

Metropolitan Mosquito Control District
***Ixodes scapularis* DISTRIBUTION STUDY**
2009

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. Small mammal sampling was used to collect ticks from 100 wooded locations that have all been sampled since 1990 or 1991. For the 3rd consecutive year we collected *I. scapularis* from at least one site in all seven counties that comprise our service area (first occurrence was 2007). Overall, we tabulated 57 positive sites (at least one *I. scapularis* collected), a total in the 50's for the 5th consecutive year and for only the 7th time (all since 2000). We also continued to tabulate higher than typical number of positive sites from counties south of the Mississippi River and our 2009 total of 19 (11 Dakota, 3 Hennepin, 3 Scott, and 2 Carver) equals 2008; our previous high of 16 occurred in 2007. A total of 808 *I. scapularis* were removed from 941 mammals for an overall season mean of .859 *I. scapularis* per mammal; comparable to our elevated averages of 2000 – 2002, 2004, 2005, and 2007 (all \geq .806). The Anoka County sites accounted for 42% of the total 2009 *I. scapularis* collections (308L; 35N), with the highest numbers collected in Oak Grove (124L; 17N) township. Our Washington County sites accounted for an additional 37% (281L; 16N) of our *I. scapularis* collections with another 17% collected in Dakota County. Townships maintaining *I. scapularis* per mammal averages \geq 1.0 included Oak Grove, Saint Francis, Ham Lake, and Lino Lakes of Anoka County (range 1.105– 5.222), May, Lake Elmo, Afton, Grant, New Scandia, Lakeland, Woodbury, and Stillwater of Washington County (range 1.0 – 5.357), as well as Burnsville (2.111), Inver Grove Heights (2.0) and Ravenna (1.0) of Dakota County and Credit River (1.400) of Scott County. East Bethel, Andover, Linwood, Ramsey (Anoka), Cottage Grove, Denmark (Washington), and Eden Prairie (Hennepin) townships all averaged \geq .500 *I. scapularis* per mammal. Anoka County maintained the highest 1990-2009 overall season mean (.946), followed by Washington County (.744). Our compiled 1990-2009 township averages (all $>$ 1.0) include May, New Scandia, Hugo, and Grant of Washington County, and Coon Rapids, Blaine, Saint Francis, Ham Lake, and East Bethel of Anoka County. South of the Mississippi River, the highest 1991-2009 averages ($>$.500 *I. scapularis* per mammal) occurred in Inver Grove Heights, Vermillion, and Ravenna townships of Dakota County. Both small mammal and immature tick species diversity in 2009 appeared comparable to past years. As in past years, *Peromyscus leucopus* was the predominant mammal species collected and although *I. scapularis* had comprised \geq 50% of our overall collections four times between 2002 and 2006, in 2009 *Dermacentor variabilis* again comprised the majority of our collections. The 2009 average number of mammals collected per site (9.41) is higher than we have tabulated since 2006 but lower than most years of this study. Examining human data, as of June 24, 2010, final tallies for 2009 were not yet available from the MN Dept Health (MDH). In preliminary counts, the 2009 totals for Lyme (roughly 1065) and human granulocytic anaplasmosis (317) are similar yet smaller than the record setting totals of 2007. Our overall results seem to indicate that the metro *I. scapularis* population remains elevated, as we believe it has been since 2000. We believe that a Twin Cities resident's risk of encountering *I. scapularis* locally is likely greater than it once was.

Introduction

In 1990 the Metropolitan Mosquito Control District initiated a Lyme Disease Tick Surveillance Program to determine the distribution and prevalence of *Ixodes scapularis* and *Borrelia burgdorferi* within the Minneapolis- Saint Paul metropolitan area. District re-structuring in 1996 integrated the former tick surveillance program activities into the District's overall field processes. Small mammal trapping has been the primary sampling method used, with examination of road-killed mammals and flagging (dragging flannel cloth along vegetation) each used as secondary collection methods in the past.

A total of 545 sites were sampled from 1990 through 1992, including 100 sites that had been selected for repetitive sampling prior to the 1991 or 1992 field season. Baseline *I. scapularis* distribution data for our area was determined from the 1990 and 1991 studies with most of the ticks collected north of the Mississippi River in Anoka, Washington, and northern Ramsey counties. 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* collections continued to be obtained in the northeastern counties.

Since 1993, our distribution study has focused on the re-sampling of 100 sites to detect any potential changes in *I. scapularis* distribution over time. Seventy-five of these sites were re-sampled beginning in 1991 and 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 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 may intensify our sampling effort in areas that have shown potential *I. scapularis* range expansion.

Periodically, additional sites have been sampled:

From 1995-1997 two additional sites were sampled; section 7 of New Market Township in Scott County (where a single adult *I. scapularis* tick had been collected in 1995) and section 19 of West Saint Paul Township in Dakota County (Dodge Nature Center- to foster improved relations through providing a general risk assessment). Sampling at these two locations was discontinued in 1998 since zero *I. scapularis* had been collected in either location in the three-year period.

From 2007-2009 several park sites were sampled and results compared to our 1990 results. Although we are still sampling a limited number of parks today, in 1990 a larger number of our sites had been selected inside metropolitan parks to provide a primitive assessment of park user risk to potential *I. scapularis* encounters. Included were Joy Park in North Saint Paul (62-08-01) and a location near Pigs Eye Lake in St Paul (62-13-02). In 1990 *I. scapularis* had not been collected at either park in three rounds of sampling. We re-sampled both parks, for two rounds only, as extra sites in 2007 and 2008. The 2007-08 Pigs Eye site was moved over one section, to section 3 while the 2007-08 Joy Park site was in the same (square mile) section, but east of our 1990 location. Unlike 1990, we detected *I. scapularis* in both parks in both years. In 2009 Joy Park and a previously unsampled Ramsey County location, Priory Preserve (62-04-24), were both sampled for three rounds.

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 27, 2009 and ended on October 29, 2009 with small mammal trapping used as the primary sampling method. 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, and stored the ticks in alcohol for later identification.

Results

➤ 2009 Study (Repeat Sites):

For the third consecutive year we collected *I. scapularis* from at least one site in all seven counties that comprise our service area. Specifically, in 2009 we found at least one *I. scapularis* at 57 of our 100 sampling sites, with 38 of these positive sites located north of the Mississippi River in Anoka (20 sites positive/28 sites sampled), Washington (17 sites positive/25 sites sampled), and Ramsey (1 site positive/3 sites sampled) counties. Nineteen additional positive sites were detected south of the river in Dakota (11), Hennepin (3), Scott (3), and Carver (2) counties (Figure 5A).

Overall, 941 mammals (Figure 1 and 2009 results in Table 2) were inspected: 357 from north of the Mississippi River and 584 from south of the river and a total of 808 *I. scapularis* (Figure 2 and 2009 results in Table 3) were collected from them. The Anoka County sites accounted for 42% of the total *I. scapularis* collections (308L; 35N) with the highest numbers collected in Oak Grove (124L; 17N) township. An additional 37% of the total (281L; 16N) were collected from our Washington County sites, with the highest collections occurring in May (144L; 6N) township. We collected a total of 162 *I. scapularis* (154L; 8N) from our sites located south of the Mississippi River, with the majority (136L; 3N) collected from within Dakota County.

The overall season mean number of *I. scapularis* collected per mammal in 2009 was .859 (larvae: .794, nymphs: .065). The mean increases to 1.372 (larvae: 1.268, nymphs: .104) when all sites negative for *I.*

scapularis are excluded (see 2009 results in Figure 6). The highest average number of *I. scapularis* per mammal was calculated for Anoka County, which had a season mean of 1.971 compared with Washington (1.929), Ramsey (1.207) and Dakota (.489) county's season means (see 2009 results in Figure 3). Townships in Anoka County averaging ≥ 1.0 *I. scapularis* per mammal in 2009 included Oak Grove (5.222), Saint Francis (4.909), Ham Lake (3.833), Lino Lakes (2.600), and Coon Rapids (1.105), with East Bethel (.875), Andover (.789), Linwood (.613), and Ramsey (.611) townships averaging $\geq .500$ *I. scapularis* per mammal. May (5.357), Lake Elmo (2.714), Afton (1.933), Grant (1.833), New Scandia (1.500), Lakeland (1.125), Woodbury (1.0), Stillwater (1.0), Cottage Grove (.667), and Denmark (.585) townships of Washington County maintained averages $\geq .500$ *I. scapularis* per mammal (Figure 4), as did Burnsville (2.111), Inver Grove Heights (2.0), and Ravenna (1.0) of Dakota County, Credit River (1.400) of Scott County, and Eden Prairie (.643) of Hennepin County, south¹ of the Mississippi River (no figure).

