

Metropolitan Mosquito Control District
***Ixodes scapularis* DISTRIBUTION STUDY**
2008

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. In 2008 we again collected *I. scapularis* from at least one site in all seven counties that comprise our service area (first occurrence was 2007). Overall, we tabulated 52 positive sites (at least one *I. scapularis* collected), a total in the 50's for the 4th consecutive year and for only the 6th 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 2008 total of 19 (12 Dakota, 3 Hennepin, 2 Scott, and 2 Carver) is another new record; our previous high of 16 occurred in 2007. A total of 452 *I. scapularis* were removed from 702 mammals for an overall season mean of .644 *I. scapularis* per mammal; comparable to 2006 (.637) and while lower than our elevated averages of 2000 – 2002, 2004, 2005, and 2007 (all \geq .806), still higher than any other year. While our larval *I. scapularis* collections were low, we collected 112 nymphs - a nymph count in the 100's for only the 5th time (all since 2000). The Anoka County sites accounted for 52% of the total 2008 *I. scapularis* collections (136L; 98N) with the highest numbers collected in Coon Rapids (69L; 64N) township. Our Washington County sites accounted for an additional 23% (99L; 5N) of our *I. scapularis* collections with another 20% collected in Dakota County. Townships maintaining *I. scapularis* per mammal averages \geq 1.0 included Coon Rapids, Ham Lake, Linwood, Saint Francis, Andover, East Bethel, and Blaine of Anoka County (range 1.0 – 7.824), Cottage Grove, Grant, Denmark, and Lakeland of Washington County (range 1.0 – 1.917), and Inver Grove Heights (1.727) and Rosemount (1.069) of Dakota County. Oak Grove (Anoka), May (Washington), Vermillion (Dakota), and Credit River (Scott) townships all averaged \geq .500 *I. scapularis* per mammal. Anoka County maintained the highest 1990-2008 overall season mean (.917), followed by Washington County (.742). Our compiled 1990-2008 township averages (all $>$ 1.0) include May, New Scandia, Hugo, and Grant of Washington County, and Coon Rapids, Blaine, Ham Lake, East Bethel, and Saint Francis of Anoka County. South of the Mississippi River, the highest 1991-2008 averages ($>$.500 *I. scapularis* per mammal) occurred in Inver Grove Heights and Vermillion townships of Dakota County. Both small mammal and immature tick species diversity in 2008 appeared comparable to past years although the tabulation of “only” 45% *I. scapularis* overall is atypical; *I. scapularis* comprised \geq 50% of our overall collections four times between 2002 and 2006. As in past years, *Peromyscus leucopus* was the predominant mammal species collected. The 2008 average number of mammals collected per site (7.02) is our lowest tabulated average since 1990, although comparable to 1997 (7.28). Examining human data, as of June 24, 2009, final tallies for 2008 were not yet available from the MN Dept Health (MDH). However, the 2008 totals for Lyme (roughly 1050) and human granulocytic anaplasmosis (nearing 280) will be close to their record setting totals of 2007. Although 2008 tallies for the metro area were not yet available as of June 24, 2009, the 2007 metro-exposed case totals had also been all-time highs (80 Lyme, 9 HGA). Despite the numeric drop in our 2008 *I. scapularis* collections, our overall results seem to indicate that the metro *I. scapularis* population continues to remain 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. Of note was the collection of *I. scapularis* in 2007 and 2008 at two Ramsey County parks-extra sites that until 2007 were last sampled in 1990 and where *I. scapularis* had been previously undetected.

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:

Two additional sites were sampled from 1995-1997; 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.

Although we are still sampling a limited number of parks today, in 1990 a larger number of our sampling sites had been selected inside metropolitan parks to provide a primitive assessment of park user risk to potential encounters with *I. scapularis*. Included were Joy Park in North Saint Paul (62-08-01) and a location near Pigs Eye Lake in St Paul (62-13-02) and *I. scapularis* was not collected at either park in three rounds of sampling. These two Ramsey County parks were re-sampled in 2007 and again in 2008 as extra sites. The 2007-08 Joy Park site was in the same (square mile) section, but east of our 1990 location. The 2007-08 Pigs Eye site was moved over one section, to section 3. Unlike 1990, only two rounds of sampling were performed at these two sites in 2007 and 2008.

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 21, 2008 and ended on October 23, 2008 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

➤ 2008 Study (Repeat Sites):

In 2008 we replicated our 2007 results, when for the first time in a single sampling season we had collected *I. scapularis* from at least one site in all seven counties comprising our service area. Specifically, in 2008 we found at least one *I. scapularis* at 52 of our 100 sampling sites, with 33 of these positive sites located north of the Mississippi River in Anoka (15 sites positive/28 sites sampled), Washington (16 sites positive/25 sites sampled), and Ramsey (2 sites positive/3 sites sampled) counties. Nineteen additional positive sites were detected south of the river in Dakota (12), Hennepin (3), Scott (2), and Carver (2) counties (Figure 5A).

Overall, 702 mammals (Figure 1 and 2008 results in Table 2) were inspected: 282 from north of the Mississippi River and 420 from south of the river and a total of 452 *I. scapularis* (Figure 2 and 2008 results in Table 3) were collected from them. The Anoka County sites accounted for 52% of the total

I. scapularis collections (136L; 98N) with the highest numbers collected in Coon Rapids (69L; 64N) township. An additional 23% of the total (99L; 5N) were collected from our Washington County sites, with the highest collections occurring in Denmark (35L) and Cottage Grove (23L) townships. We collected a total of 100 *I. scapularis* (94L; 6N) from our sites located south of the Mississippi River, with the majority (84L; 6N) collected from within Dakota County.

