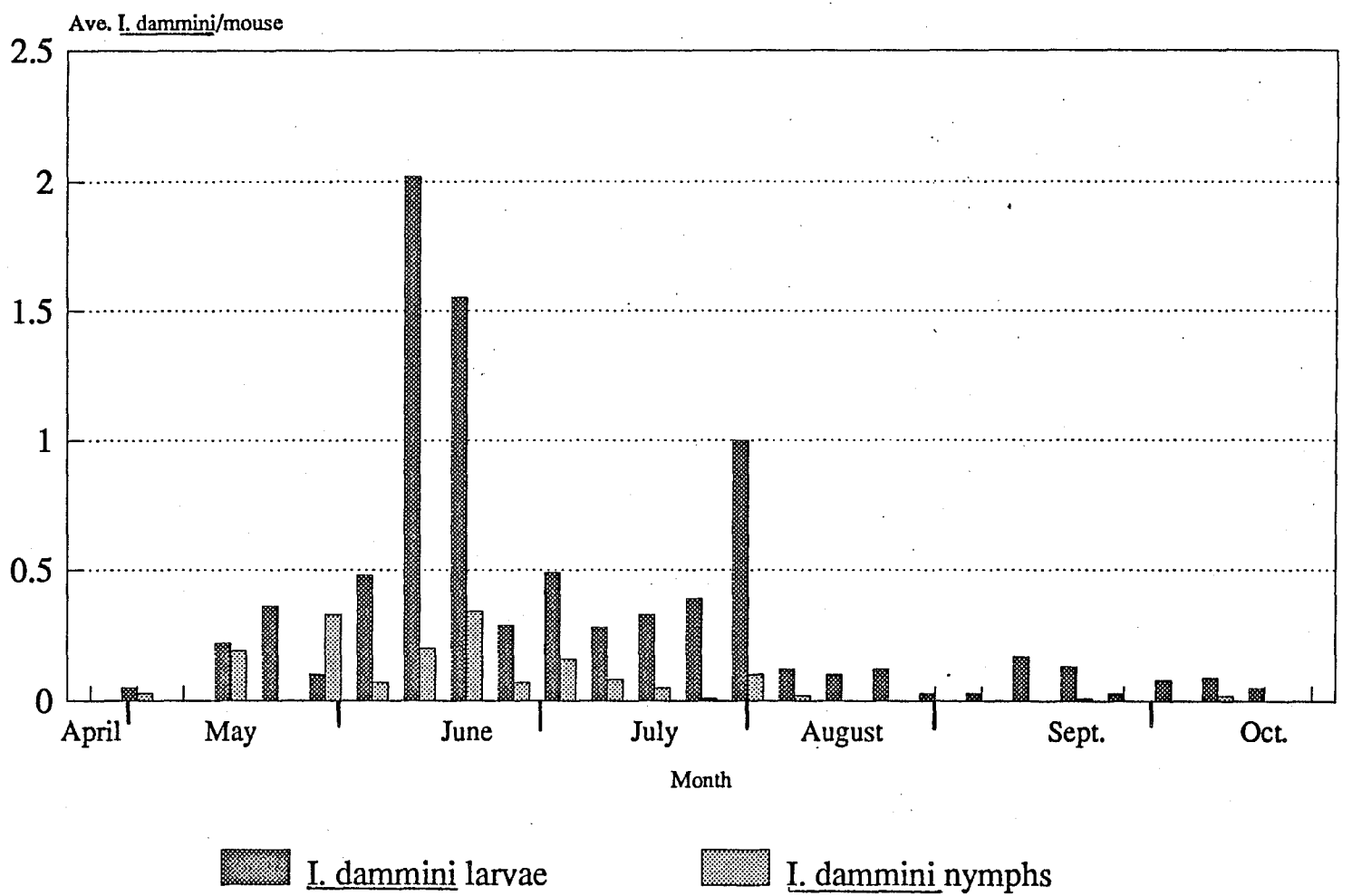
Figure 4.

