Metropolitan Mosquito Control District
IXODES SCAPULARIS DISTRIBUTION STUDY
2011

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. Although from 2007-2010 we had collected *I. scapularis* from at least one site in all seven counties that comprise our service area, in 2011 we collected *I. scapularis* from all but Carver County. Overall, we tabulated 55 positive sites (at least one *I. scapularis* collected), a decrease from our record high of 70 (2010) but a more typical yearly result since 2000. From counties south of the Mississippi River, our 2011 positive site total of 26 (11 Dakota, 9 Hennepin, 6 Scott) is yet another new record (previous high of 24 (2010)). It was a low collection year for both mammals and ticks, with a total of 466 *I. scapularis* (high numbers of nymphs but low numbers of larvae) removed from 756 mammals for an overall season mean of .616 *I. scapularis* per mammal. Our Washington (28%) and Dakota (28%) county sites accounted for the majority of our 2011 collections with an additional 23% obtained from Anoka County. Townships maintaining *I. scapularis* per mammal averages $\geq$ 1.0 included Coon Rapids (5.846) of Anoka County, May, Stillwater, and Hugo of Washington County (range 1.0 – 1.871), Vermillion, Hastings, Randolph, Ravenna, and Burnsville of Dakota County (range 1.053 – 2.667), Eden Prairie (1.667) and Brooklyn Park (1.0) of Hennepin County, and Saint Lawrence (1.0) of Scott County. Andover, Linwood, Blaine (Anoka), Lake Elmo, New Scandia (Washington), Shoreview (Ramsey), Hassan (Hennepin), Eagle Creek, Blakeley, and Credit River (Scott) townships all averaged $\geq$ .500 *I. scapularis* per mammal. Anoka County maintained the highest 1990-2011 overall season mean (.960), followed by Washington County (.807). Our compiled 1990-2011 township averages (all > 1.0) include May, Hugo, New Scandia, and Grant of Washington County, and Coon Rapids, Blaine, Saint Francis, East Bethel, and Ham Lake of Anoka County. South of the river, the highest 1991-2011 averages (> .500 *I. scapularis* per mammal) occurred in Inver Grove Heights (1.035) and Vermillion (.713) townships of Dakota County. Both small mammal and immature tick species diversity in 2011 appeared comparable to past years. As in past years, *Peromyscus leucopus* was the predominant mammal species collected and for *I. scapularis*, since 2002 and including 2011, *I. scapularis* has comprised $\geq$ 50% of our overall collections six times. Our 205 nymphs collected is our second-highest nymph total since inception of the study. Although our 2011 totals were small, we feel that a Twin Cities resident's risk of encountering *I. scapularis* locally remains greater now 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 and *I. scapularis* was found again at Joy Park. Zero mammals were collected at Priory Preserve.

In 2010 Joy Park and Priory Reserve were sampled for two rounds and a new site, section 18 of Laketown Township in Carver County (a single adult *I. scapularis* had been collected in late July 2009), was sampled for all three rounds. *I. scapularis* were detected in Joy Park and Laketown Township; zero at Priory Reserve.

Materials and Methods

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

Sampling was initiated on April 25, 2011 and ended on October 27, 2011 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

- **2011 Study (Repeat Sites):**

From 2007-2010 we had collected *I. scapularis* from at least one site in all seven counties that comprise our service area, but in 2011 we collected *I. scapularis* from all counties but Carver County. Specifically, we found at least one *I. scapularis* at 55 of our 100 sampling sites, with 29 of these positive sites located north of the Mississippi River in Anoka (11 positive of 28 sites), Washington (17 of 25), and Ramsey (1 of 3) counties. Twenty-six additional positive sites were detected south of the river in Dakota (11 of 15), Hennepin (9 of 14), and Scott (6 of 8) counties (Figure 5A).

Overall, 756 mammals (Figure 1 and 2011 results in Table 2) were inspected: 287 from north of the Mississippi River and 469 from south of the river and a total of 466 *I. scapularis* (Figure 2 and 2011 results in Table 3) were collected from them. The Washington County sites accounted for 28% of the total *I. scapularis* collections (48L; 82N) with the highest numbers collected in May (21L; 37N) Township. Dakota County accounted for another 28% of our total *I. scapularis* collections (78L; 52N), with the highest numbers collected in Hastings (4L; 37N), Vermillion (17L; 24N), and Randolph (11L; 21N) townships. An additional 23% of the total (88L; 19N) were collected from our Anoka County sites, with the highest collections occurring in Coon Rapids (66L; 10N) Township.

The overall season mean number of *I. scapularis* collected per mammal in 2011 was .616 (larvae: .345, nymphs: .271). The mean increases to .923 (larvae: .517, nymphs: .406) when all sites negative for *I. scapularis* are excluded (see 2011 results in Figure 6). The highest average number of *I. scapularis* per mammal was calculated for Anoka County, which had a season mean of 1.138 compared with Dakota (.765) and Washington (.751) county's season means (see 2011 results in Figure 3). The only township

in Anoka County averaging ≥ 1.0 *I. scapularis* per mammal in 2011 was Coon Rapids (5.846), with Andover (.727), Linwood (.600), and Blaine (.522) townships averaging ≥ .500 *I. scapularis* per mammal. May (1.871), Lake Elmo (1.733), Stillwater (1.100), Hugo (1.0), New Scandia (.692), and Denmark (.545) townships of Washington County and Shoreview (.700) township of Ramsey County maintained averages ≥ .500 *I. scapularis* per mammal (Figure 4), as did Vermillion (2.667), Hastings (1.480), Randolph (1.313), Ravenna (1.250), and Burnsville (1.053) of Dakota County, Saint Lawrence (1.0), Eagle Creek (Shakopee .800), Blakeley (.750), and Credit River (.500) of Scott County, and Brooklyn Park (1.900), Eden Prairie (1.667) and Hassan (.667) of Hennepin County, south[1] of the Mississippi River (no figure).

- **Compiled Results (Repeat Sites) from 1990 - 2011 or 1991 - 2011:**

The 1990-2011 mean number of *I. scapularis* collected per mammal is .335, 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 again in 2010 and Anoka County maintained the highest yearly county season means from 1998-2009 and 2011 (Figure 3). The highest compiled 1990-2011 overall season mean (north of the Mississippi River) was tabulated for Anoka County (.960), followed closely by Washington County (.807). The 1990-2011 township averages (all > 1.0) include May, Hugo, New Scandia, and Grant of Washington County and Coon Rapids, Blaine, Saint Francis, East Bethel, Ham Lake of Anoka County, while the averages for Linwood, Oak Grove, and Andover of Anoka County and Afton, Lakeland, and Lake Elmo 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 – 2011), Inver Grove Heights (1.035), Vermillion (.713), and Ravenna (.522) townships of Dakota County maintained 1991-2011 averages > .500 *I. scapularis* per mammal[2] (no figure).