The overall season mean number of *I. scapularis* collected per mammal in 2008 was .644 (larvae: .484, nymphs: .160). The mean increases to 1.079 (larvae: .811, nymphs: .267) when all sites negative for *I. scapularis* are excluded (see 2008 results in Figure 6). The highest average number of *I. scapularis* per mammal was calculated for Anoka County, which had a season mean of 2.187 compared with Washington (.698), Ramsey (.538) and Dakota (.459) county's season means (see 2008 results in Figure 3). Townships in Anoka County averaging ≥ 1.0 *I. scapularis* per mammal in 2008 included Coon Rapids (7.824), Ham Lake (4.600), Linwood (2.800), Saint Francis (1.667), Andover (1.036), East Bethel (1.0), and Blaine (1.0), with Oak Grove (.556) township averaging $\geq .500$ *I. scapularis* per mammal. Cottage Grove (1.917), Grant (1.100), Denmark (1.0), Lakeland (1.0), and May (.692) townships of Washington County maintained averages $\geq .500$ *I. scapularis* per mammal (Figure 4), as did Inver Grove Heights (1.727), Rosemount (1.069), and Vermillion (.536) of Dakota County and Credit River (.500) of Scott County, south¹ of the Mississippi River (no figure).

I. scapularis detected again at several Ramsey County parks.

Joy Park in North St Paul (near Silver Lake) and a location near Pigs Eye Lake in St Paul had been sampled in 1990 and *I. scapularis* was not collected at either park in three rounds of sampling. These same general areas were re-sampled as extra sites in 2007 and again in 2008. In 2007 we had removed a total of ten *I. scapularis* larvae from two mammals in Joy Park as well as one nymph from one mammal at Pigs Eye in two rounds of sampling. In 2008 we collected another three nymphs from one mammal in Joy Park and a total of two larvae and one nymph from two mammals at Pigs Eye. In both years it was possible that additional *I. scapularis* could have been collected but neither park was sampled in our final, third round.

➤ **Compiled Results (Repeat Sites) from 1990 - 2008 or 1991 - 2008:**

The 1990-2008 mean number of *I. scapularis* collected per mammal is .462, 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 1990-2008 overall season mean (north of the Mississippi River) was tabulated for Anoka County (.917), followed closely by Washington County (.742). The 1990-2008 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 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 – 2008), both Inver Grove Heights (.932) and Vermillion (.695) townships of Dakota County maintained 1991-2008 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 81 of the sites since 1990 or 1991 (see 2008 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-next page).

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

	1992	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. sites changing status	26	38	47	58	61	66	69	72	75	76	78	80	81
Ticks found:													
all years	21	17	11	5	5	5	4	3	1	1	1	1	1
most years	5	15	19	27	31	34	35	37	38	41	41	45	42
least	21	23	28	31	30	32	34	35	37	35	37	35	39
(not found)	53	45	42	37	34	29	27	25	24	23	21	19	18

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 2008 is yet another new record total (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
Total sites south of river	*1	2	4	4	7	10	12	6	9	10	12	16	19
By county:													
Dakota	*1	2	4	2	6	7	8	6	8	7	9	10	12
Hennepin	*0	0	0	1	1	2	3	0	0	1	2	3	3
Scott	*0	0	0	1	0	1	1	0	1	2	1	2	2
Carver	*0	0	0	0	0	0	0	0	0	0	0	1	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 2008 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, although the tabulation of “only” 45% *I. scapularis* overall is similar to 2007 and atypical for recent years; *I. scapularis* comprised $\geq 50\%$ of our overall collections four times in the five year period between 2002 - 2006 (Table 3). Our 2008 overall season mean of .644 *I. scapularis* per mammal is comparable to 2006 (.637) and while lower than 2000 – 2002, 2004, 2005 and 2007’s elevated averages (all $\geq .806$), still higher than any other year (Figures 3 and 6). In 2008 we collected a total number of larval *I. scapularis* comparable to 2003, but due to our low overall 2008 small mammal collection total (Table 2), the overall compiled percentage of larval *I. scapularis* is similar to many other “higher collection” years (Table 3). Further, in 2008 we collected 112 *I. scapularis* nymphs – a nymphal total in the hundreds for only the 5th time (all since 2000) since the inception of this study. *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 2008 average number of mammals collected per site (7.02) appears to represent a lower than typical yearly small mammal collection level, and, while comparable to 1997 (7.28), is in fact the lowest average we have tabulated

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 reports.

since the inception of this study (Table 2). Our compiled average small mammal collection success level per site for 1990 through 2008 is 13.02 (1991-2008 average of 12.27 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.

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 cannot deny that Lyme disease risk via greater *I. scapularis* exposure opportunities may be occurring now in areas south of the Mississippi River as well.