Frequency Distribution Of Ixodes dammini
Collected From Mammals
At 54 Sampling Locations (1991)



We found no I. dammini at 216/270 sites

1991 Ixodes dammini Larvae and Nymphs
Average Ticks/Mouse By Month

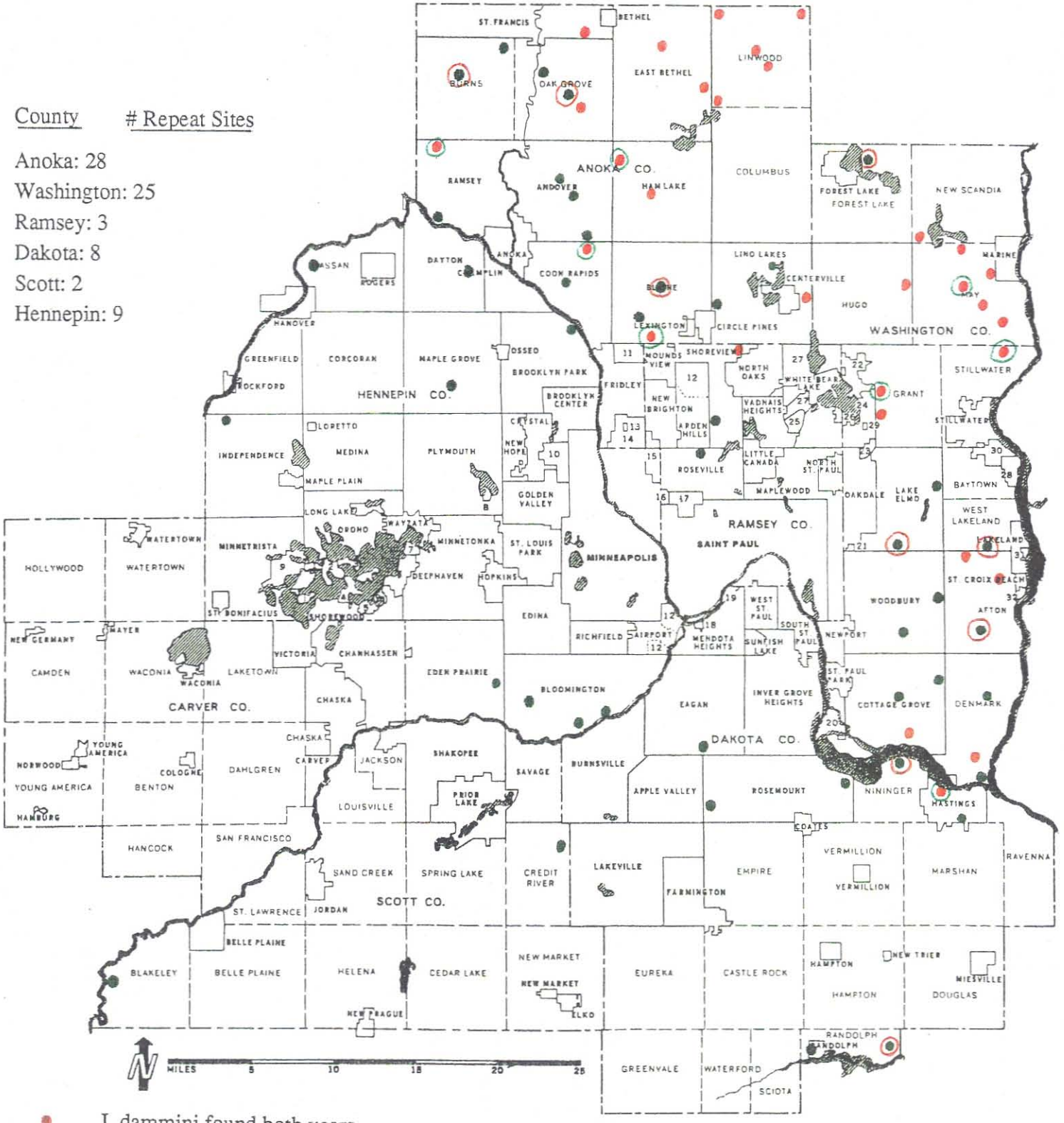


For the 54 positive sites only

Figure 6.