I. scapularis status at the 100 repeat sampling locations is shown on Figure 5. The status has changed at 90 of the sites since 1990 or 1991 (see 2011 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).

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, 2008 and 2010. South of the river from 1990 – 1999 it had been 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 counties[3] and in 2000 we began to tabulate more sites south of the river. Our tabulation of 26 positive sites south of the river in 2011 is a new record total, surpassing the previous high of 24 that had been set in 2010 (Table 1A). Figure 7.1 shows how our yearly overall positive site total used to mimic our *I. scapularis* collections from just our sites north of the Mississippi River (Anoka, Washington, Ramsey counties) but is now more

[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 ≥ .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.

[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.

reflective of the entire metro as our *I. scapularis* collections from south of the river (Dakota, Scott, Hennepin, Carver counties) have increased. While not significant, 2011 was the first year that we calculated a higher percentage of positive sites from south of the river versus north (Figure 7.2).

Comparing our 2011 small mammal and immature *I. scapularis* collection results with past study efforts, 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 for *I. scapularis*, since 2002 and including 2011, *I. scapularis* has comprised $\geq$ 50% of our overall collections six times. Comparatively, in any other year *Dermacentor variabilis* had comprised the majority of our collections (Table 3). As Figures 3 and 6 show, our 2011 overall season mean of .616 *I. scapularis* per mammal is low if only compared to the averages we have come to expect in recent years (2000 – 2002, 2004, 2005, 2007, 2009 and 2010 were all $\geq$ .806), but it is similar to our averages of 2006 (.637) and 2008 (.644) and remains higher than the averages we had compiled from 1990-1999 (range .089 - .406). Similar to 2003, our 2011 average was negatively impacted by the low number of *I. scapularis* larvae we collected; there was a four-fold drop between our 2010 and 2011 larval collections and in raw numbers we collected the fewest number of larvae (261) since 1997 (96). Our average was, however, positively impacted by the very high numbers of *I. scapularis* nymphs we collected (205) which represents our second-highest nymph total since inception of the study. Additionally, our larval and nymphal *I. scapularis* collection totals have never before been so comparable that they are roughly equal (Table 3). *P. leucopus* consistently has been the predominant mammal species collected each year with some variability in the total percentages collected[4] (Figure 1 and Table 2). The 2011 average number of mammals collected per site (7.56) represents a lower than typical yearly small mammal collection level (Table 2). Our compiled average small mammal collection success level per site for 1990 through 2011 is 12.68 (1991-2011 average of 11.95 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 some 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 area[5]. However, as we have begun to document more positive sites south of the Mississippi River in recent years, 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. When viewing our positive site data as a percentage of sites positive (Figure 7.2), the reader can easily distinguish our metro historically endemic area (sites north of the Mississippi River) from our more historically non-endemic area (south of the Mississippi River), along with our recent upswing in *I. scapularis* collections south of the river, especially since 2000.

Although we did not collect *I. scapularis* in Carver County in 2011 (Figure 5A, Table 1A), we feel our results continue to provide evidence of an elevated *I. scapularis* population. As we have already expressed in our report, our 2011 overall positive site total of 55 is a typical yearly total (in the 50's) for our study since 2000 (white boxes in Figure 3, numbered line in Figure 7.1), we continue to document apparent geographic expansion of *I. scapularis* in the metro (Table 1, Table 1A), and in

[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

[5] Yearly 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).

2011 recorded yet another new high with our tabulation of 26 positive sites from only counties located south of the Mississippi River[6] (Table 1A, red line in Figure 7.1). Although the average number of *I. scapularis* collected per mammal (.616) in 2011 is lower than many averages of recent years, it is higher than the averages from 1990-1999 (range .089 - .406) and in our opinion provides justification for our conclusion of an ongoing elevated *I. scapularis* population since 2000 (Figures 3 and 6).

It was a low collection year for both mammals and larval *I. scapularis* ticks (Tables 2 and 3) and while we can't quantify it, the weather could have impacted either or both. Winter 2010-2011was historically the metro's fourth snowiest and the ground was covered with at least one inch of snow from November 24, 2010 through March 17, 2011[7]. Theoretically, heavy snow cover would aid survivability of both mammals and ticks. However, the resulting high snowmelt waters that occurred in spring could have caused higher than typical mortality to either organism or somehow limited either organism's reproduction success. Additional environmental factors could have been temperature or precipitation-related[8] as, aside from a brief warm spell in early April, the cold and wetness of spring lasted through May and then moved on to high heat and humidity with continued wet conditions through early August when precipitation abruptly stopped. Very dry yet warmer than typical conditions continued throughout the fall, past the October end of our collection season, actually. Although our small mammal collections were consistently low throughout 2011 which may possibly support weather influences as an impact, as we have stated previously[9], small mammal populations naturally fluctuate and also, as shown in Table 2, there has always been variability in our yearly small mammal collection success. As for *I. scapularis*, the low larval versus the high nymphal totals (Table 3) suggests to us that one broad environmental factor brush should not be used. We have provided theories for differing larval and nymphal co-hort collection numbers in the past[10] without much confidence and although a more recent publication (Neelakanta et al, 2010) [11] suggests that ticks infected with *Anaplasma phagocytophilum* (i.e. *I. scapularis* adults and nymphs but not larvae) may achieve better overwintering survivability than non-infected ticks, we do not believe that a single explanation such as this is sound as for one thing, most ticks, even through the adult stage, do not ever become infected. While possible that some infected nymphs did successfully overwinter that may not have survived if uninfected, one would think that an *I. scapularis* nymphal infection rate would have to be immense in order to have a strong positive effect on our collection success, and also one would expect to see a continual increase in our *I. scapularis* immature tick collections over time, if true, which does not appear to be reflected in our yearly *I. scapularis* totals in Table 3. It also runs counter to our low larval collection success in that any that molted into adults would then have been able to lay eggs that would have hatched into larvae. We will note any decreases in our collection tallies of larval and nymphal *Dermacentor variabilis* in 2012 as due to life cycle differences[12] any impacts to that species reproductive success would not be evident until 2012. However, based on our collections of similar numbers of *D. variabilis* larvae and nymphs in both 2010 and 2011, it appears that typical mortality for this species was not noticeably affected by high snowmelt waters, atypical temperatures, nor the high precipitation amounts that had occurred in 2011.