Our 2008 results are interesting and not what we had hypothesized before our data was summarized and inserted into tables and graphs. From our initial hand counted tabulations we knew that our small mammal and overall tick collections (both *Dermacentor variabilis* and *I. scapularis*) were going to be low (Tables 2 and 3) and therefore considered that we might document fewer positive sites and other indicators of a low *I. scapularis* population when compared to recent years. However, as we began compiling information and placing into historical tables and graphs we quickly realized that we were again detecting signs of an elevated metro *I. scapularis* population. A quick examination of Table 3 does show low numerical tick collections for 2008, but it also shows that in overall percentages our *I. scapularis* collections are higher than many other years. Further, it illustrates the overall rarity in our study of an *I. scapularis* nymph count in the hundreds (112 for 2008) and documents that all five of these high counts have occurred since 2000. We consider our overall positive site total of 52 as another sign; it is high when looking at all years of this study even though it generally appears to be roughly the new expected norm since 2000 (Figure 3). The placement of the positive sites as illustrated in Figure 5A is yet another sign, as for the 2nd consecutive year we collected at least one *I. scapularis* from all seven counties that comprise our service area. We also continue to tabulate more positive sites south of the Mississippi River and again in 2008 documented yet another new record high positive site total, as evidenced in Table 1A. Although an argument could be made that our low small mammal collections of 2008 (Table 2) could have artificially inflated our 2008 *I. scapularis* average, we feel our ongoing compilations of high averages and positive site totals since 2000 along with additional indicator signs like new single season records and the detection of *I. scapularis* in an expanding geographic area seem to justify our ongoing elevated *I. scapularis* population conclusion.

Further support to our elevated *I. scapularis* conclusion seems to be provided by our continued detection of *I. scapularis* in our supplemental surveillance of two Ramsey County park sites in 2007 and 2008; *I. scapularis* was found in these areas in both years whereas they had not been detected in 1990. While we acknowledge that *I. scapularis* could have simply remained undetected in 1990, especially as we had sampled for only one season, and while we acknowledge that both Figure 5A and Figure 5 document positive *I. scapularis* sites near both parks, we feel it is just as likely that *I. scapularis* populations have increased or small numbers magnified enough so that our surveillance has been able to detect them in two consecutive years.

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).

Examining human data, as of June 24, 2009, final tallies for 2008 were not yet available from the MN Dept Health (MDH). However, the 2008 totals for Lyme (roughly 1050) and human granulocytic anaplasmosis (nearing 280) will be close to their record setting totals of 2007 (Lyme (1239) and human granulocytic anaplasmosis (322)). The prior all-time high statewide Lyme disease tabulation had been 1023 cases (2004) with the Lyme case totals of 2005 (918), 2006 (914), and 2002 (867) also at very high levels compared to other years.

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. It was also in 2000 that the MDH began compiling larger human tick-borne disease totals. Compared with roughly 250 cases per year for prior years, their statewide Lyme case total in 2000 was 463 cases, with the Lyme case totals of 2001 (465 cases), and 2003 (473 cases) being comparable. 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 new record of 322 HGA cases for 2007 that much more impressive.

The Twin Cities metro tick-borne disease case totals have also risen over time, but not as dramatically as the statewide totals. Although 2008 tallies were not available as of June 24, 2009, 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 - 2006 MDH typically tabulated a few metro-exposed HGA cases each year (range 0-7) and this trend obviously continued in 2007 with their tabulation of 9 metro-exposed HGA cases.

All in all we feel our data continues to support our conclusion of an elevated *I. scapularis* population since 2000. If our future surveillance continues to show similar overall results, at some point we will have to consider that the metro *I. scapularis* population has stabilized from an elevated level to a new norm. Our recent yearly results, including those from 2008, appear to offer evidence that our Twin Cities residents' risk of encountering *I. scapularis* locally is likely not only greater than in the past due to higher volumes of ticks in general, but also due to a greater spread geographically than we had once detected.

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:

CONTINUING STUDIES FOR 2009.

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

Small mammal collections through June 26, 2009 were higher than they had been in 2008, but were still lower than the average numbers collected in Round A in a typical year since 1990.

VECTOR TICKS IN MINNEAPOLIS AND ST PAUL – NEW STRATEGY 2009

In fall 2008 MMCD received two independent credible reports** of *I. scapularis* being found along the Mississippi River in the cities of Minneapolis and Saint Paul. In each case the tick was found on a dog. Mid-May through mid-June 2009, each area was intensely surveyed (flagged and/or dragged) by MMCD, but no additional ticks were found. While the survey effort was underway, staff made a point to communicate with citizens who were encountered. Citizens consistently continued to report finding ticks.

June 11, 2009 the Minnesota Department of Health (MDH) informed MMCD of an *Amblyomma americanum* (lone star tick) submission to MDH, most likely from Theodore Wirth Park, Mpls. This tick also had been collected from a dog. Previous *Amblyomma* ticks have been submitted to MMCD from the public on a rare, sporadic basis, but have all come from Scott County. *Amblyomma americanum* can transmit human monocytic ehrlichiosis (HME) in Minnesota, although both the tick and HME are more common to the southern US. A survey of Theodore Wirth Park was completed by MMCD on June 15, 2009 and zero ticks were collected. Staff did continue to receive citizen reports of ticks being collected in this park, too, however. In tandem, a survey in northern Dakota County confirmed that our sampling method and timing was adequate by collecting a total of 20 *Dermacentor variabilis* (wood tick).

On a stand alone basis each report is just an interesting submission. However, we now have three independent reports of tick vectors being collected well inside city limits that have all been found on dogs. Citizens in each of these survey areas continue to report that ticks are being found in 2009. MMCD put out a press release June 25, 2009 asking the public to submit ticks.