I. scapularis detected again at Joy Park (Ramsey County).

Joy Park in North St Paul (near Silver Lake) had been sampled in 1990 and *I. scapularis* was not collected in three rounds of sampling. The same general area of Joy Park was re-sampled in 2007, 2008 and 2009. In 2007 we had removed a total of ten *I. scapularis* larvae from two mammals in Joy Park in two rounds of sampling. In 2008 we collected another three nymphs from one mammal. In both years it was possible that additional *I. scapularis* could have been collected but neither park was sampled in our final, third round. In 2009 we sampled Joy Park for all three rounds and again collected *I. scapularis* (35L; 1N) from six of the twelve total mammals collected. Zero of the twelve mammals were collected in our third round of sampling.

Priory Preserve was a previously unsampled area of Ramsey County and a trapline was set during all three rounds in 2009. Zero mammals were collected from the Preserve in 2009 so any degree of tick establishment remains unknown.

➤ **Compiled Results (Repeat Sites) from 1990 - 2009 or 1991 - 2009:**

The 1990-2009 mean number of *I. scapularis* collected per mammal is .478, with the highest averages continuing to occur north of the Mississippi River. Washington County maintained the highest yearly county season means from 1990-1997 and Anoka County has maintained the highest yearly county season means since 1998 (Figure 3). The highest compiled 1990-2009 overall season mean (north of the Mississippi River) was tabulated for Anoka County (.946), followed closely by Washington County (.774). The 1990-2009 township averages (all > 1.0) include May, New Scandia, Hugo, and Grant of Washington County and Coon Rapids, Blaine, Saint Francis, Ham Lake, and East Bethel of Anoka County, while the averages for Linwood, Oak Grove, and Andover of Anoka County and Afton and Lakeland townships of Washington County are $> .500$ *I. scapularis* per mammal (Figures 4A and B—inserts on Figure 4). In compiled results from south of the Mississippi River (1991 – 2009), Inver Grove Heights (1.011), Vermillion (.671), and Ravenna townships of Dakota County maintained 1991-2009 averages $> .500$ *I. scapularis* per mammal² (no figure).

I. scapularis status at the 100 repeat sampling locations is shown on Figure 5. The status has changed at 83 of the sites since 1990 or 1991 (see 2009 results in Table 1). While the number of sites where *I. scapularis* is detected every year has decreased since 1992, we continue to detect *I. scapularis* at several new sampling locations each year (Table 1).

¹ Prior to 2005, township averages south of the river were not tabulated. See footnote 1 (and the report text) in the 2005 report for detailed yearly averages for positive townships south of the Mississippi River through 2005. In brief, Inver Grove Heights Township first averaged $> .500$ in 1998 while Vermillion Township first averaged $> .500$ in 1991. 2005 was the first year that Hassan Township (Hennepin County) had an average $\geq .500$.

² Inver Grove Heights Township has maintained a compiled 1991-current year average of $> .500$ *I. scapularis* per mammal since 1999 while Vermillion's first compiled 1991-current year average $> .500$ *I. scapularis* per mammal occurred in 2004.

Table 1: Comparison of *I. scapularis* Presence/Absence Status at 100 Repeat Sampling Locations

No. sites changing status	1992	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ticks found:														
all years	21	17	11	5	5	5	4	3	1	1	1	1	1	1
most years	5	15	19	27	31	34	35	37	38	41	41	45	42	44
least	21	23	28	31	30	32	34	35	37	35	37	35	39	39
(not found)	53	45	42	37	34	29	27	25	24	23	21	19	18	16

Our positive sites have been primarily located north of the Mississippi River in Anoka and Washington counties, with one consistently positive Ramsey County site (northern Shoreview Township). We tabulated two positive Ramsey County sites (both of our Shoreview Township sites) for the first time in 2003. The second Shoreview Township site was positive for *I. scapularis* again in 2005, 2006, and 2008. South of the river from 1990 – 1999 it was typical to tabulate a maximum total of 3-4 positive sites each season. Except for 1991 when several *I. scapularis* were collected at one site each in Scott and Carver counties, positive sites were located only in Dakota County from 1990 through 1997. In 1998 we first detected *I. scapularis* in Hennepin and Scott counties³ and in 2000 we began to tabulate more sites south of the river. Our tabulation of 19 positive sites south of the river in 2009 ties the new record total that had been set in 2008 (Table 1A).

Table 1A: Number of Sites South of the Mississippi River Positive for *I. scapularis*

	1992	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total sites south of river	*1	2	4	4	7	10	12	6	9	10	12	16	19	19
By county:														
Dakota	*1	2	4	2	6	7	8	6	8	7	9	10	12	11
Hennepin	*0	0	0	1	1	2	3	0	0	1	2	3	3	3
Scott	*0	0	0	1	0	1	1	0	1	2	1	2	2	3
Carver	*0	0	0	0	0	0	0	0	0	0	0	1	2	2

*This count includes only our current site network. However, despite our intensive 1992 effort, the overall total was only 2 (both Dakota County).

Comparing our 2009 small mammal and immature *I. scapularis* collection results with past study efforts, both small mammal (Table 2) and immature tick (Table 3) species diversity appears comparable to past years. As in past years, *Peromyscus leucopus* was the predominant mammal species collected and although between 2002 and 2006 *I. scapularis* had comprised $\geq 50\%$ of our overall collections four times, in any other year, including 2009, *Dermacentor variabilis* has comprised the majority of our collections (Table 3). Our 2009 overall season mean of .859 *I. scapularis* per mammal is technically our third highest calculated average, behind 2002 (.889) and 2007 (.876), but comparable overall to our 2000 – 2002, 2004, 2005 and 2007's elevated averages, which were all $\geq .806$ (Figures 3 and 6). *P. leucopus* consistently has been the predominant mammal species collected each year with some variability in the total percentages collected⁴ (Figure 1 and Table 2). The 2009 average number of mammals collected per site (9.41) appears to represent a lower than typical yearly small mammal collection level although it is higher than we have tabulated since 2006 (Table 2). Our compiled average small mammal collection success level per site for 1990 through 2009 is 12.87 (1991-2009 average of 12.12 for 100 repeat sites only), with results ranging from the low of 7.02 mammals collected per site in 2008 to the high of 20.61 (23.54 at the 100 repeat sites only) in 1991.

³ *I. scapularis* was collected previously in Hennepin County in a collaborative study with Dr. R. Johnson of the University of Minnesota and in very small numbers in Scott and Carver counties (one site each) in our 1991 study effort. In 1995 District staff performing pest mosquito activities inadvertently found a single adult tick in Scott County's New Market Township but no additional *I. scapularis* were detected there in a 3 year sampling effort. Staff or the public have continued to occasionally turn in adult *I. scapularis* from Scott County, especially from New Market Township, since 1995.

⁴ see the discussion sections in the 1993 (*I. scapularis* population estimates) and 1994 (graph handout-mammal density equality across sites) *I. scapularis* distribution study report

Discussion

Our results seem to indicate that *I. scapularis* populations are established within northeastern Anoka and northern Washington counties while remaining localized or nonexistent in areas 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, where greater numbers of *I. scapularis* continue to be collected in the northeastern metropolitan area each season, we believe that the greatest Lyme disease risk continues to occur in the northeastern metropolitan area⁵. However, as we have begun to document more positive sites south of the Mississippi River in recent years, especially within the borders of Dakota County, we believe that tick-borne disease risk via greater *I. scapularis* exposure opportunities may be occurring now in areas south of the Mississippi River as well.

As has been noted in this and previous reports, 2000 was the year that MMCD began to detect obvious increases in our *I. scapularis* collections. Our 2009 positive site total of 57 is a total in the 50's for the 5th consecutive year and for only the 7th time (all since 2000) since inception of this study (white boxes in Figure 3). We also detected at least one *I. scapularis* from all seven counties for the 3rd consecutive year (1st occurrence was 2007) and we equaled our 2008 record number of positive sites from counties south of the Mississippi River, as illustrated in Figure 5A and Table 1A. The year 2000 is also when we began to compile higher average numbers of *I. scapularis* collected per mammal (Figures 3 and 6) for a season. This trend of higher data compilations since 2000 is reflected in MDH human case data, as well, as described in the next paragraph.

Examining human data, as of June 24, 2010, final tallies for 2009 were not yet available from the MN Dept Health (MDH). In preliminary counts, the 2009 totals for Lyme (roughly 1065) and human granulocytic anaplasmosis (317) are similar to their record setting tick-borne disease case totals of 2007 (Lyme 1239; HGA 322) and also close to the 2008 totals (Lyme 1050; HGA 278). Their prior all-time high statewide Lyme disease tabulation had been 1023 Lyme cases (2004) with the Lyme case totals of 2005 (918), 2006 (914), and 2002 (867) also at very high levels compared to other years. For reference, compared with roughly 250 cases per year through 1999, their statewide Lyme case total in 2000 was 463 cases, with the Lyme case totals of 2001 (465 cases), and 2003 (473 cases) being similar. Statewide human granulocytic anaplasmosis (HGA) case totals have increased in recent years, too. Through 1999 the MDH had only been compiling an average of roughly 15 HGA cases per year but case totals ranged from 78 to 152 from 2000 – 2004. Their previous all-time high HGA case total (186) had been set in 2005 and they recorded 177 HGA cases for 2006, making the record 322 HGA cases for 2007 that much more impressive. Although slightly lower than the 2007 record total of 322, the HGA case totals for 2008 and 2009 are similar in count and very high in comparison to prior years.