Sites Sampled In 1990 & 1991 (n=75)

County	# Repeat Sites
Anoka:	28
Washington:	25
Ramsey:	3
Dakota:	8
Scott:	2
Hennepin:	9



- I. dammini found both years
- I. dammini not found either year
- I. dammini found in 1990, but not 1991
- I. dammini not found in 1990, but found in 1991

Discussion:

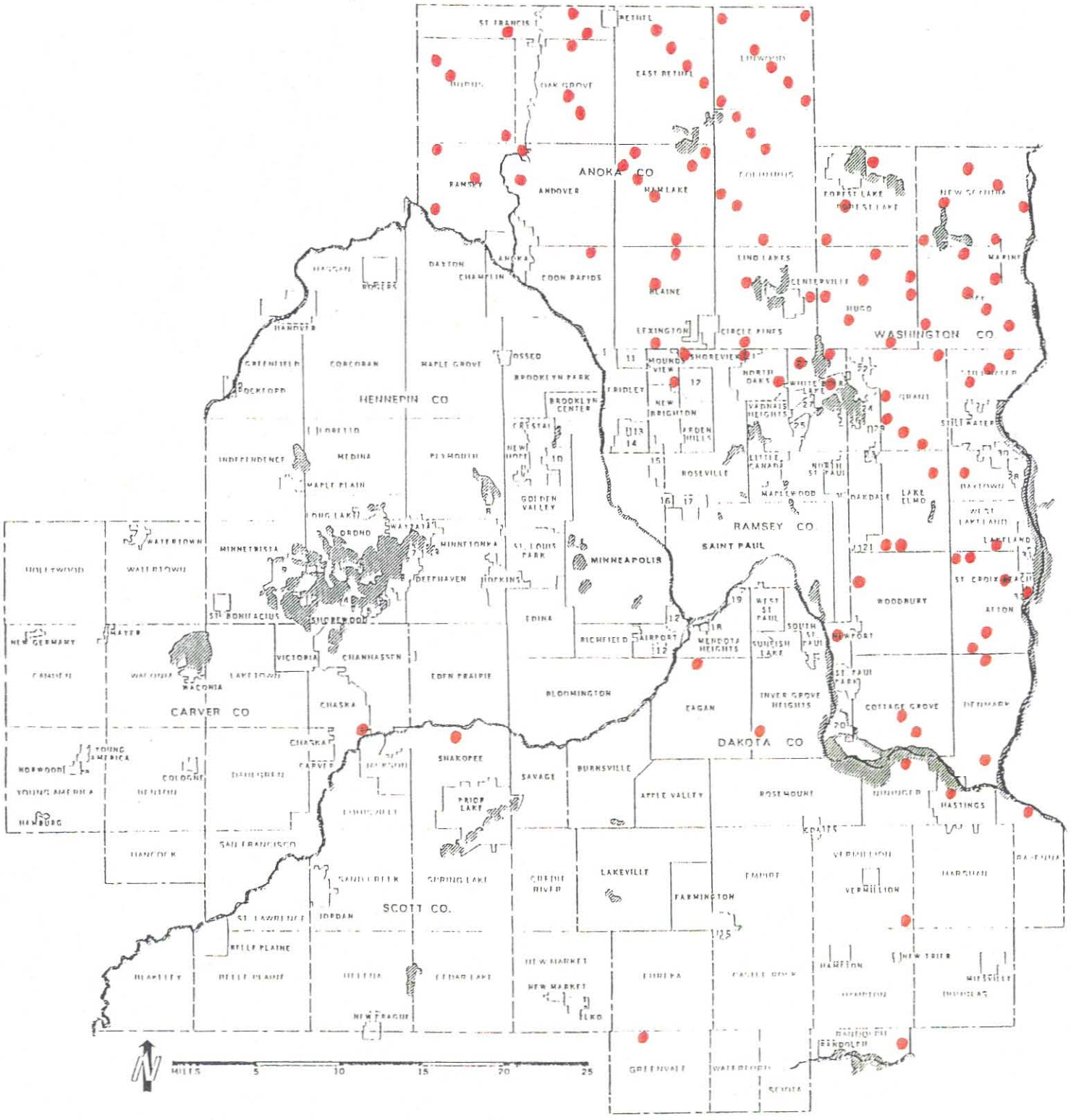
During the 1991 distribution study we found I. dammini in the same general locations as in 1990. In both years I. dammini was found in Anoka, northern Ramsey, and Washington counties (Fig. 7). The scattered I. dammini positive sites south and west of the Mississippi river appear to indicate areas where isolated and/or low populations of the tick occur. We found it interesting that we could not find the tick at any of our Hennepin county sites. If the tick is present there, it is either highly localized, or at such low population levels we have not detected them yet. It is apparent after two years of data collection, that most of the detectable (by our methods) deer tick populations are in Anoka, northern Ramsey, and Washington counties.