Examining human data, as of April 9, 2012, statewide tallies for 2011 were not yet available from the MDH. Their 2010 Lyme (1293) and human anaplasmosis (720) totals were new record highs. Their 2009 totals for Lyme (roughly 1065) and HA (317) were similar to their then record setting totals of 2007 (Lyme 1239; HA 322) and also close to the 2008 totals (Lyme 1050; HA 278). Their prior

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[6] indicative of geographic spread in areas that we were not likely to detect *I. scapularis* in the past

[7] http://climate.umn.edu/doc/journal/top_ten_snowiest_winters_msp.htm (86.6 inches total)

[8] See graph Figure 1.2 Monthly departures from normal for temperature and precipitation March-December 2011 p. 4 in MMCD's 2011 Operational Review and Plans for 2012, accessible at www.mmcd.org (source: National Weather Service, Twin Cities Station, accessible at http://www7.ncdc.noaa.gov/IPS/)

[9] 1998 *Ixodes scapularis* distribution study report, excerpt from The Mammals of Minnesota. Hazard, 1982. p. 87.

[10] For example our 2003 and 2007 *Ixodes scapularis* distribution study reports

[11] Girish Neelakanta, Hameeda Sultana,Durland Fish, John F. Anderson, and Erol Fikrig ***Anaplasma phagocytophilum* induces *Ixodes scapularis*** ticks to express an antifreeze glycoprotein gene that enhances their survival in the cold J Clin Invest. 2010 September 1; 120(9): 3179–3190.

[12] Eggs laid in 2011 hatched and then the unfed larvae overwintered. These larvae will be feeding during the 2012 season and successful ticks will molt into nymphs and search for a blood meal in 2012 also.

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. Additional statewide human anaplasmosis (HA, in prior reports referred to as human granulocytic anaplasmosis or HGA) case totals - through 1999 the MDH had only been compiling an average of roughly 15 HA cases per year but case totals ranged from 78 to 152 from 2000 – 2004. Their previous all-time high HA case total (186) had been set in 2005 and they recorded 177 HA cases for 2006, which had made the then record 322 HA cases for 2007 that much more impressive at the time.

The Twin Cities metro-exposed tick-borne disease case totals have also risen over time, but not as dramatically as the statewide totals. Although metro-exposed case tallies have not been available since 2008, the 2007 totals had been at all-time highs (80 Lyme, 9 HA). 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 HA had been detected in metro-collected small mammals beginning in 1995[13] in MMCD collaborative research, locally acquired human HA cases were not documented by MDH until 2000. From 2000 – 2007 MDH typically tabulated a few metro-exposed HA cases each year (range 0-9). If discussion is expanded to case numbers for metro residents as a whole and not just those who were exposed in the metro, the case totals obviously would be higher. When the MDH has separated metro residents from people who reside elsewhere in the state, they had documented that metro residents comprised roughly half of the Lyme cases they tallied[14].

At the same time as the MDH is documenting rising human tick-borne disease case numbers, we believe that we are documenting that the risk of tick encounters in our service area in the metro is higher than it once was. While our 2011 result totals as a whole are smaller than what we have tallied for a typical year since 2000, we continued to document an increase in our *I. scapularis* collections from a broader geographic area, a trend that we feel has been ongoing for some time. We feel that a Twin Cities resident's risk of encountering *I. scapularis* locally remains greater now than it once was.

[13] Several 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.

[14] Slide 37 www.health.state.mn.us/divs/idepc/diseases/**lyme**/**lyme**slide.ppt

ADDITIONAL UPDATES/RESEARCH:

POWASSAN VIRUS DEATH AND NEW TICK-BORNE DISEASE, *EHRLICHIA* MURIS-LIKE.

First Minnesota tick-borne disease death - Powassan virus. On June 29, 2011 the Minnesota Department of Health (MDH) reported the first death from Powassan virus ever recorded in MN, from a northern MN resident thought to have been exposed near her home. It has a US overall case fatality rate of 10% with some survivors suffering long term neurological effects. Signs and symptoms typically begin to occur 1-5 weeks after an infected *I. scapularis* bite. The disease could be transmitted in as few as 5 minutes, although science is unsure of exactly when transmission begins to occur.

POW has been recognized since 1958, is most prevalent in the Eastern US (roughly 5 cases per year), and, like EEE (the mosquito-borne disease Eastern equine encephalitis), was detected in Wisconsin for a long time prior to having been recorded from MN. The MDH tabulated the first MN exposed POW case in 2008. Since then, through June 2011 the MDH recorded 8 POW cases with MN exposure. Through June 2011 all cases except for an undetermined Anoka County resident case (2011) have been determined to have been exposed in northern MN but POW positive ticks have been collected in northern and southern MN and as close to the metro area as Pine County (north of our service area and along the Saint Croix River). POW will likely remain a rare disease but cases of POW, as with tick-borne disease cases in general, are on the rise.

New tick-borne disease—*Ehrlichia* muris-like. The disease reported in the August 4, 2011 edition of the New England Journal of Medicine is caused by an as yet unnamed bacterium. The bacterium had been found in MN deer ticks several years ago but its impact to human health had been unknown. As the same antibiotic (typically doxycycline) is used to treat this disease as well as Lyme disease, human anaplasmosis (HA) and human monocytic ehrlichioisis, prior human cases had been likely tabulated as the more traditionally endemic tick-borne diseases of MN. So far these bacteria have only been found in MN and WI so they are unique to our area. This bacterium apparently causes less severe symptoms than does the more common HA. The publication reported a total of 25 cases from both MN and WI.

B. S. Pritt and others. Emergence of a New Pathogenic Ehrlichia Species, Wisconsin and Minnesota, 2009 N Engl J Med 2011. 365:422-429.

PUBLICATION OF CAMP RIPLEY (CENTRAL MINNESOTA) WORK FROM 2000 AND 2001.

Discussion points include small mammal infections (including dual infections) with *Anaplasma phagocytophilum* and *Borrelia burgdorferi* in central Minnesota.

Johnson R. C., C. Kodner, J. Jarnefeld, D.K. Eck, and Y. Xu. Agents of Human Anaplasmosis and Lyme Disease at Camp Ripley, Minnesota. Vector-borne and Zoonotic Diseases.Vol.11 (12), 2011. 1529-1534.

NEW STRATEGY, FALL 2011 – EVALUATING *I. SCAPULARIS* ACTIVITY FOR POSSIBLE MEDIA ALERT.

The North Region and the Plymouth, Rosemount, and Jordan facilities performed drags on November 10, 2011 to evaluate need for a media alert in response to an ongoing perception of higher *I. scapularis* questing levels in fall 2011 compared to past years. Zero ticks were found on November 10, possibly due to very cold temperatures (39°F for a high), compared to the warmer than average temperatures that had been occurring throughout the fall. Jordan facility staff had found an adult *I. scapularis* female just the day previous, November 9 (high 50°F), while performing non-tick related field work.

INCORPORATING TECHNICAL ADVISORY BOARD (TAB) SUGGESTIONS-POSTING AT DOG PARKS.