The Twin Cities metro tick-borne disease case totals have also risen over time, but not as dramatically as the statewide totals. Although 2008 or 2009 tallies were not available as of June 24, 2010, the 2007 metro-exposed case totals were at all-time highs (80 Lyme, 9 HGA). Comparatively, the range for metro-exposed Lyme cases for all seven counties combined was 15 to 43 from 1991 – 1999 and 40 to 69 from 2000 – 2006. Although HGA had been detected in metro-collected small mammals beginning in 1995⁶ in MMCD collaborative research, locally acquired human HGA cases were not documented by MDH until 2000. From 2000 – 2007 MDH typically tabulated a few metro-exposed HGA cases each year (range 0-9).

Our overall results seem to indicate that the metro *I. scapularis* population remains elevated, as we believe it has been since 2000. We believe that a Twin Cities resident's risk of encountering *I. scapularis* locally is likely greater than it once was.

⁵Yearly metro human exposure case totals vary from 1 case per year occurring sporadically in Scott and Carver counties to double-digit amounts (typically teens to twenties) for both Anoka and Washington counties (personal communication MN Dept Health).

⁶Several serology studies have been performed since 1995 using both distribution-study collected small mammals and small mammals collected at different sites. A map showing the results of our 1995 and 1997 efforts is available on our website (http://www.mmcd.org/tick_links.html). The 1995 work has been published--Walls, J. J., B. Greig, et al. (1997). "Natural Infection of Small Mammal Species in Minnesota with the Agent of Human Granulocytic Ehrlichiosis." *Journal of Clinical Microbiology* 35(4): 853-855. Additional unpublished studies have been performed in collaboration with Dr. Russell Johnson, UM Microbiologist. Serology results of the later distribution study serology efforts are similar overall to the 1995 and 1997 work shown on the website map.

ADDITIONAL UPDATES/RESEARCH:

STUDIES/PROJECTS FOR 2010.

➤ ***Ixodes scapularis* distribution study** (sites unchanged from 1993).

Small mammal collections through June 26, 2010 were higher than 2009 and higher than the average number collected in Round A in a typical year since 1990.

➤ **Possible projects:**

Rocky Mountain spotted fever follow up: If requested, MMCD will collect additional *D. variabilis* for the MDH to determine if *Rickettsia rickettsii* (RMSF bacterial agent) can be detected.

- Update July 2010. MMCD collected *Dermacentor variabilis* (wood tick / American dog tick) for the Minnesota Department of Health. As of June 11 we estimated that we had reached our minimum targeted goal of 400 (DV) ticks.

Re-sample Waconia (Carver County) to re-investigate a 2009 post peak *I. scapularis* collection.

- Update July 2010. We did re-sample this Waconia location in June. Results not yet available.

➤ **Additional projects 2010:**

As we had in 2009, MMCD will provide samples to Dr. Roger Moon (UM – St Paul), to further the knowledge of the rodent bot fly (Genus *Cuterebra*).

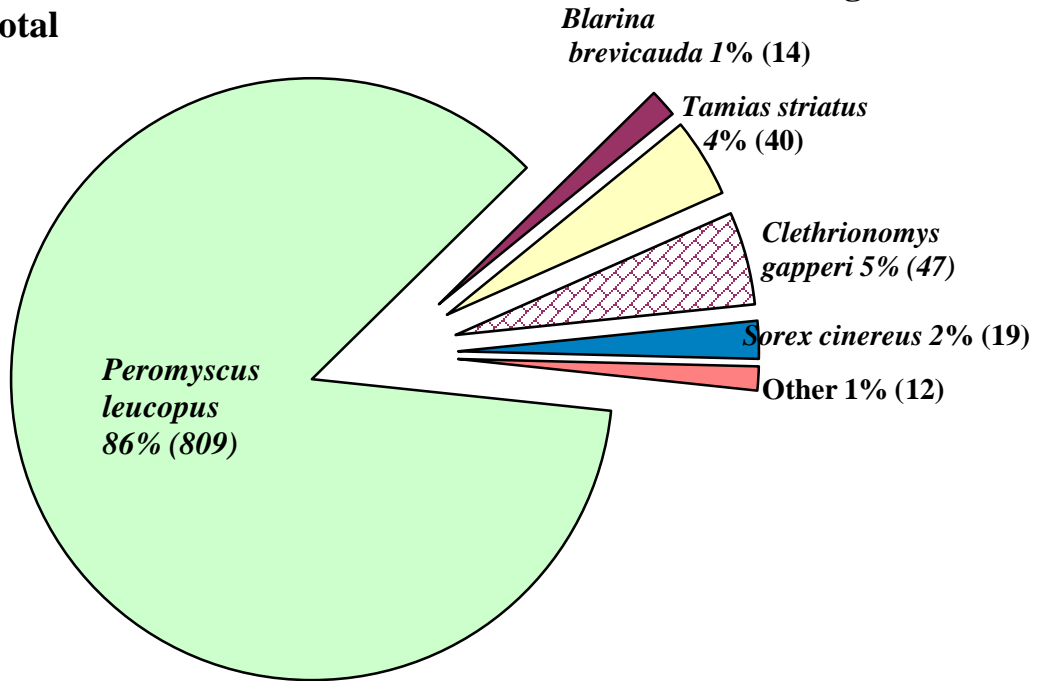
***AMBLYOMMA AMERICANUM* –2009 & 2010**

Amblyomma americanum (lone star tick) records are significant because these ticks vector human monocytic ehrlichiosis, they are an aggressive human biter, and their range is known to be moving northward. Though found here since 1990 on a rare, sporadic basis, Minnesota is not within their historic range. In 2009 there were several *Amblyomma* collections (one adult, submitted to the MDH, one nymph, submitted to MMCD) in one year; an unusual event. This trend is continuing in 2010.

- An adult female *Amblyomma americanum* was mailed to us from Eagan, collected June 17, 2010. Rosemount staff dragged for additional ticks. No more ticks were found.
 - As a result of a tick article in the Star Tribune in July, another *Amblyomma* was mailed to us for identification. This tick was an adult male *Amblyomma americanum*, collected in Mound from the family's dog on July 9.
 - An adult female *Amblyomma americanum* was mailed to us by a metro citizen (received July 16) with a travel history of Orono or Lake Minnetonka. This tick was collected on/near July 2.
-

**Small Mammals Collected
2009: 941 total**

Figure 1



**Ticks, by Species and Stage,
Removed from Small Mammals
2009: 1897 total**

Figure 2

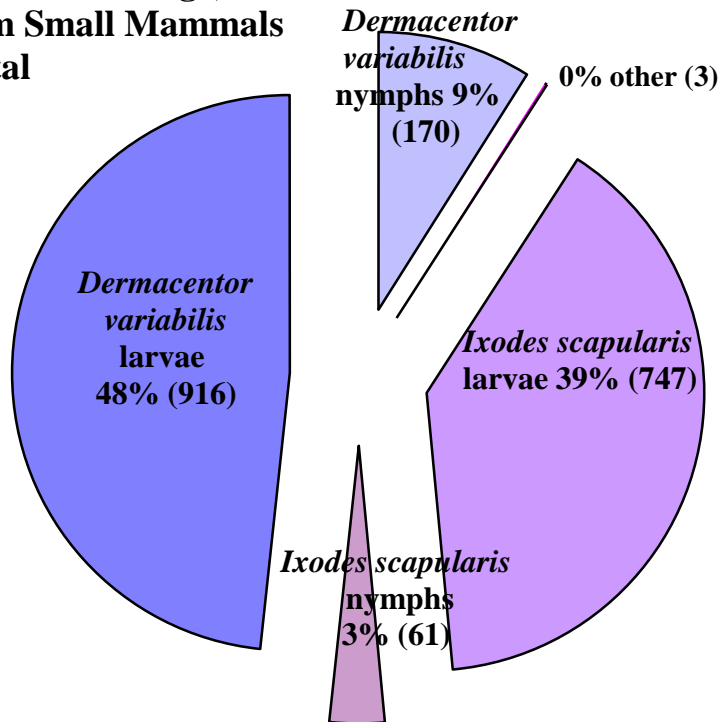


Figure 3

Average number of *I. scapularis* collected per mammal at 100 sampling locations in Anoka, Washington, and Ramsey counties: 1990 - 2009
(white box shows the total number of sites where at least one *I. scapularis* was found: by year)