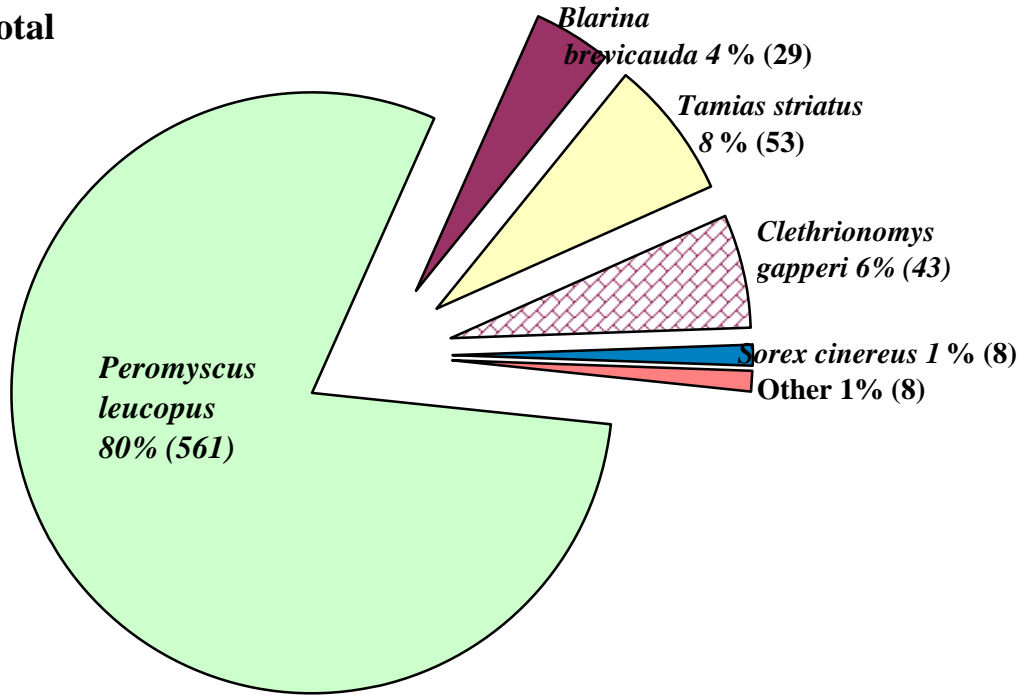
MMCD wishes to thank Lyme Disease Tick Advisory Board Member Dr. William Schmid for taking the time to provide us with his *Ixodes scapularis* collection report. His was the initial report of tick vector activity in the core city area.

How survey method was chosen:

Habitat in the general area described by Dr. Schmid and elsewhere was evaluated for the possible setting of small mammal traplines in May 2009. MMCD determined that though it would be physically possible to set a line in many spots, it was not worth the time commitment (there was good canopy coverage but it was difficult to see deer tick establishment happening due to no herb layer in many places as well as only intermittent brush. Further, it would be easy to hide traps from humans but not from the many dogs that were also along on a weekday walk). Use of an MMCD staff member's dog as a "collector dog" was briefly considered, but the idea was discarded for multiple reasons. Therefore, flagging and/or dragging became the chosen survey method.

**Small Mammals Collected
2008: 702 total**

Figure 1



**Ticks, by Species and Stage,
Removed from Small Mammals
2008: 1005 total**

Figure 2

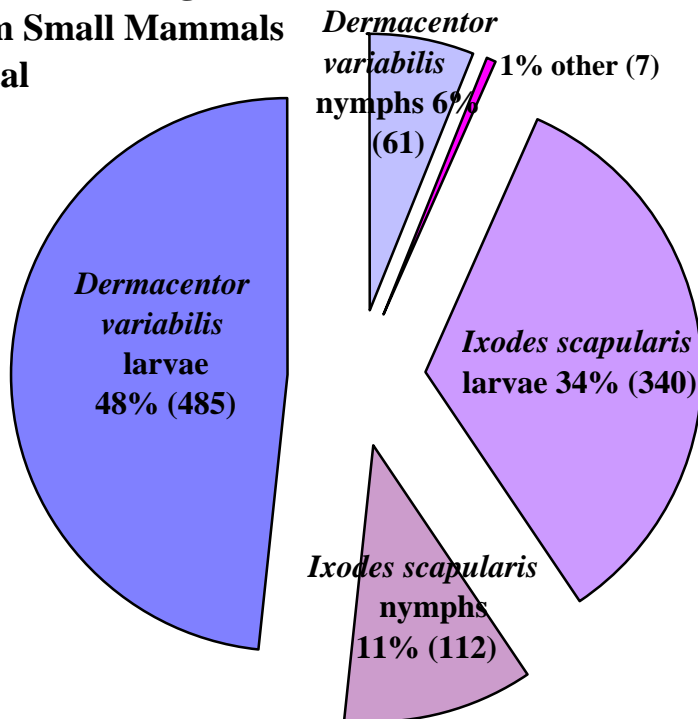


Figure 3

Average number of *I. scapularis* collected per mammal at 100 sampling locations in Anoka, Washington, and Ramsey counties: 1990 - 2008
(white box shows the total number of sites where at least one *I. scapularis* was found: by year)