Since the initial suggestion of the Technical Advisory Board (TAB) in 2010, we have visited dog parks and vet offices as part of our outreach to collect more unusual tick data (species and atypical locations) and to remind people of the risk of encountering *I. scapularis*. As in 2010, in spring 2011 signs were

posted in approximately 21 parks and an additional four signs were posted in active dog walking areas, including at Stubbs Bay Park, Luce Line Trail Entrance. Staff retrieved signs at all parks in fall 2011. We have also worked on expanding our sign placements into additional metro locations.

AMBLYOMMA AMERICANUM

Amblyomma americanum is an aggressive human biter and can transmit human monocytic ehrlichiosis (HME), among other potential pathogens. Both the tick and HME are more common to the southern US, but *A. americanum*'s range is known to be moving northward. *Amblyomma* ticks have been submitted to MMCD from the public on a rare, sporadic basis and this species was first collected by MMCD in 1991 via a road kill examination of a white-tailed deer (*Odocoileus virginianus*). However, for the first time in a number of years, *Amblyomma* had been submitted to MDH and MMCD by the public in 2009 (Minneapolis and Circle Pines). This trend continued in 2010, with *Amblyomma* submitted to MMCD from Eagan, Mound, and the Orono/Lake Minnetonka areas of the metro. All 2009 and 2010 records were of single ticks. MMCD did not receive any *Amblyomma* in 2011. The MDH, however, had submissions of adults from Shakopee (no travel other than a trip to the southern US for three months- home three weeks prior to collection on April 28), Lindstrom (June 7), and one June 22 record, unconfirmed (tick not submitted), from Hennepin County: Golden Valley, Richfield, Bloomington, or Minneapolis.

STUDIES/PROJECTS FOR 2012.

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

- **Additional projects:**

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

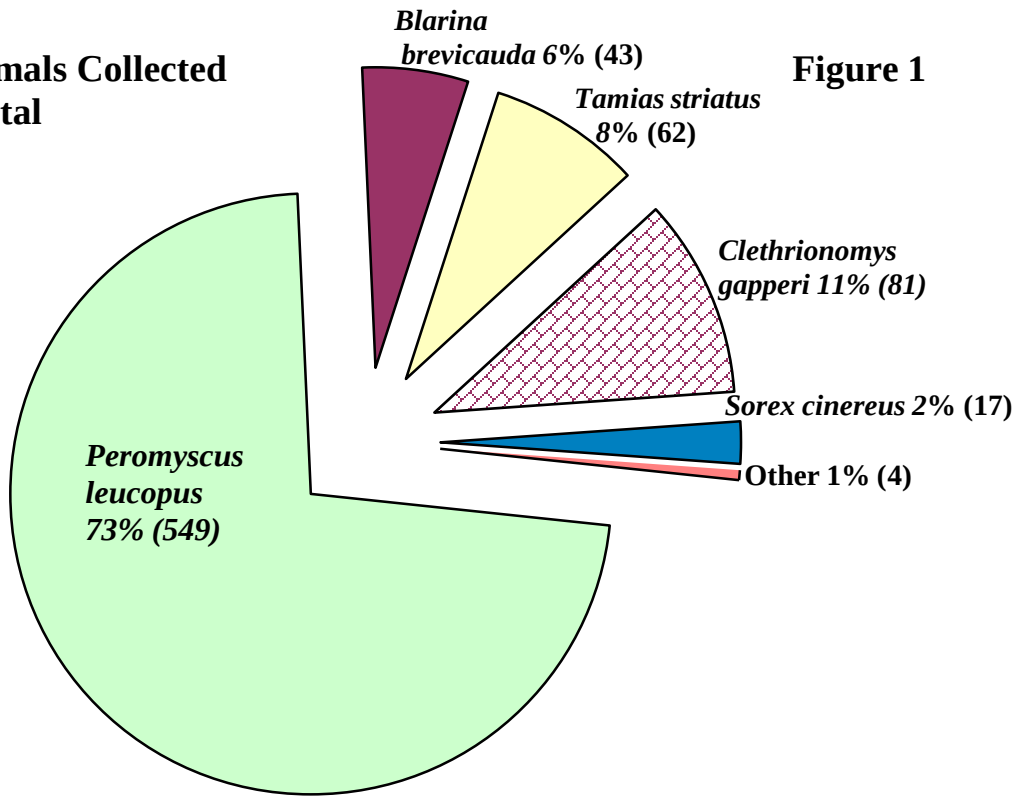
- **New public education activities, 2012.**

Social media, tick alerts. We have developed a monthly schedule of standard bulleted messages for the period March – November to be used on MMCD's social media (Facebook, Twitter) accounts. We will also post tick-related events and/or updates that come up during the year.

Current tick activity estimates posted on website (www.mmcd.org). We have developed a graphic (gauge) that will depict our estimate of current deer tick activity levels (low, medium, high) on our website throughout the entire 2012 season. The graphic chosen each week for the low, medium, or high level will be based on the dynamics of peaks in the general deer tick life cycle bell curve for Minnesota in combination with actual numbers of deer ticks found on MMCD field staff. Current estimates of weekly tick activity risk will be posted by noon each Friday.