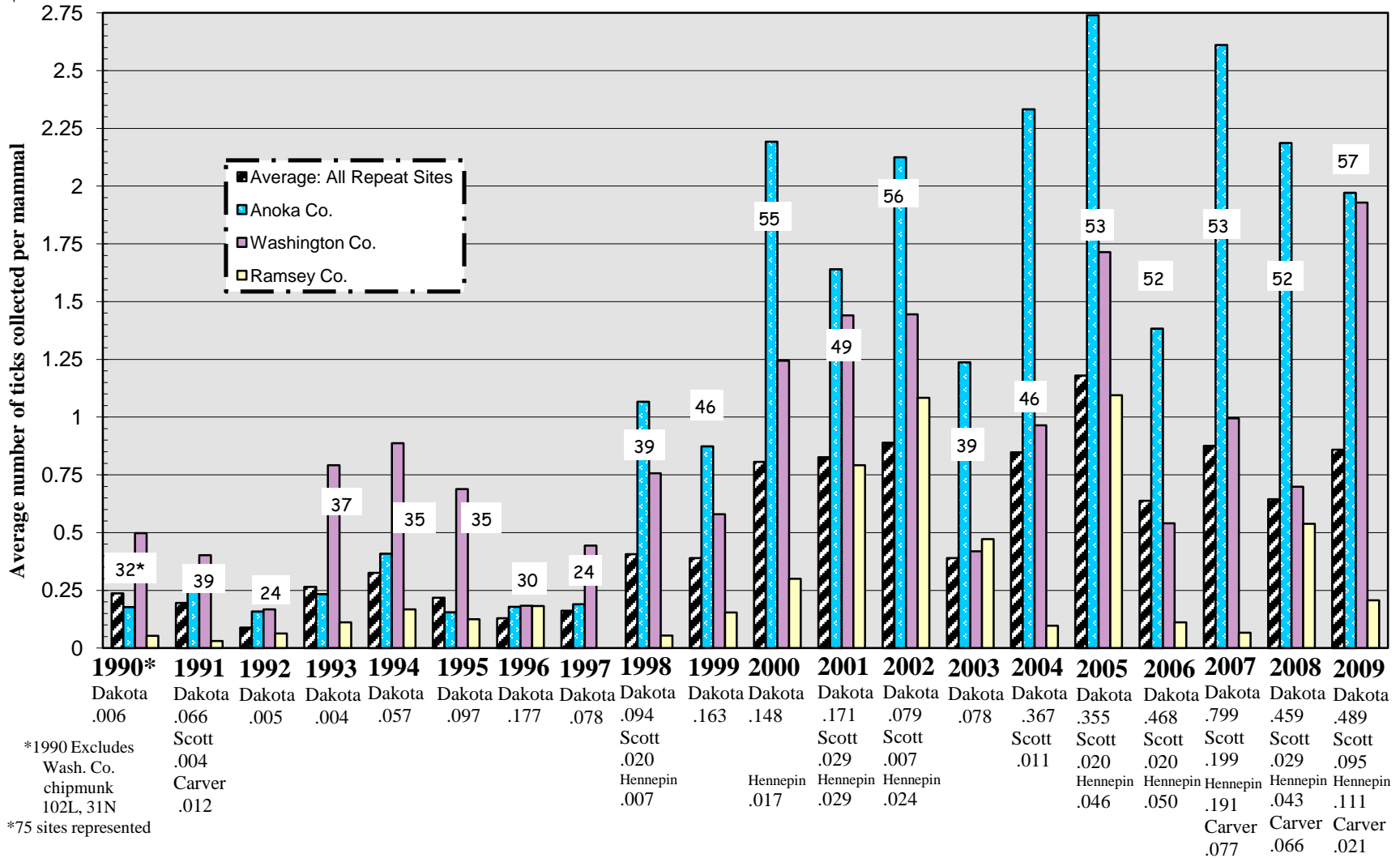
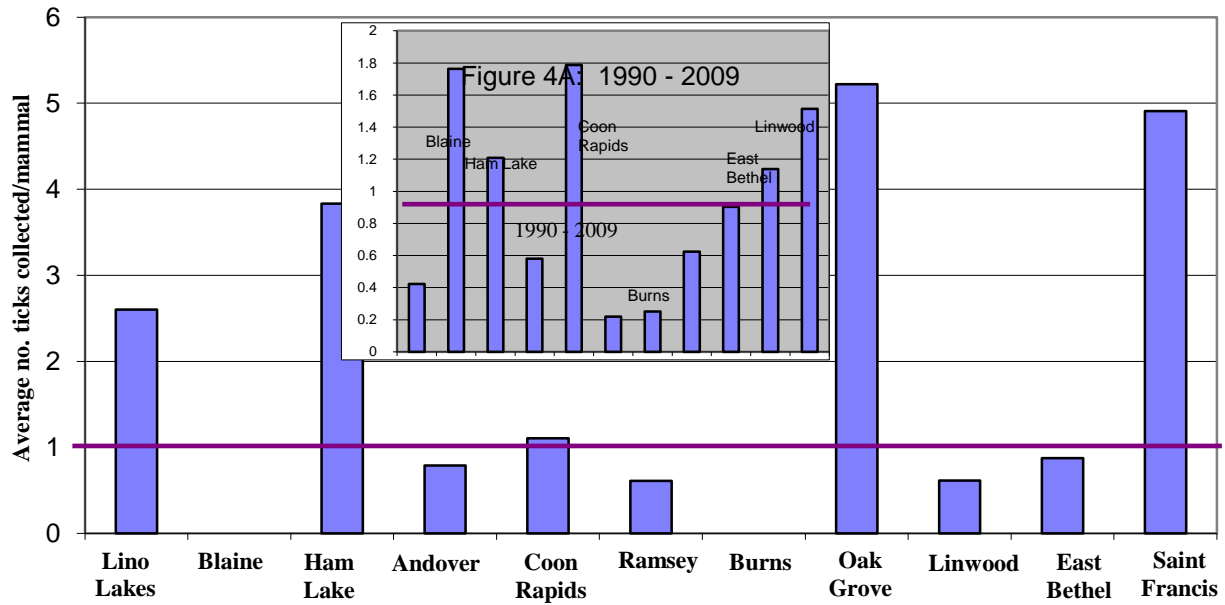


Figure 4

Average number of *I. scapularis* collected per mammal in Anoka county (by township): 2009 results



Average number of *I. scapularis* collected per mammal in Washington county (by township): 2009 results