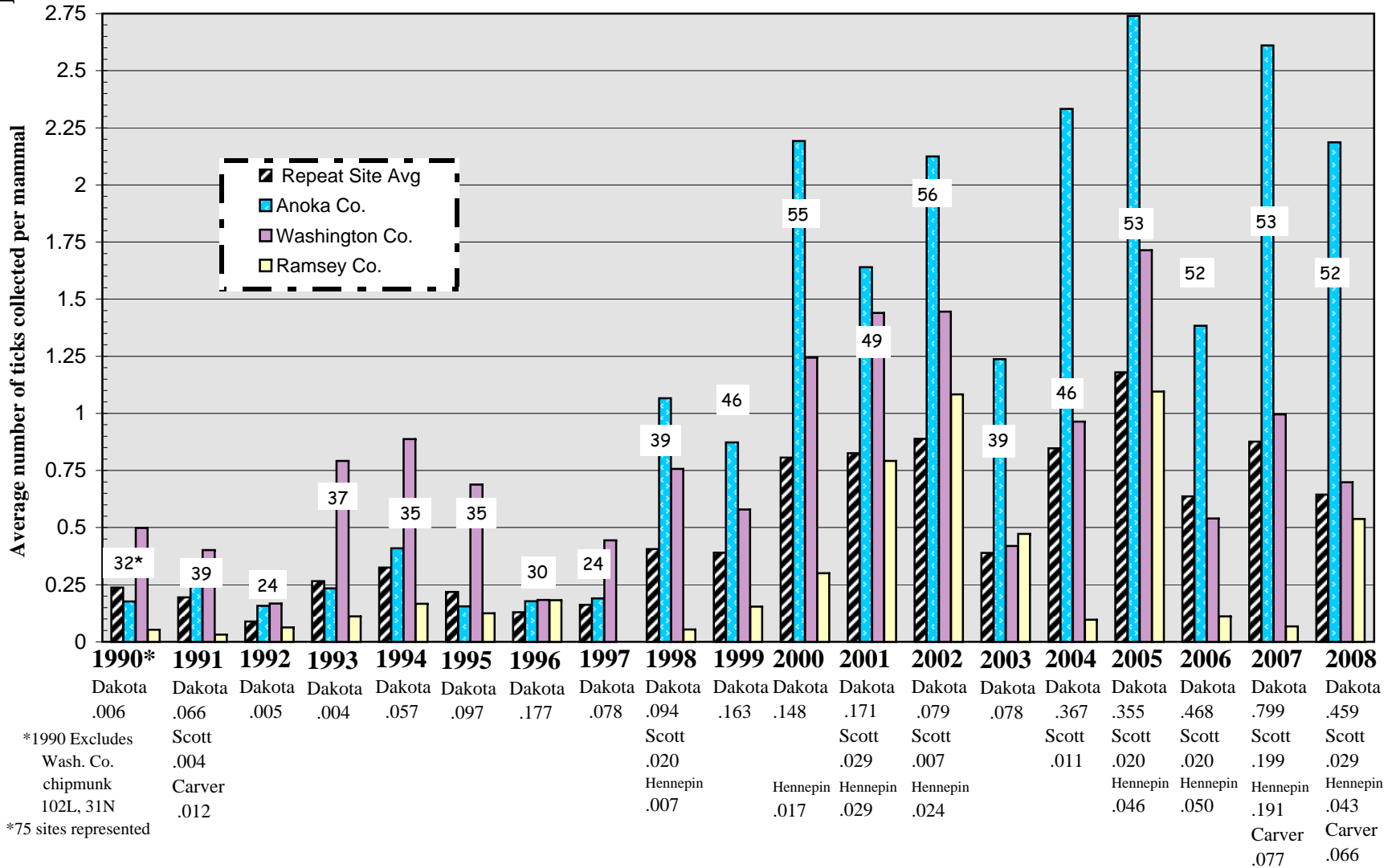
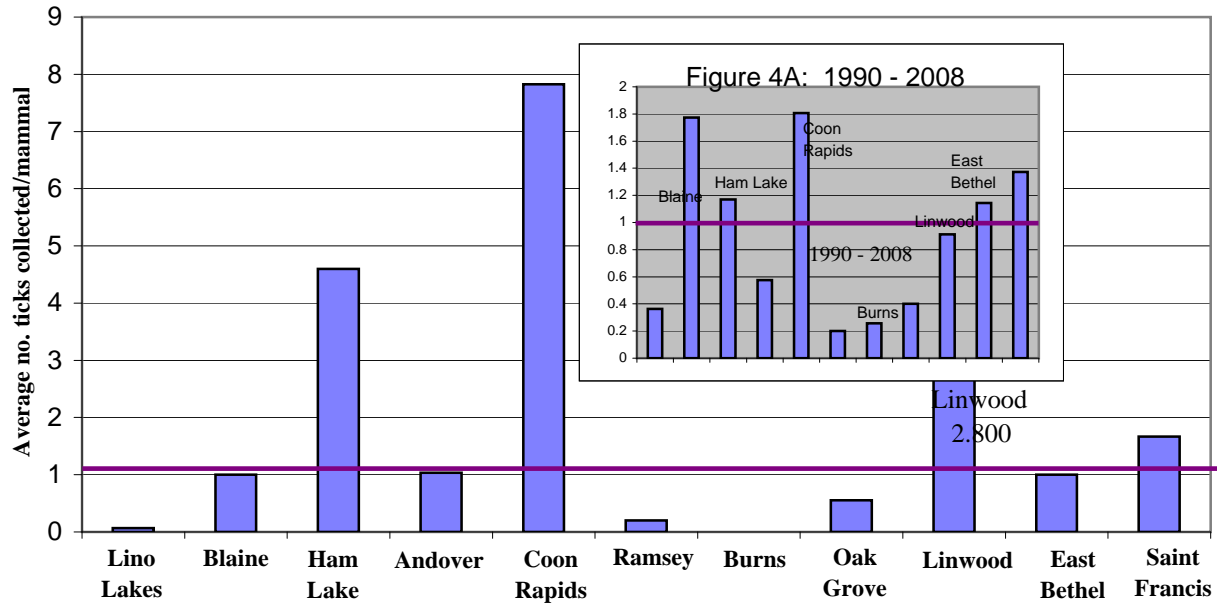