The first year of repeat site sampling did not demonstrate major changes in I. dammini presence/absence status. Most of the sites that changed status were locations where very few I. dammini were collected in one of the two years. These sites tended to be in the middle of the District, nearer the edge of the area where we are detecting I. dammini. Sites in the northeastern part of the District (where most sites are positive) and the southern part (where most sites are negative) did not change status as frequently.

In 1991 we confirmed Ixodes muris among our tick samples. We found approximately 30 ticks that looked very much like I. dammini except for a few minor, but consistent, morphological differences. We speculated that the ticks were likely I. muris and sent a sample of larvae and nymphs to Dr. Andrew Spielman (Harvard School of Public Health). Spielman, and a graduate student currently working in an area where this species is present, both confirmed the specimens as I. muris. Three nymphs, morphologically similar to the ones sent to Dr. Spielman, were among 132 ticks sent to CBR laboratories in Boston, Massachusetts for spirochete analysis. Dr. Tom Mather identified the ticks, but could not find enough differences to separate the three nymphs from I. dammini. We have decided, however, to operate under the assumption that the rest of these distinctive ticks are I. muris. The importance of this tick in the epidemiology of Lyme disease is currently unknown.

Quality assurance measures were conducted on random small mammal and tick samples. We rechecked 172/5566 mammals (3%) for any ticks missed on the first inspection. We found additional ticks on 8/172 mammals (4.65%). Of the 264 total ticks on these mammals, only 8 (3%) were found on the second inspection. None of these ticks were I. dammini. Tick identification accuracy was checked by re-identifying 70

Ixodes dammini Presence/Absence Study
1990 & 1991 Sites Positive For I. dammini



samples. Of 313/316 total ticks, 99% were counted and identified correctly. Of the three problem ticks, 2 were uncounted *D. variabilis*, and one was an *I. muris* incorrectly identified as *I. dammini*. All 1991 *I. dammini* were subsequently rechecked to confirm that they were not *I. muris*.

In 1992 we plan to continue the distribution study to look for changes in *I. dammini* distribution. We will also initiate efforts to determine the distribution and prevalence of the Lyme spirochete (*Borrelia burgdorferi*).

DEER TICK DISTRIBUTION STUDY
ROADKILL SAMPLING 1991

Abstract:

As a small part of our Deer Tick Distribution Study, roadkilled mammals were examined for deer ticks (Ixodes dammini) . We found no I. dammini on the 90 mammals examined during 1991 in the seven county metropolitan area. We collected a total of 62 ticks representing 5 tick species.