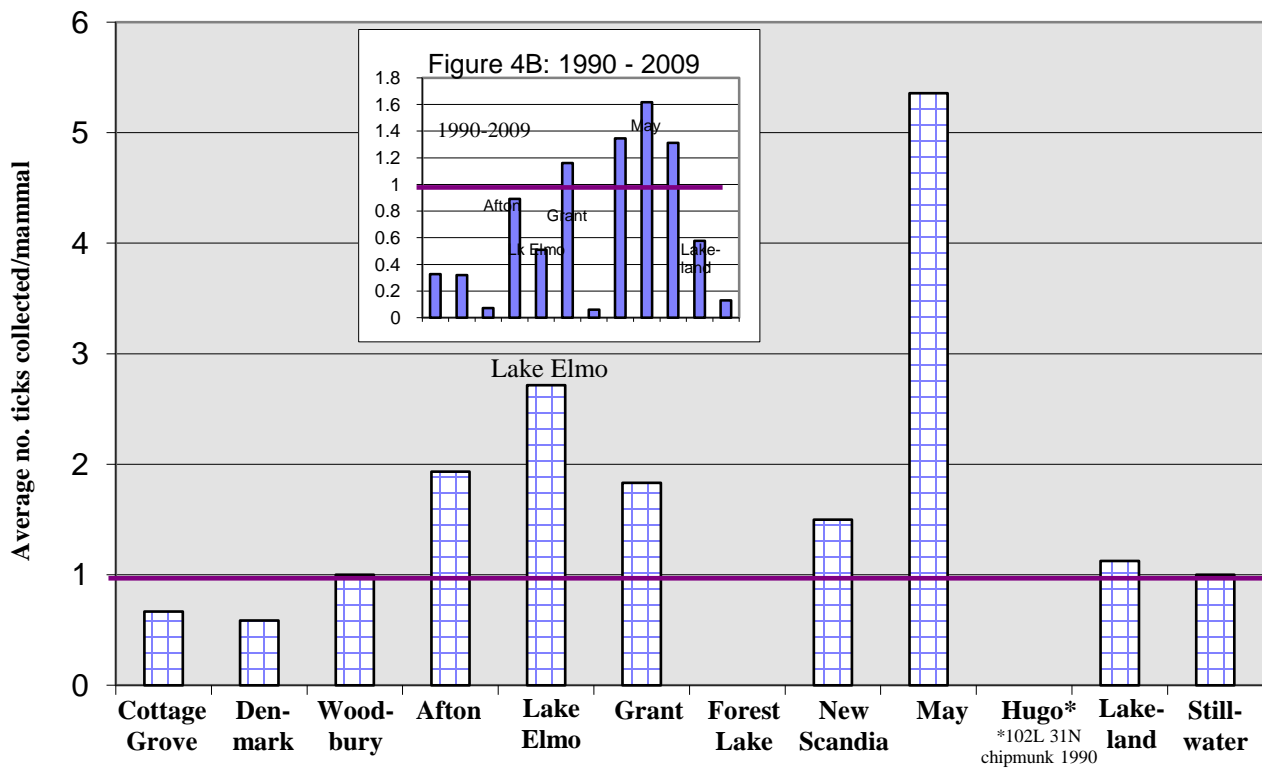
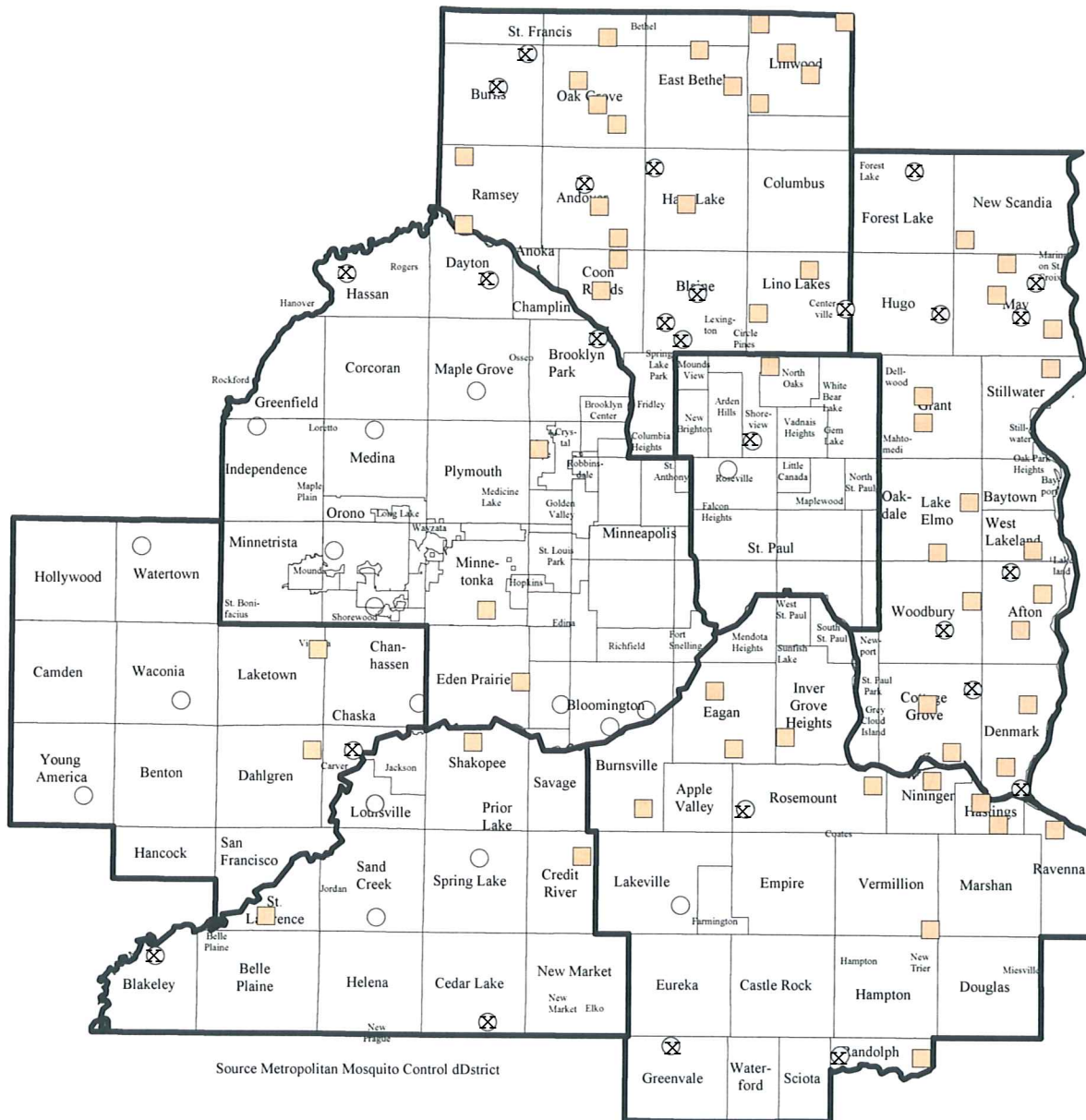


Figure 5A

Ixodes scapularis Presence / Absence status: 2009
 (present if at least one *I. scapularis* is collected)

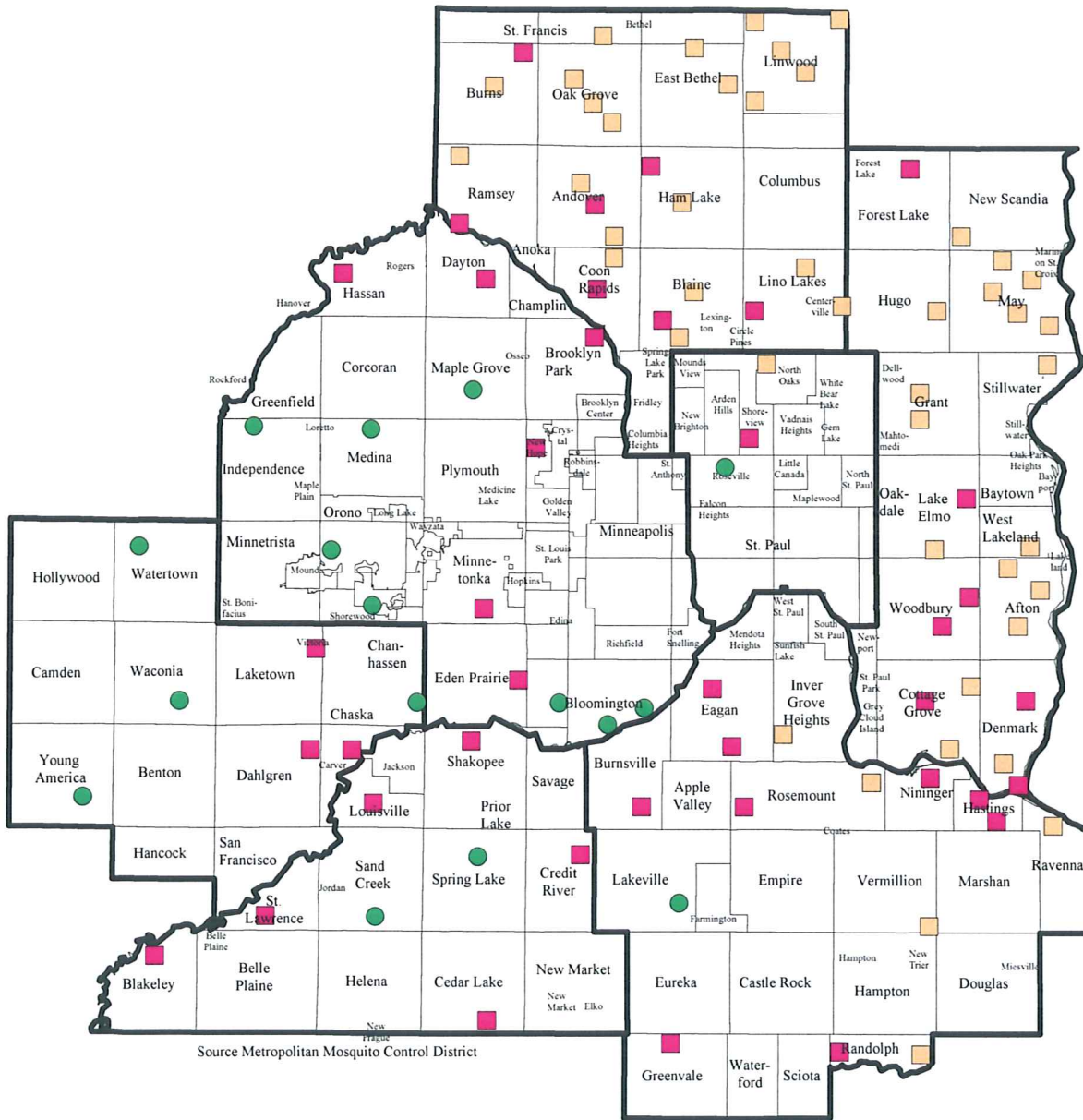


Source Metropolitan Mosquito Control District

Status 2009	
■ present	(57)
⊗ absent this year	(27)
○ not found 1990-2009	(16)

Figure 5

Ixodes scapularis Presence/Absence status: 1990 - 2009
 (present if at least one *I. scapularis* is collected during a year)



At least one tick found during:	
Orange square	all/most years (45)
Pink square	at least one year (39)
Green circle	(not found) (16)

Figure 6

Average number of *I. scapularis* collected per mammal at 100 repeat sampling locations 1990-2009 overall vs. sites where at least one *I. scapularis* was collected (positive sites)