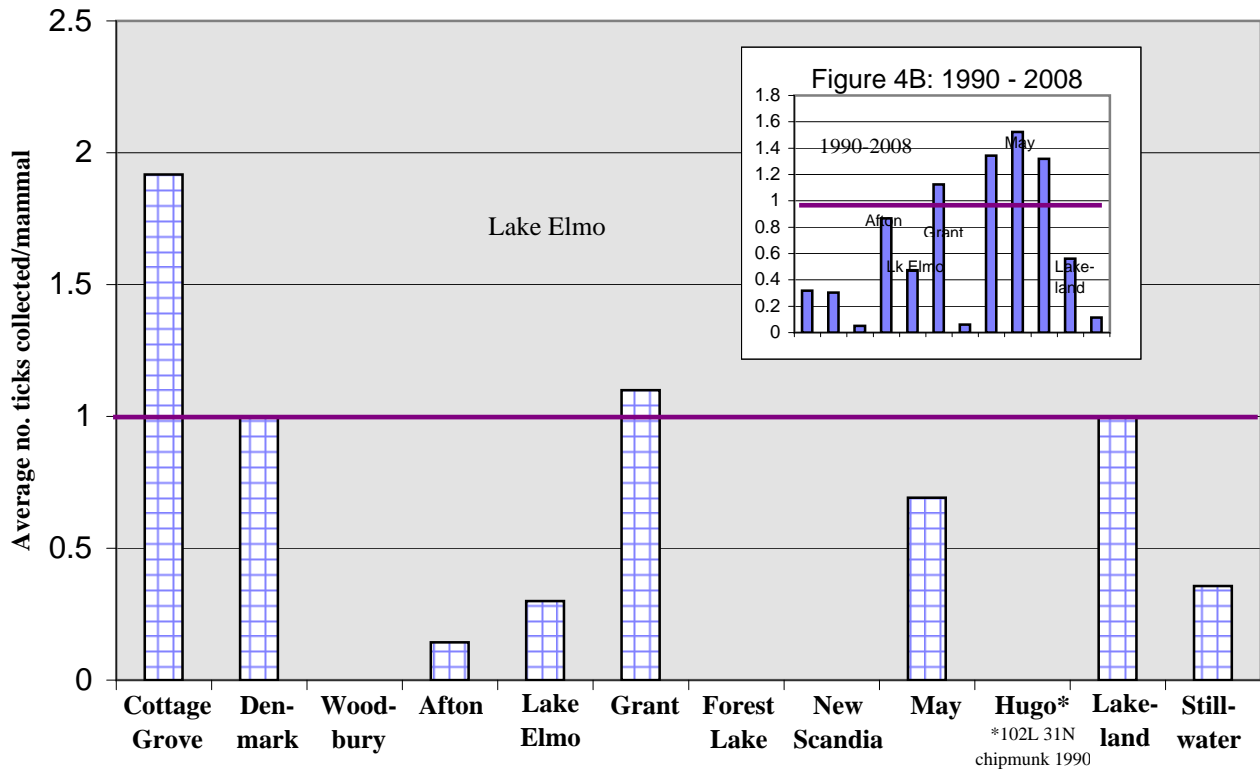