Introduction:

In 1990 the Metropolitan Mosquito Control District initiated a study to determine the distribution of deer ticks (Ixodes dammini) within the seven county District. The major portion of the sampling effort is a small mammal sampling program. Ticks are collected from their small mammal hosts, trapped at 250-270 sampling locations. In addition, ticks are collected using a drag cloth in these same woodlots.

As a supplement to this work, we decided to try collecting deer ticks off of medium to large sized roadkilled mammals. These mammals have larger home ranges than most small mammals. Therefore, they may have more opportunity 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.).

Methods and Materials:

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, placed in a plastic bag, and brought back to the laboratory for tick removal. Many of the mammals (including all white-tailed deer) were checked for ticks in the field where they were found.

Results:

A total of 90 mammals (representing 19 species) were inspected for ticks in 1991 (fig. 1). Eighteen of these animals had ticks on them. The 62 ticks removed from the mammals were of five species:

43 Dermacentor variabilis
12 Ixodes cookei
5 Ixodes marxi,
1 Haemaphysalis leporispalustris
1 Amblyomma americanum

As in 1990, no I. dammini were found on roadkilled mammals.

Figure 1.

Roadkilled Mammal Data Summary

Species	# Sampled	# positive for ticks	# ticks found & species
Raccoon	37	8	31 *D. variabilis* 2 *I. cookei*
Gray squirrel	18	1	5 *I. marxi*
Fox squirrel	1	0	
Red squirrel	3	0	
Thirteen-lined Ground squirrel	4	0	
Chipmunk	1	0	
Woodchuck	5	2	1 *D. variabilis* 4 *I. cookei*
Cottontail rabbit	3	1	1 *H. lepor.*
Norway rat	1	0	
Red fox	2	1	8 *D. variabilis*
Gray fox	1	0	
Ermine (weasel)	1	1	4 *I. cookei*
Mink	1	0	
Opossum	1	1	2 *I. cookei*
Striped skunk	2	1	2 *D. variabilis*
White-tailed deer	4	1	1 *A. americanum*
Eastern mole	1	0	
Short-tailed shrew	3	0	
White-footed mouse	1	1	1 *D. variabilis*

Discussion:

In 1991, we collected roadkilled mammals from all seven counties of our metropolitan District. We inspected a large variety of species (including some small mammals). Unfortunately, due to the time needed to conduct our small mammal portion of the program, we did not sample large numbers of any given mammal in any specific area.

However, the limited roadkill sampling conducted in 1990-1991 has been valuable to us. We have collected tick species that would otherwise go undetected in our small mammal sampling efforts (eg. A. americanum). In addition, the absence of I. dammini from the roadkills corresponds well with our small mammal data that are indicating low or nonexistent populations of I. dammini throughout most of the Twin Cities area.

Because this study does not require much extra preparation or labor, I recommend that it be continued in upcoming years.