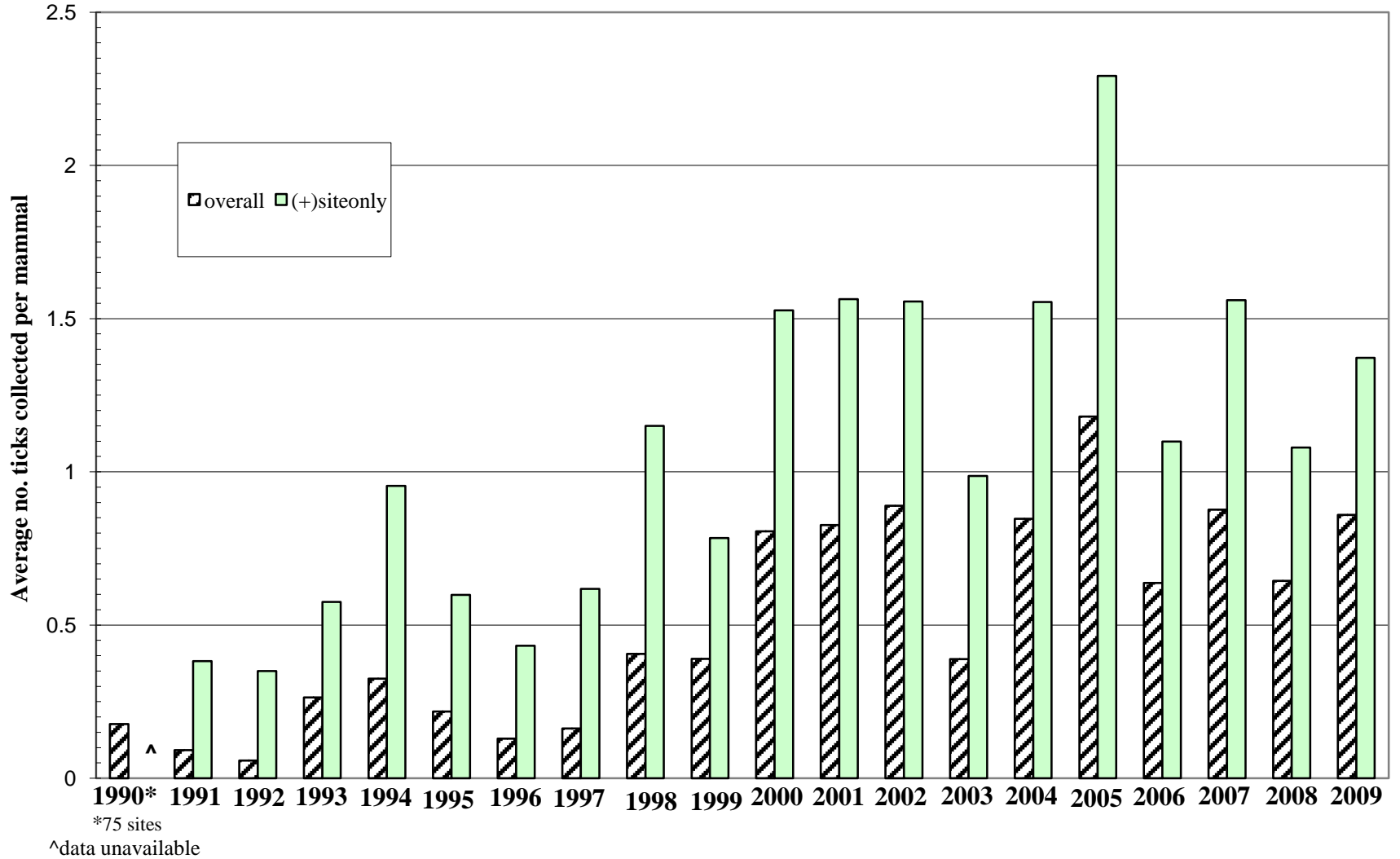


Table 2. Numbers and Percentages of Small Mammals Collected by Year

Year	No. sites	Total mammals collected	Avg collected per site and [100 repeat sites only]	<i>Peromyscus leucopus</i> percent (n)	<i>Tamias striatus</i> percent (n)	<i>Clethrionomys gapperi</i> percent (n)	<i>Blarina brevicauda</i> percent (n)	Other* percent (n)
^a 1990	250	3651	14.6 [17.15 @75 sites]	80% (2921)	6% (224)	7% (240)	4% (155)	3% (111)
1991	270	5566	20.61 [23.54]	77% (4308)	7% (395)	5% (264)	7% (402)	4% (197)
1992	200	2544	12.72 [12.68]	71% (1804)	9% (223)	4% (103)	13% (329)	3% (85)
1993	100	1543	[15.43]	81% (1243)	4% (69)	7% (101)	7% (107)	1% (23)
1994	100	1672	[16.72]	78% (1309)	10% (171)	5% (79)	5% (76)	2% (37)
1995	100	1406	[14.06]	79% (1115)	11% (156)	4% (55)	4% (61)	1% (19)
1996	100	791	[7.91]	79% (628)	11% (84)	3.5% (29)	3.5% (28)	3% (22)
1997	100	728	[7.28]	71% (515)	13% (98)	3% (24)	10% (71)	3% (20)
1998	100	1246	[12.46]	84% (1041)	4% (51)	3% (42)	6% (72)	3% (40)
1999	100	1627	[16.27]	85% (1376)	7% (108)	3% (46)	4% (63)	1% (9)
2000	100	1173	[11.73]	83% (968)	7% (86)	5% (55)	2% (28)	3% (36)
2001	100	897	[8.97]	80% (719)	6% (58)	7% (63)	4% (39)	2% (18)
2002	100	1236	[12.36]	87% (1074)	6% (73)	3% (42)	2% (27)	2% (19)
2003	100	1226	[12.26]	88% (1081)	6% (72)	3% (36)	1% (16)	2% (21)
2004	100	1152	[11.52]	87% (1007)	6% (71)	3% (40)	2% (20)	1% (14)
2005	100	965	[9.65]	87% (841)	6% (54)	4% (37)	2% (16)	2% (17)
2006	100	1241	[12.41]	85% (1056)	4% (54)	8% (94)	0% (2)	3% (35)
2007	100	849	[8.49]	85% (721)	8% (71)	5% (42)	1% (5)	1% (10)
2008	100	702	[7.02]	80% (561)	8% (53)	6% (43)	4% (29)	1% (8)
2009	100	941	[9.41]	86% (809)	4% (40)	5% (47)	1% (14)	3% (31)

*Other includes *Microtus pennsylvanicus*, *Spermophilus tridecemlineatus*, *Zapus hudsonius*, *Mustela erminea*, *Tamiasciurus hudsonicus*, *Glaucomys volans*, *Sorex arcticus*, *Sorex cinereus*, and several ground-feeding bird species.

Table 3. Numbers and Percentages of Tick Species Collected by Stage and Year

Year	No. sites	Total ticks collected	<i>Dermacentor variabilis</i> L ^b percent (n)	<i>Dermacentor variabilis</i> N ^c percent (n)	<i>Ixodes scapularis</i> L ^b percent (n)	<i>Ixodes scapularis</i> N ^c percent (n)	Other species ^d percent (n)
^a 1990	250	9957	83% (8289)	10% (994)	6% (573)	1% (74)	0% (27)
1991	270	8452	81% (6807)	13% (1094)	5% (441)	1% (73)	0% (37)
1992	200	4130	79% (3259)	17% (703)	3% (114)	1% (34)	0% (20)
1993	100	1785	64% (1136)	12% (221)	22% (388)	1% (21)	1% (19)
1994	100	1514	53% (797)	11% (163)	31% (476)	4% (67)	1% (11)
1995	100	1196	54% (650)	19% (232)	22% (258)	4% (48)	1% (8)
1996	100	724	64% (466)	20% (146)	11% (82)	3% (20)	1% (10)
1997	100	693	73% (506)	10% (66)	14% (96)	3% (22)	0% (3)
1998	100	1389	56% (779)	7% (100)	32% (439)	5% (67)	0% (4)
1999	100	1594	51% (820)	8% (128)	36% (570)	4% (64)	1% (12)
2000	100	2207	47% (1030)	10% (228)	31% (688)	12% (257)	0% (4)
2001	100	1957	54% (1054)	8% (159)	36% (697)	2% (44)	0% (3)
2002	100	2185	36% (797)	13% (280)	42% (922)	8% (177)	0% (9)
2003	100	1293	52% (676)	11% (139)	26% (337)	11% (140)	0% (1)
2004	100	1773	37% (653)	8% (136)	51% (901)	4% (75)	0% (8)
2005	100	1974	36% (708)	6% (120)	53% (1054)	4% (85)	0% (7)
2006	100	1353	30% (411)	10% (140)	54% (733)	4% (58)	1% (11)
2007	100	1700	47% (807)	8% (136)	33% (566)	10% (178)	1% (13)
2008	100	1005	48% (485)	6% (61)	34% (340)	11% (112)	1% (7)
2009	100	1897	48% (916)	9% (170)	39% (747)	3% (61)	0% (3)

^a 1990 data excludes one *Tamias striatus* with 102 larval & 31 nymphal *I. scapularis*

^b L = larvae

^c N = nymphs

^d Other species mostly *Ixodes muris* 1999-2nd adult *I. muris* collected 2007-collected 7 *I. marxi* nymphs

ADDRESSING INPUT FROM THE LYME DISEASE TICK ADVISORY BOARD – INFESTED MAMMALS.