Figure 4

Average number of *I. scapularis* collected per mammal in Anoka county (by township): 2008 results



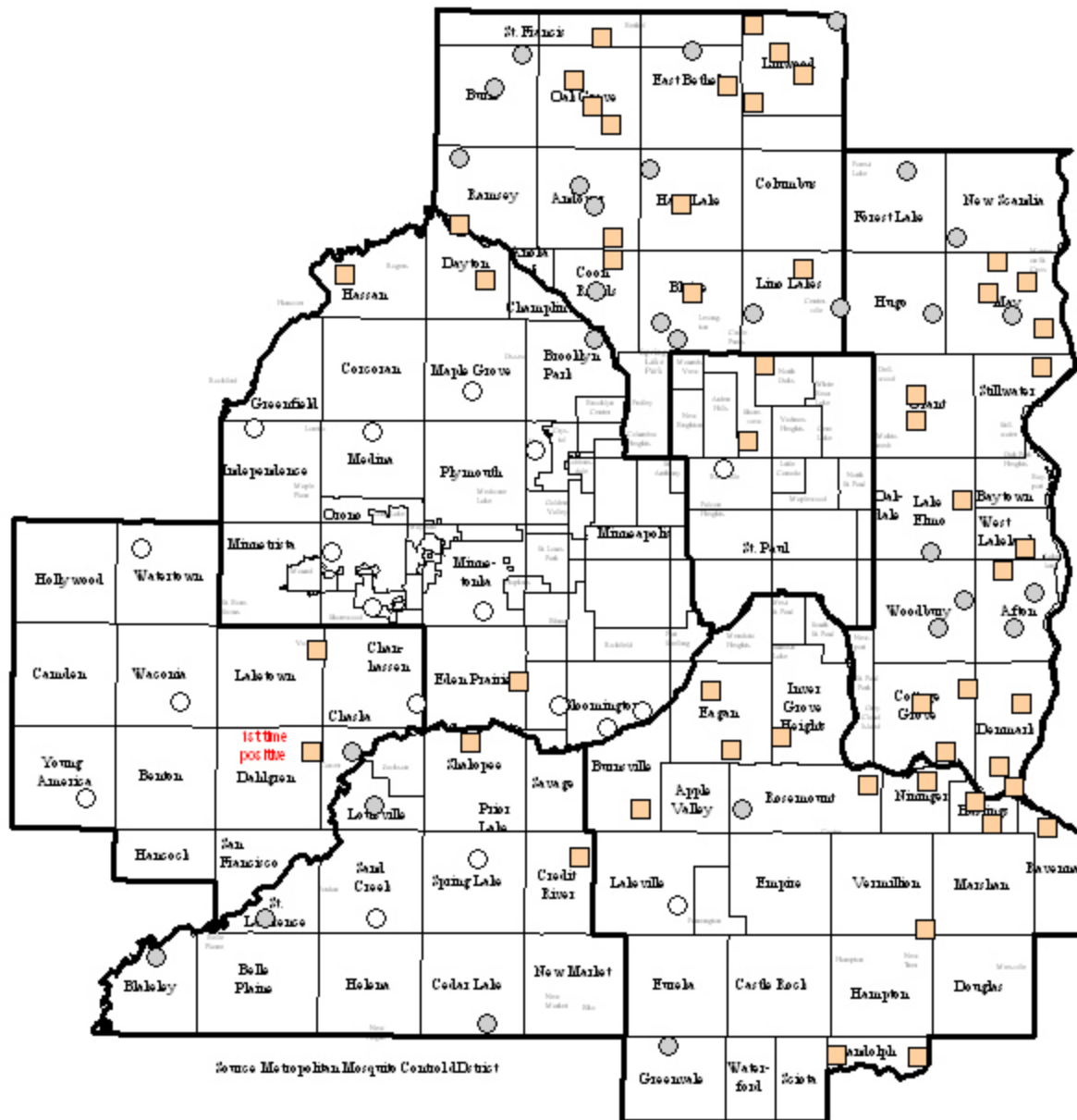
Average number of *I. scapularis* collected per mammal in Washington county (by township): 2008 results



*102L 31N chipmunk 1990

Figure 5A

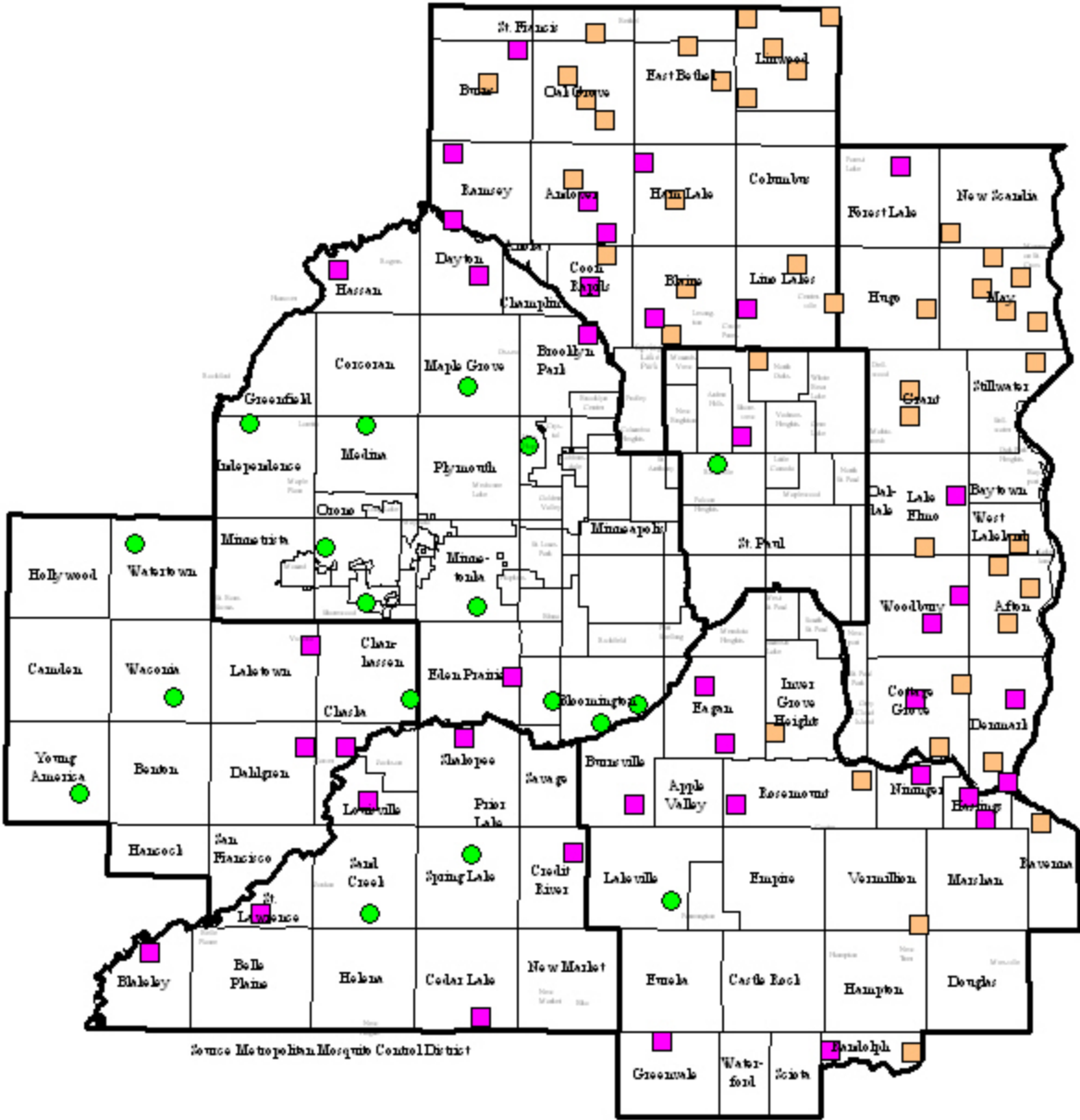
Ixodes scapularis Presence / Absence status: 2008
 (present if at least one *I. scapularis* is collected)