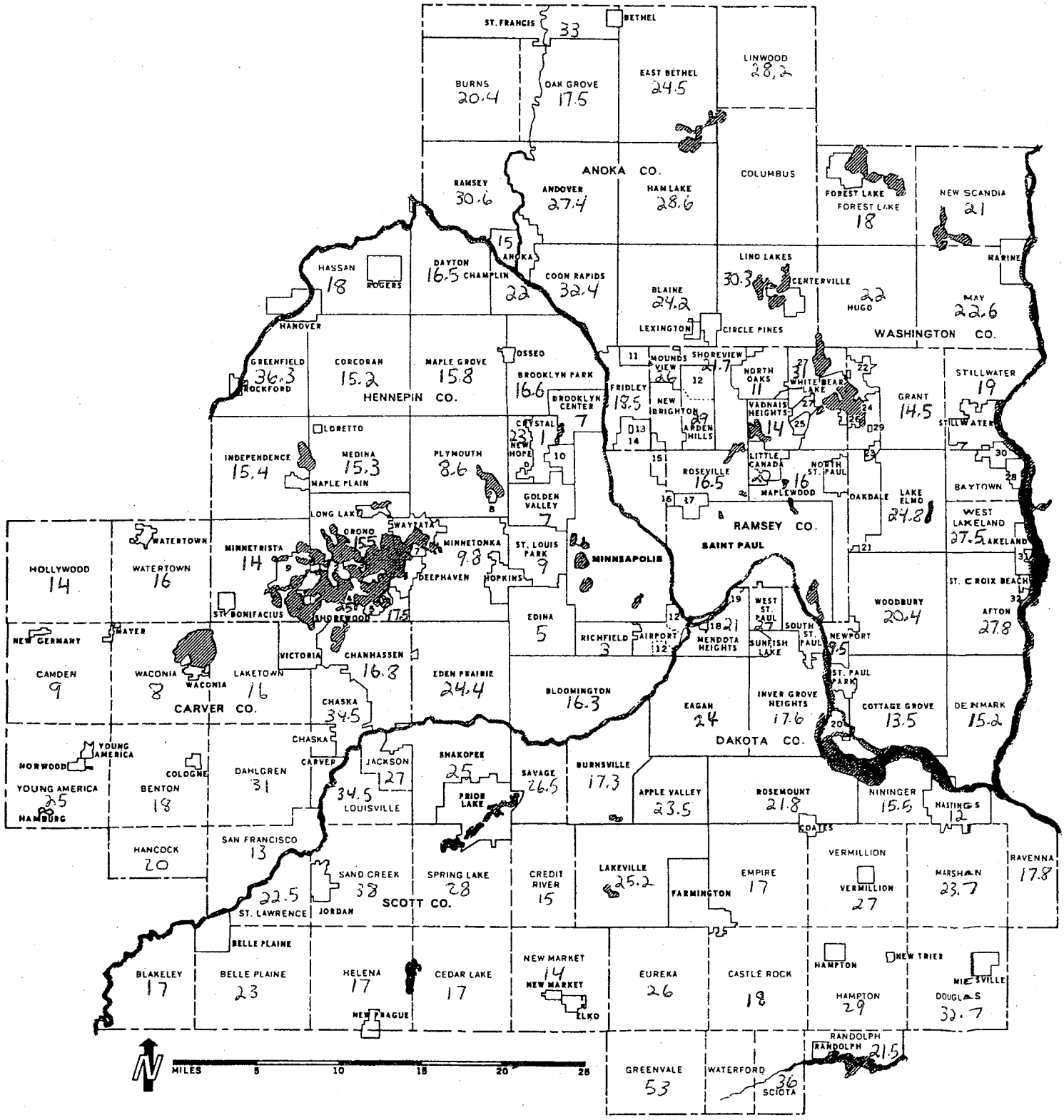
1991 Tick Surveillance
Mammal Species Collected and Associated Ticks

Species & (number sampled)	I. damm.	D. var.	other
1. Peromyscus sp. (4308) White-footed Mouse	456	7219	16
2. Tamius striatus (395) Eastern Chipmunk	28	9	1
3. Clethrionomys gapperi (264) Southern Red-backed Vole	13	626	9
4. Microtus pennsylvanicus (14) Meadow Vole	0	32	1
5. Blarina brevicauda (402) Northern Short-tailed Shrew	14	9	1
6. Sorex cinereus (152) Masked Shrew	2	1	5
7. Sorex arcticus (1) Arctic Shrew	0	0	0
8. Mus musculus (4) House Mouse	0	0	0
9. Glaucomys volans (1) Southern Flying Squirrel	0	0	0
10. Tamiasciurus hudsonicus (4) Red Squirrel	0	0	0
11. Spermophilus tridecemlineatus Thirteen-lined Ground Sq. (2)	0	0	0
12. Mustela erminea (3) Ermine	0	1	3
13. Zapus hudsonius (15) Meadow Jumping Mouse	1	4	1
14. House Wren (1) *Bird	0	0	0