Small Mammals Collected
2011: 756 total

Figure 1



Ticks, by Species and Stage, Removed from Small Mammals
2011: 938 total

Figure 2

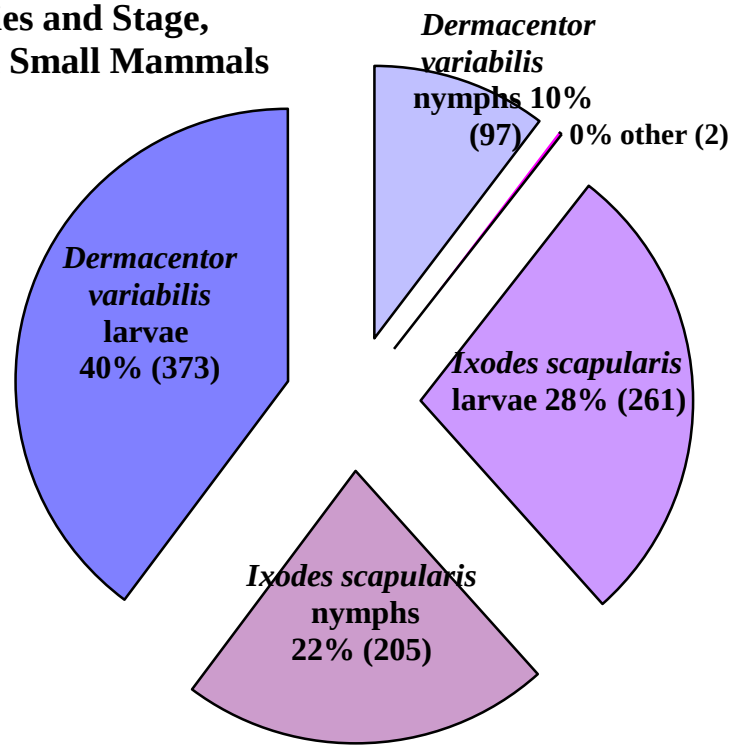
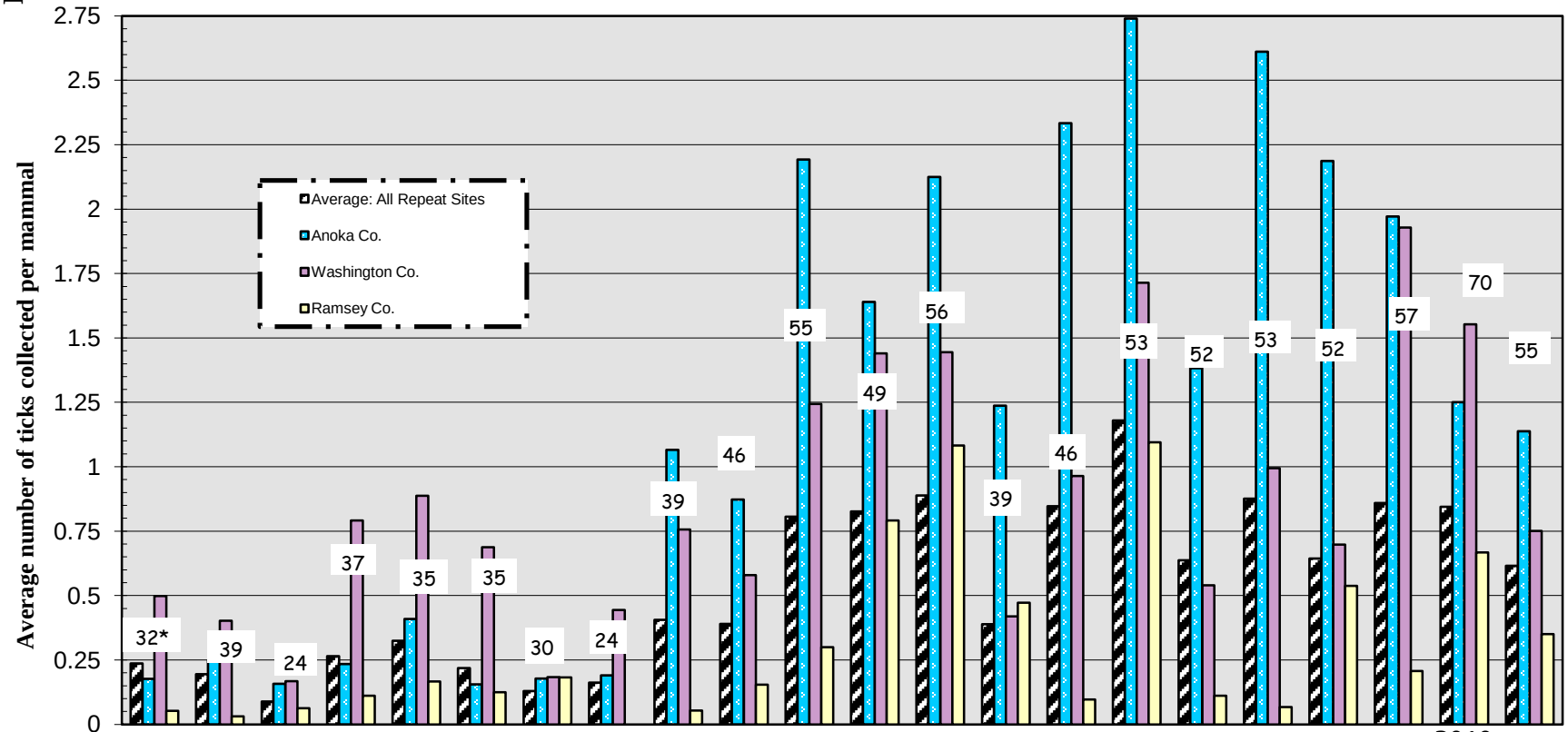


Figure 3

Average number of *I. scapularis* collected per mammal at 100 sampling locations in Anoka, Washington, and Ramsey counties: 1990 - 2011
(white box shows the total number of sites where at least one *I. scapularis* was found: by year)



1990*
Dakota
.006

1995
Dakota
.097

2000
Dakota
.148

Hennepin
.017

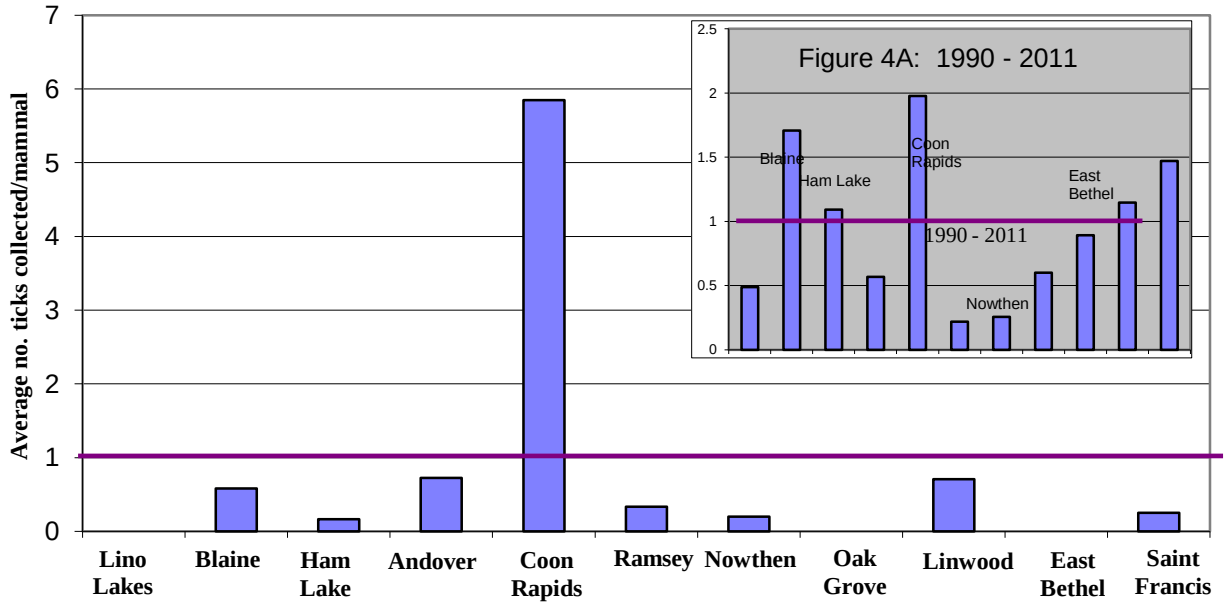
2005
Dakota
.355
Scott
.020
Hennepin
.046