EXTRA 2009 REPORT ITEM:

In each recent year's distribution study report I have been attempting to show a pattern of an elevated *I. scapularis* population primarily via describing three important pieces - the overall average number of *I. scapularis* collected per mammal, the greater numbers of positive sites tabulated now, and showing how *I. scapularis* are being collected from a larger geographical area (results specifically from our sites located south of the Mississippi River). I tend to attempt to point out differences pre-2000 and post-2000. These are also the items I tend think about to come up with my own conclusion of the current season's results.

The LDTAB was interested in infested mammal information, so I attempted to compile some information for you. To me, the attached table and maps seem to support my conclusion that there are more *I. scapularis* in the metro now. Because in 1990 we had created a primitive infested mammal map, I took our 2009 data and compiled it the same way. I also wanted to show the reader what the 2009 infested mammal percentages were, so I made an additional map. When you examine the numeric percentage map for 2009 and compare that to the 1990 map key it is pretty obvious some changes in infestation have occurred! On the maps do not assume that every township was sampled. Be sure to compare the sampling location maps with the shaded infested mammal maps.

In the table below I did not use a systematic method to select what years I chose, I just picked a higher (2002 and post-2000) and lower (1995 and pre-2000) *I. scapularis* collection year to compare with 2009.

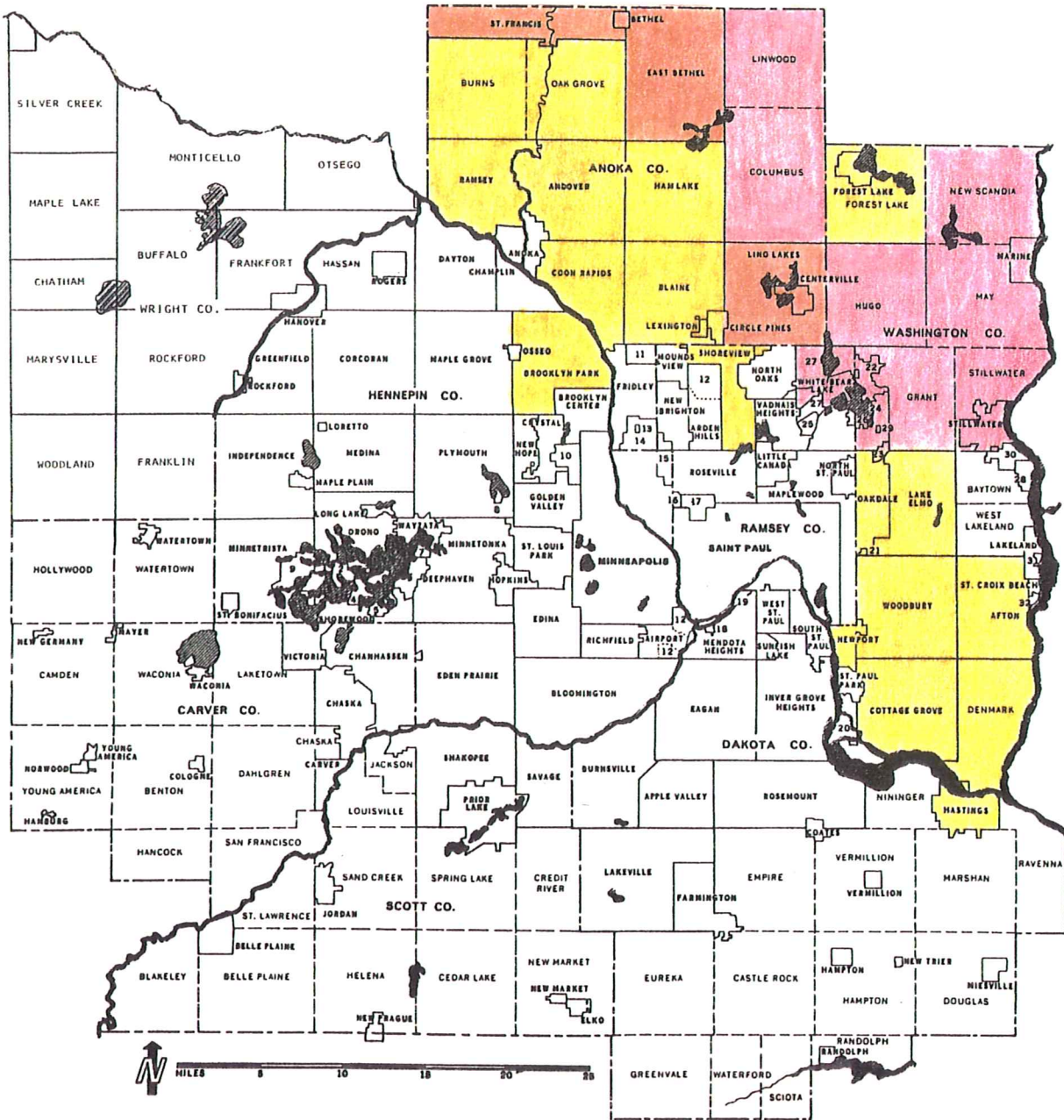
Comparison of infested mammals in three time periods (lower, higher IS collections vs 2009)

Note: Be suspicious of interpreting data by month.

High IS numbers are influenced most by what route is sampled in a particular week.

		april	may	june	july	august	sept	october	
	1995	0 of 23	2 of 92	38 of 267	24 of 244	26 of 251	28 of 281	6 of 248	# mammals w/IS vs total mam collected
IS/mammal	0.218		1 to 3	1 to 13	1 to 6	1 to 10	1 to 13	1 to 7	range of IS on infested mammals
		0%	2%	14%	10%	10%	10%	2%	% infested mammals
	2002	1 of 9	2 of 86	72 of 194	43 of 242	58 of 224	27 of 192	19 of 289	# mammals w/IS vs total mam collected
IS/mammal	0.889	1	1	*1 to 87	1 to 29	1 to 32	1 to 13	1 to 3	range of IS on infested mammals
		11%	2%	37%	18%	26%	14%	7%	% infested mammals
				*1 chip 49L;38N					
				excluding it, range becomes 1 to 35					
	2009	1 of 17	24 of 54	46 of 127	59 of 191	27 of 152	39 of 182	2 of 218	# mammals w/IS vs total mam collected
IS/mammal	0.859	1	1 to 11	1 to 21	1 to 56	1 to 17	1 to 9	3 to 7	range of IS on infested mammals
		6%	44%	36%	31%	18%	21%	1%	% infested mammals

Percentage Of Small Mammals With Ixodes dammini By Township (1990)

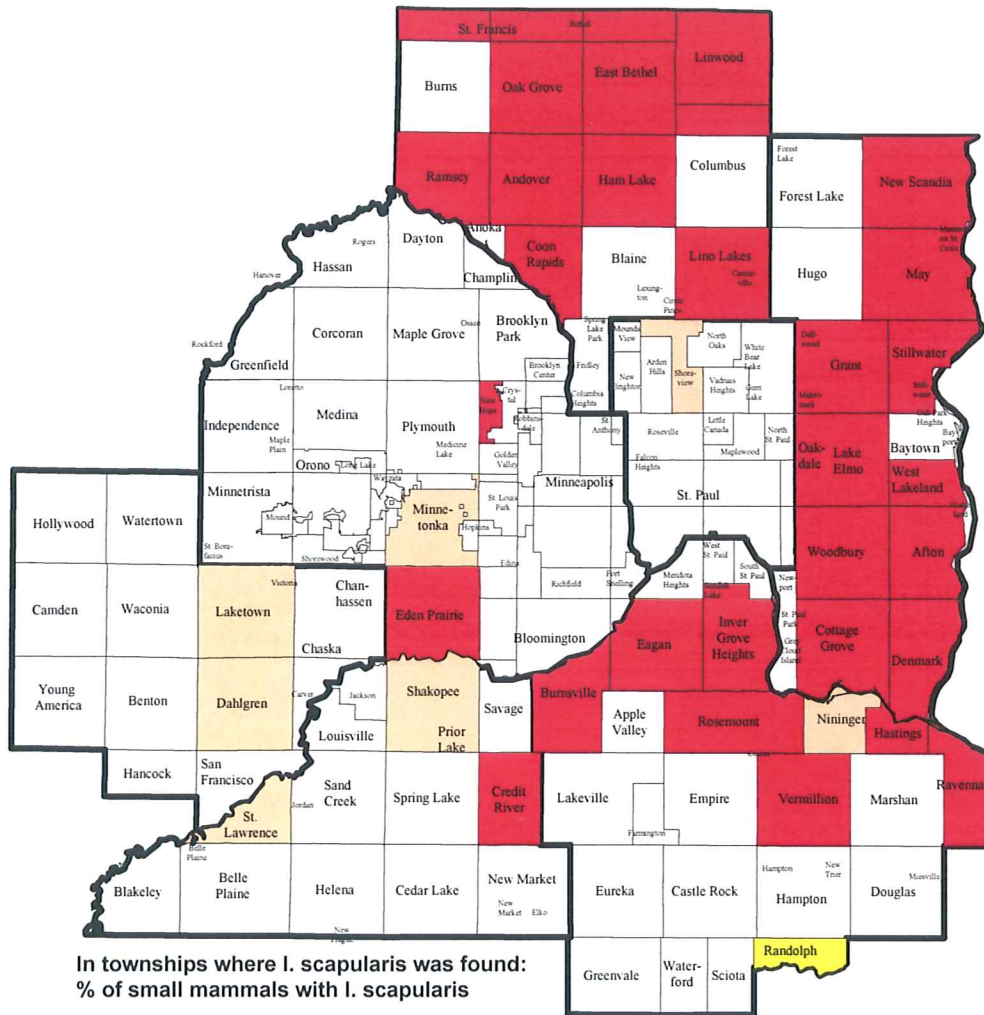


In townships where I. dammini was found:

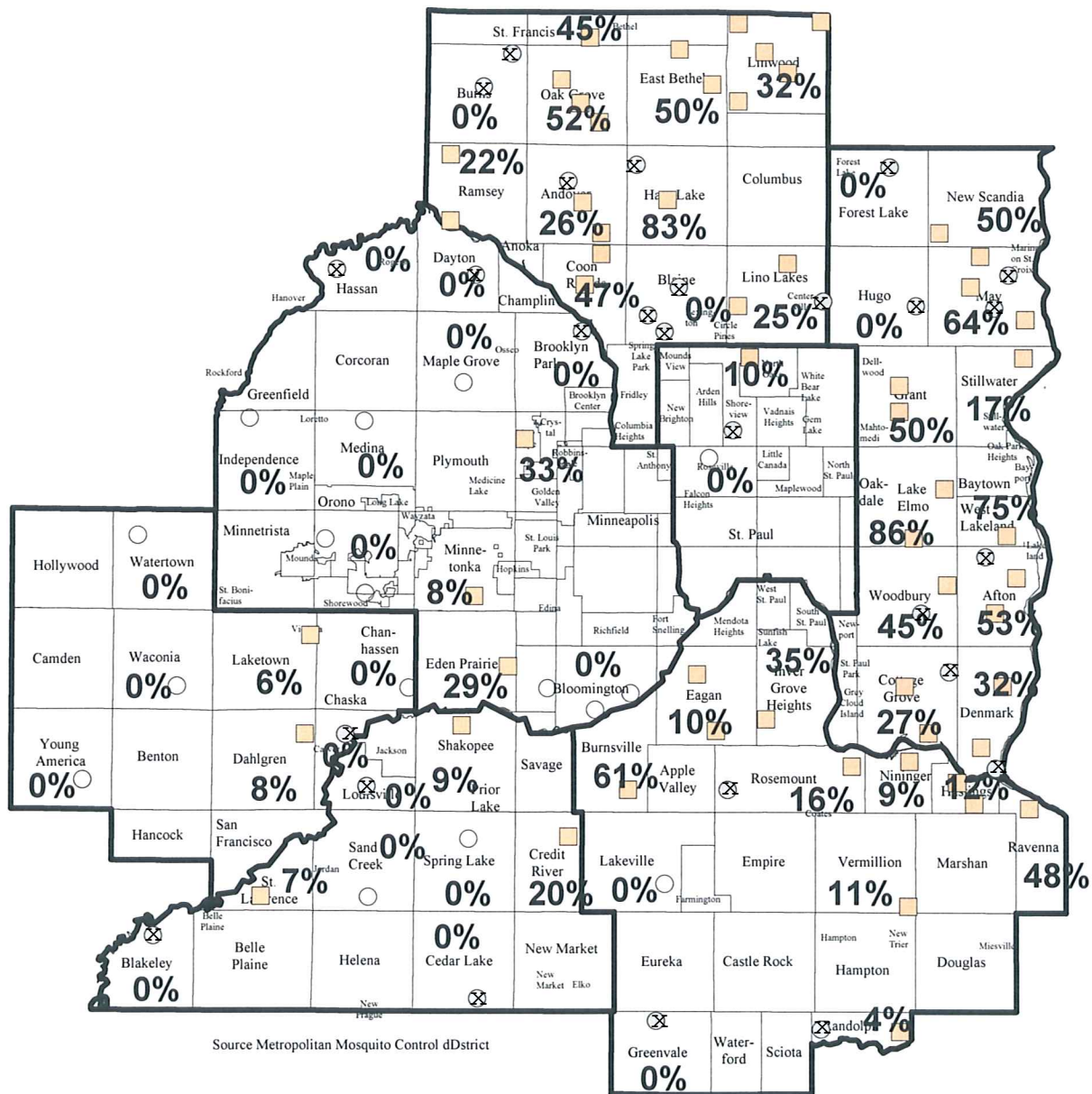
% of small mammals with I. dammini

- = ≥10%
- = ≥5% < 10%
- = < 5%

Percentage of small mammals with *Ixodes scapularis*
by township (2009)
Using key from 1990



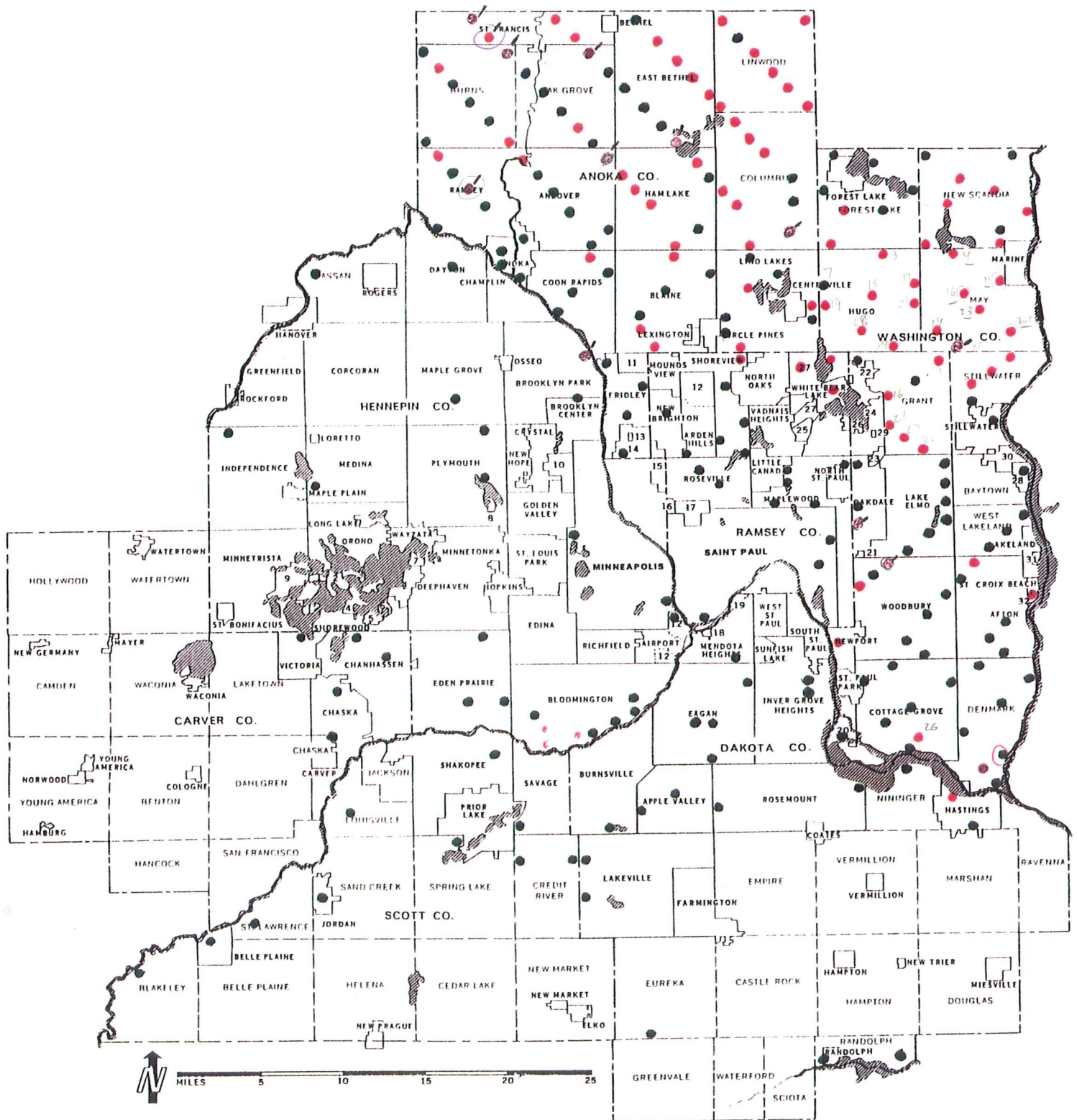
Numeric percentage of small mammals with *Ixodes scapularis* vs presence/absence status 2009 (Figure 5A)



(present if at least one *I. scapularis* is collected)

Status 2009	
present	(57)
absent this year	(27)
not found 1990-2009	(16)

1990 *Ixodes dammini* Presence/Absence Study Map of Sampling Locations (n=250)



Key:

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