IXODES DAMMINI
(TURNED IN BY STAFF OR PUBLIC 1991)

County	Township	# *I. dammini*	
Anoka	Columbus	9	
	Linwood	8	
	Andover	1	
	Ham Lake	1	
	Lino Lakes	1	
	Oak Grove	1	21 total
Washington	Grant	2	
	New Scandia	2	
	Oakdale/Lake Elmo	19	
	Afton	3	
	Hugo	2	28 total
Dakota	Hastings	1	
	Rosemount or Lakeville	1	2 total
Ramsey	North Oaks	1	
	Shoreview	1	
	Maplewood	2	
	Little Canada	1	5 total
Hennepin	Orono	1	1 total
Scott	?	1	1 total
		total:	58 *I. dammini*

Average Number of Mammals Collected By Township: 1991



County	#Sites	#Mammals Collected	Ave. Mamm/Site
Anoka	50	1289	25.8
Scott	20	488	24.4
Dakota	48	1088	22.7
Washington	44	876	19.9
Ramsey	14	272	19.4
Carver	18	339	18.8
Hennepin	76	1214	16.0

1992 LYME PROGRAM PROPOSAL

Introduction:

In 1990 the Metropolitan Mosquito Control District began a study to determine the distribution of deer ticks (Ixodes dammini) within the seven county Metropolitan area. The study was continued in 1991 to obtain a baseline understanding of the current I. dammini distribution.

In 1992 we plan to continue the distribution study to look for changes in I. dammini distribution. We will also initiate efforts to determine the distribution and prevalence of the Lyme spirochete (Borrelia burgdorferi).

Outline: 1992 Program Elements

Our 1992 program will include the following study aspects:

1. I. dammini Distribution Study

   a. repeat sampling of 100 sites sampled in 1990-91
   b. sampling of 100-150 new sites (eg. high public use areas, or areas near isolated positive sites from 1990-1991 studies)

   This work will be conducted to look for changes in I. dammini distribution, and to clarify the presence/absence status of some areas. Small mammal populations will be sampled at each site, using the same methods as in the 1990-1991 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

   a. sample a transect of 5 sites in known I. dammini and B. burgdorferi areas (sites in North Oaks, Lino Lakes, Columbus, and Linwood townships)

   b. sample a transect of 5 sites in areas where the tick has yet to be found (sites in northern Hennepin county)

   This is the first part of this multi-year study to determine the distribution and prevalence of B. burgdorferi within the seven county District. These transects should give us a good range of mammal and tick infection rate data for the District.

   Small mammals will be collected from each of these locations starting in late March.

Trapping efforts will likely be more intensive than in our previous distribution study. At least three of the sites will be monitored frequently (every other week) during the season to help construct a better picture of infection rates in mammals and ticks throughout the season.

The mammals, and any ticks found on them, will be tested for spirochetes at Dr. Russ Johnson's laboratory (University of Minnesota).

3. **Roadkilled Mammal Study**

As in 1990-91, any fresh roadkilled mammals we find while conducting other parts of our studies, will be examined for ticks. This effort will focus on medium to large sized mammals (eg. squirrels, raccoons, deer).

4. **Deer Blood Sampling**

As in the past few years, we will collect deer blood samples from deer taken in local hunts or shoots. The samples will then be tested for exposure to B. burgdorferi.

5. **Employee Survey**

A survey will be constructed to assess the level of exposure to I. dammini our field personnel are experiencing. They will be encouraged to turn in any ticks they find on themselves that cannot be readily identified as wood ticks. It is hoped that we can create an index of tick exposure potential for outdoor workers in this area.

*note: drag sampling will probably be eliminated due to its relative ineffectiveness in 1990 and 1991. We may do some drag cloth sampling for special projects or in areas of particular interest.