2010
Dakota
.913
Scott
.215
Hennepin
.216
Carver
.045

*1990 Excludes Wash. Co. chipmunk 102L, 31N
*75 sites represented

Figure 4

Average number of *I. scapularis*collected per mammal in Anoka county (by township): 2011 results



Average number of *I. scapularis*collected per mammal in Washington county (by township): 2011 results

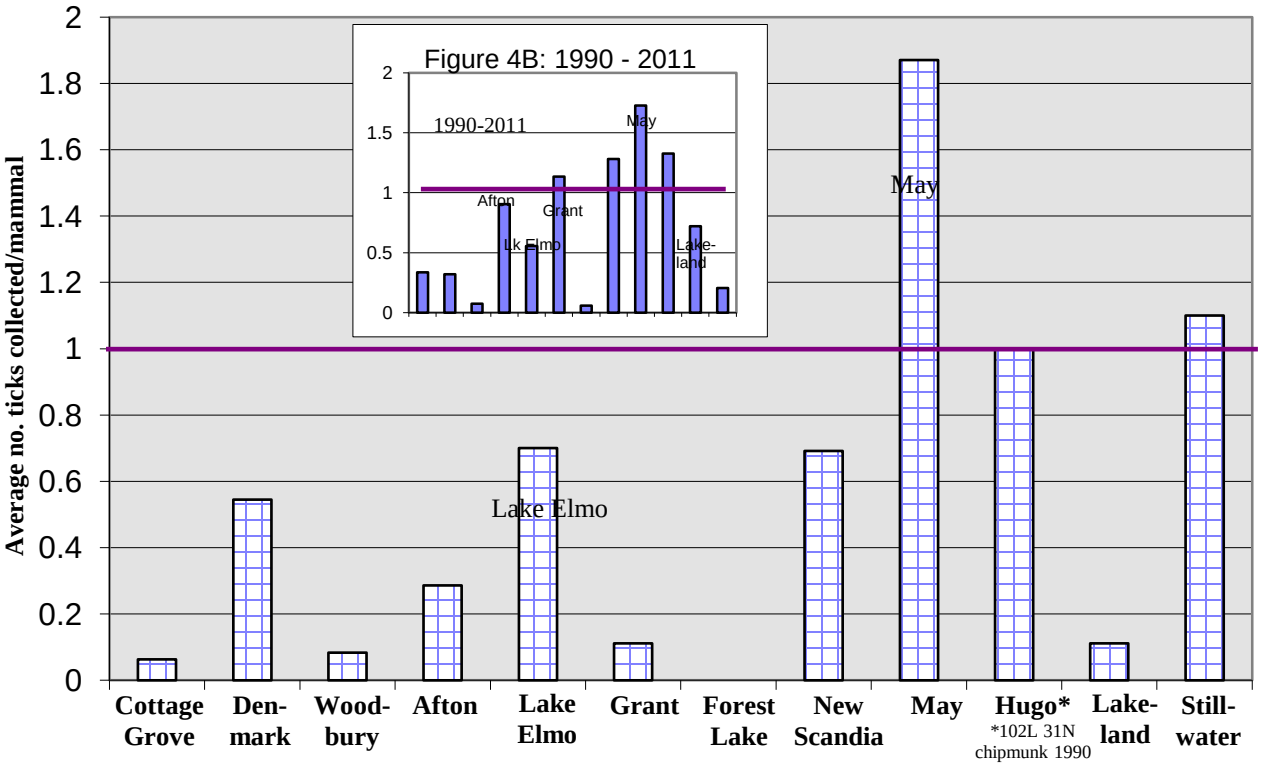
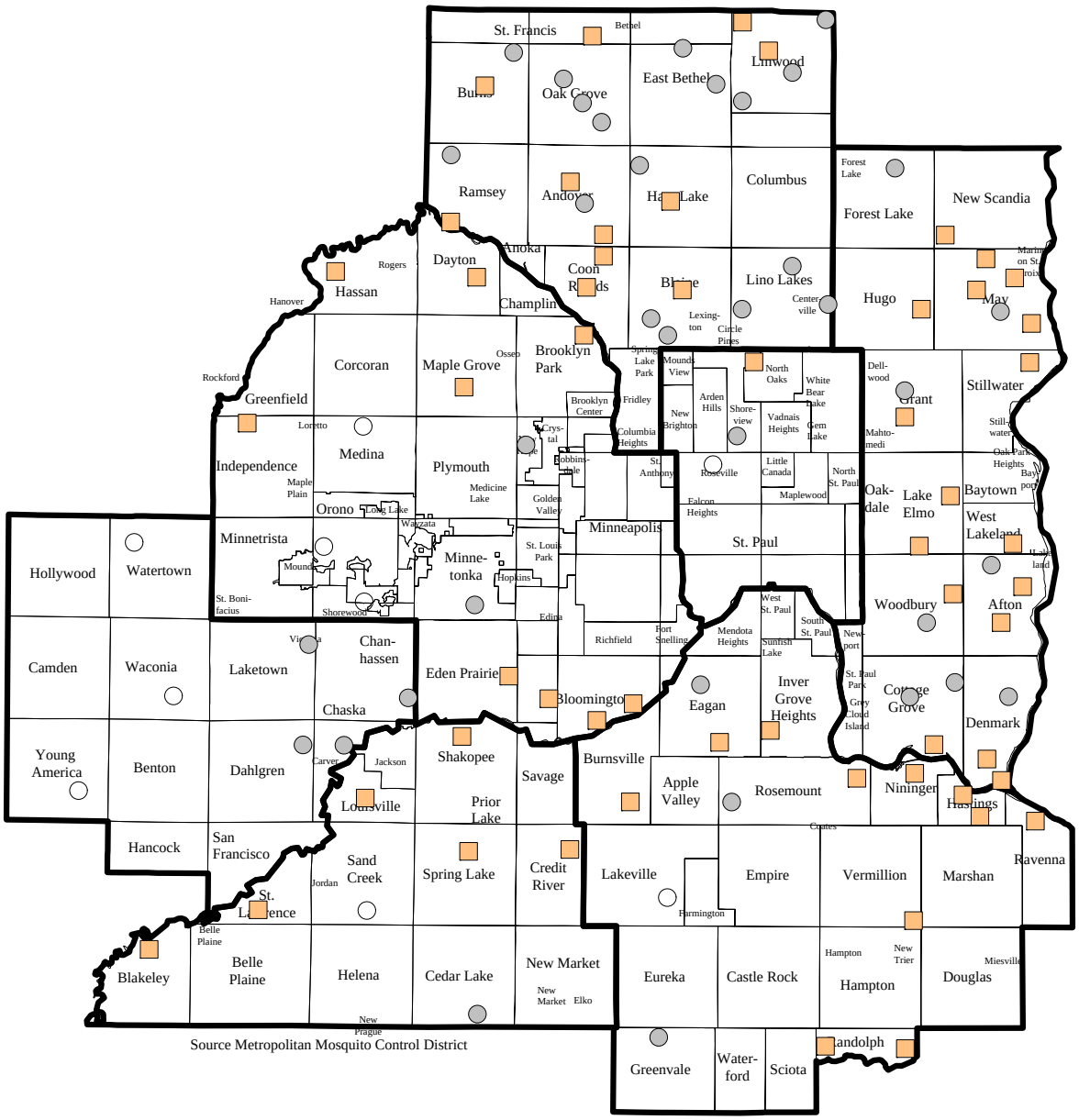