Status 2008	
■ present	(52)
● absent this year	(30)
○ not found 1990-2008	(18)

Figure 5

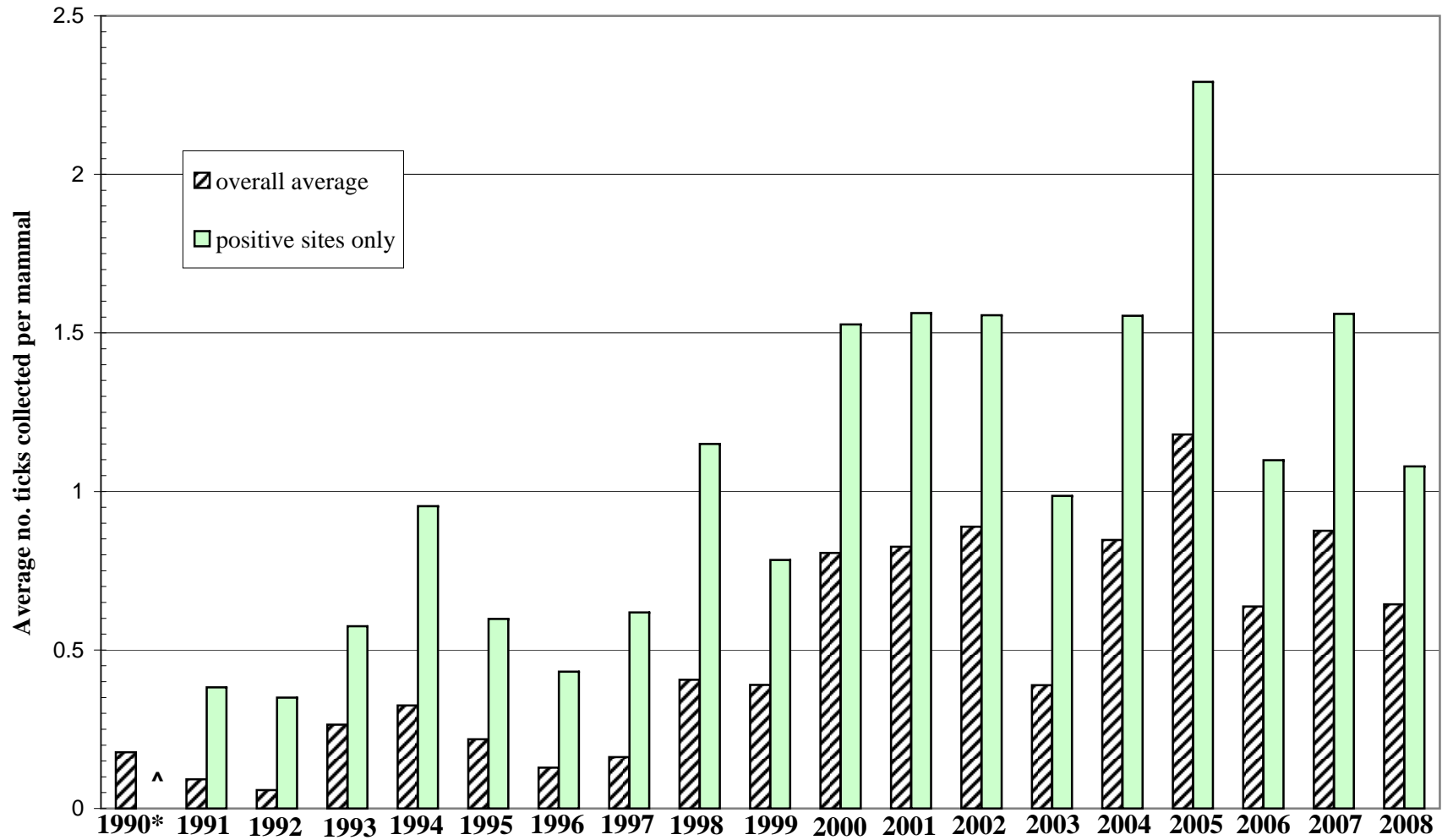
Ixodes scapularis Presence/Absence status: 1990 - 2008
(present if at least one *I. scapularis* is collected during a year)



At least one tick found during:	
Orange square	all/most years (43)
Pink square	at least one year (39)
Green circle	(not found) (18)

Figure 6

Average number of *I. scapularis* collected per mammal at 100 repeat sampling locations 1990-2008 overall vs. sites where at least one *I. scapularis* was collected (positive sites)



*75 sites

^data unavailable

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% (101)	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)

^aOther 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)

^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