Figure 5A

Ixodes scapularis Presence/Absence status: 2011

(present if at least one I. scapularis is collected during a year)



Source Metropolitan Mosquito Control District

Status 2011

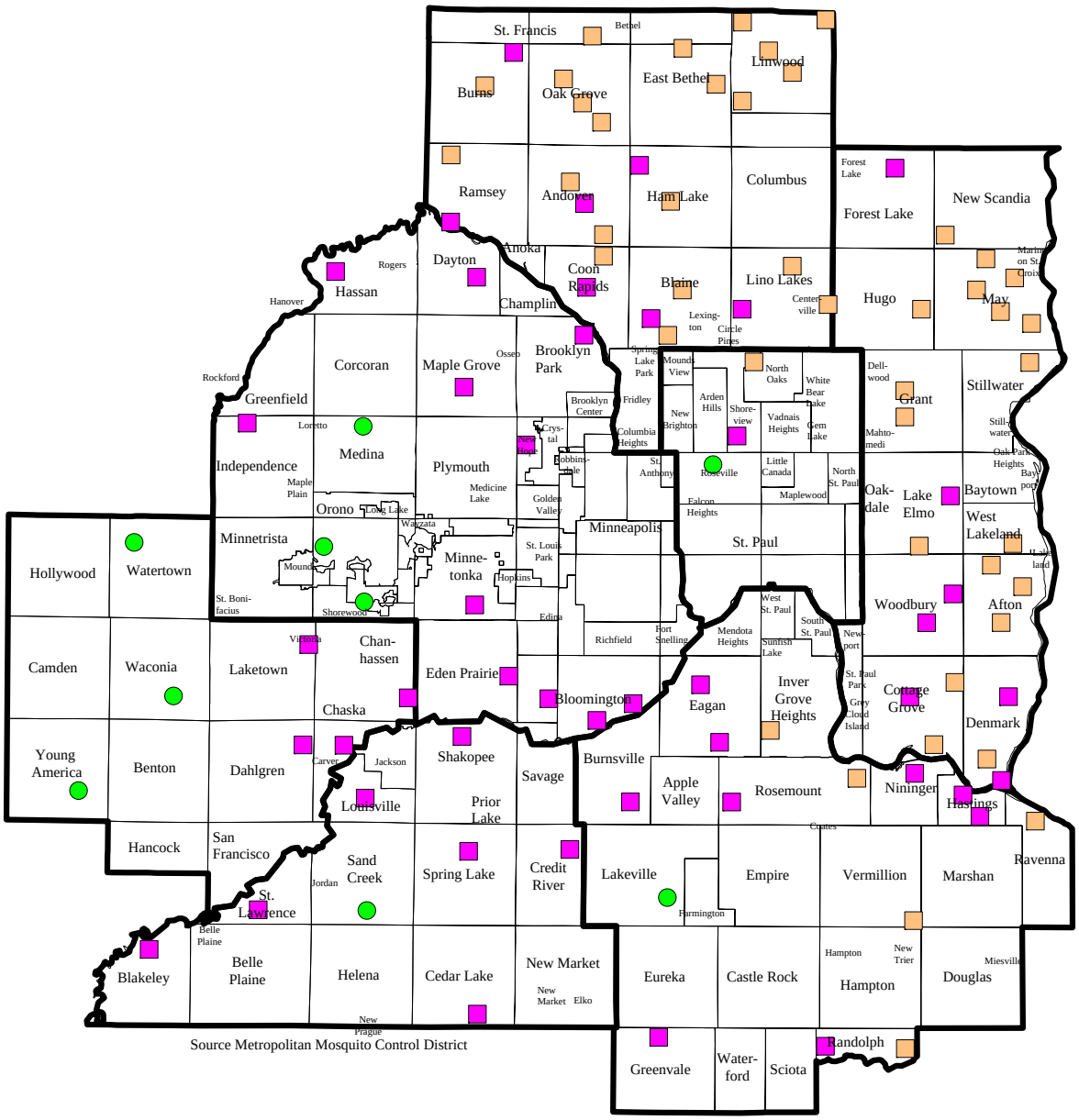
- present (55)
- absent this year (36)
- not found 1990-2011 (9)

2011 Ixodes scapularis Distribution Study Report- Metropolitan Mosquito Control District

Figure 5

Ixodes scapularis Presence/Absence status: 1990 - 2011

(present if at least one I. scapularis is collected during a year)



Source Metropolitan Mosquito Control District

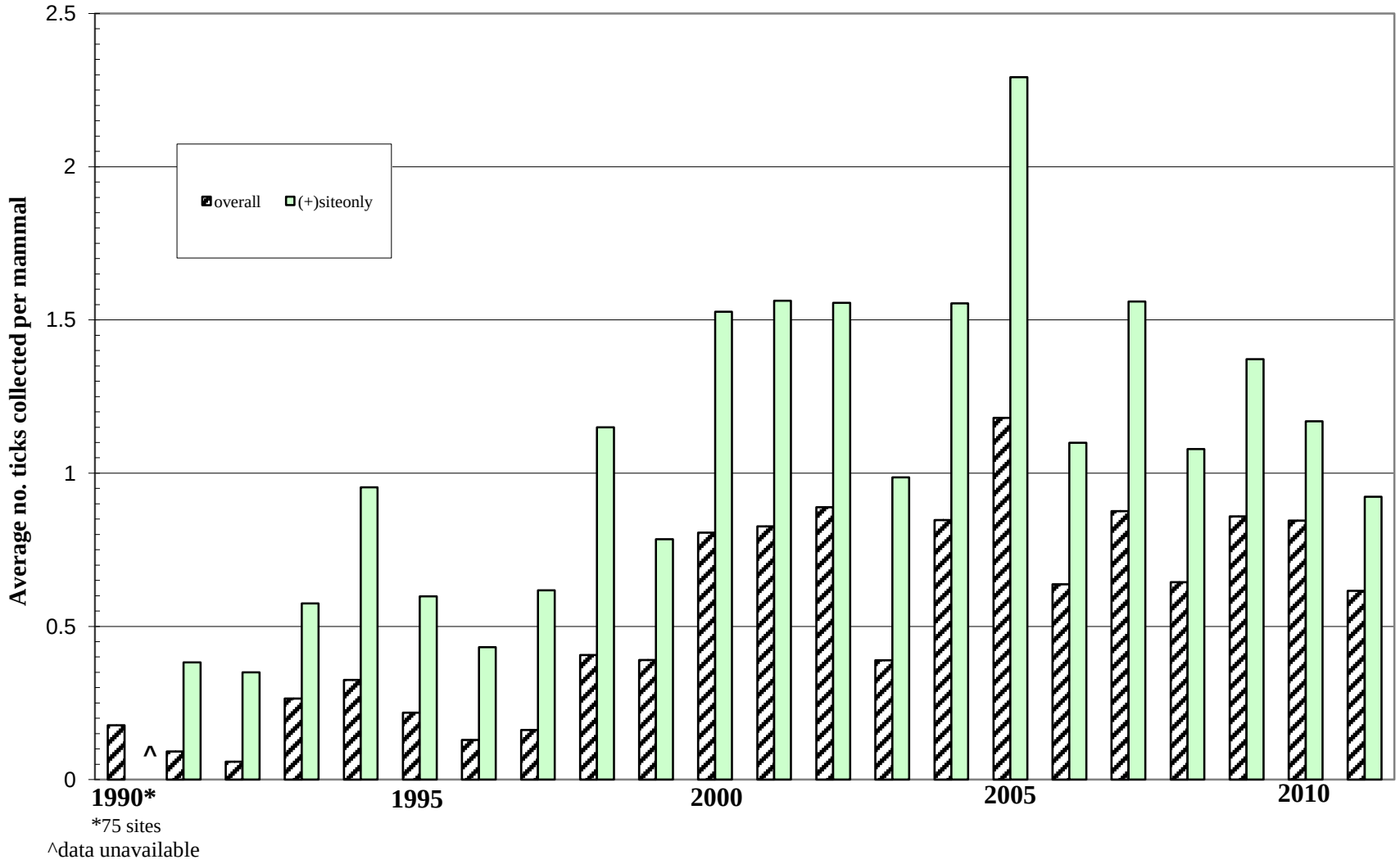
At least one tick found during:

- all/most years (45)
- at least one year (46)
- (not found) (9)

2011 Ixodes scapularis Distribution Study Report- Metropolitan Mosquito Control District

Figure 6

Average number of *I. scapularis* collected per mammal at 100 repeat sampling locations 1990-2011 overall vs. sites where at least one *I. scapularis* was collected (positive sites)



*75 sites

^data unavailable

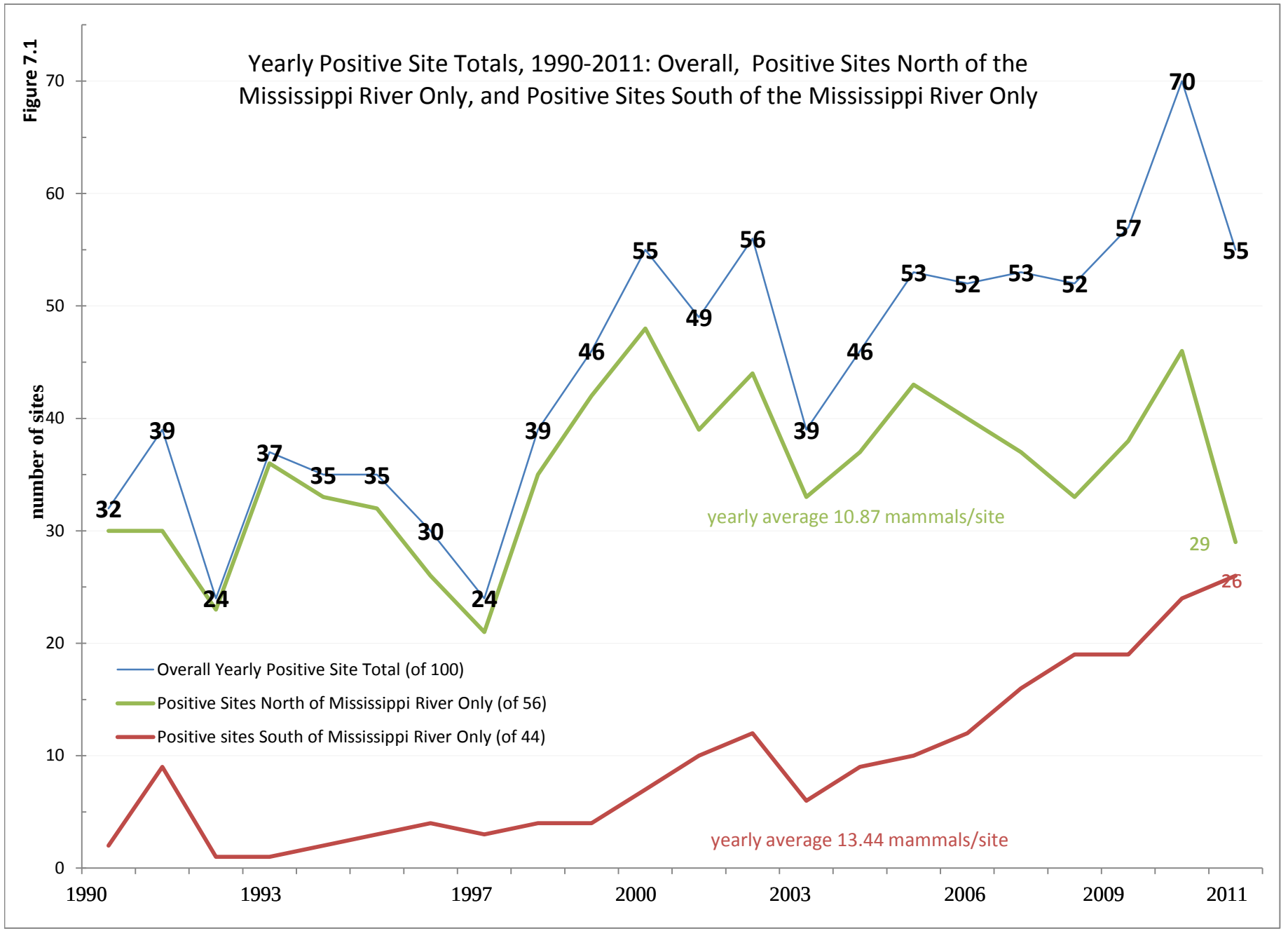
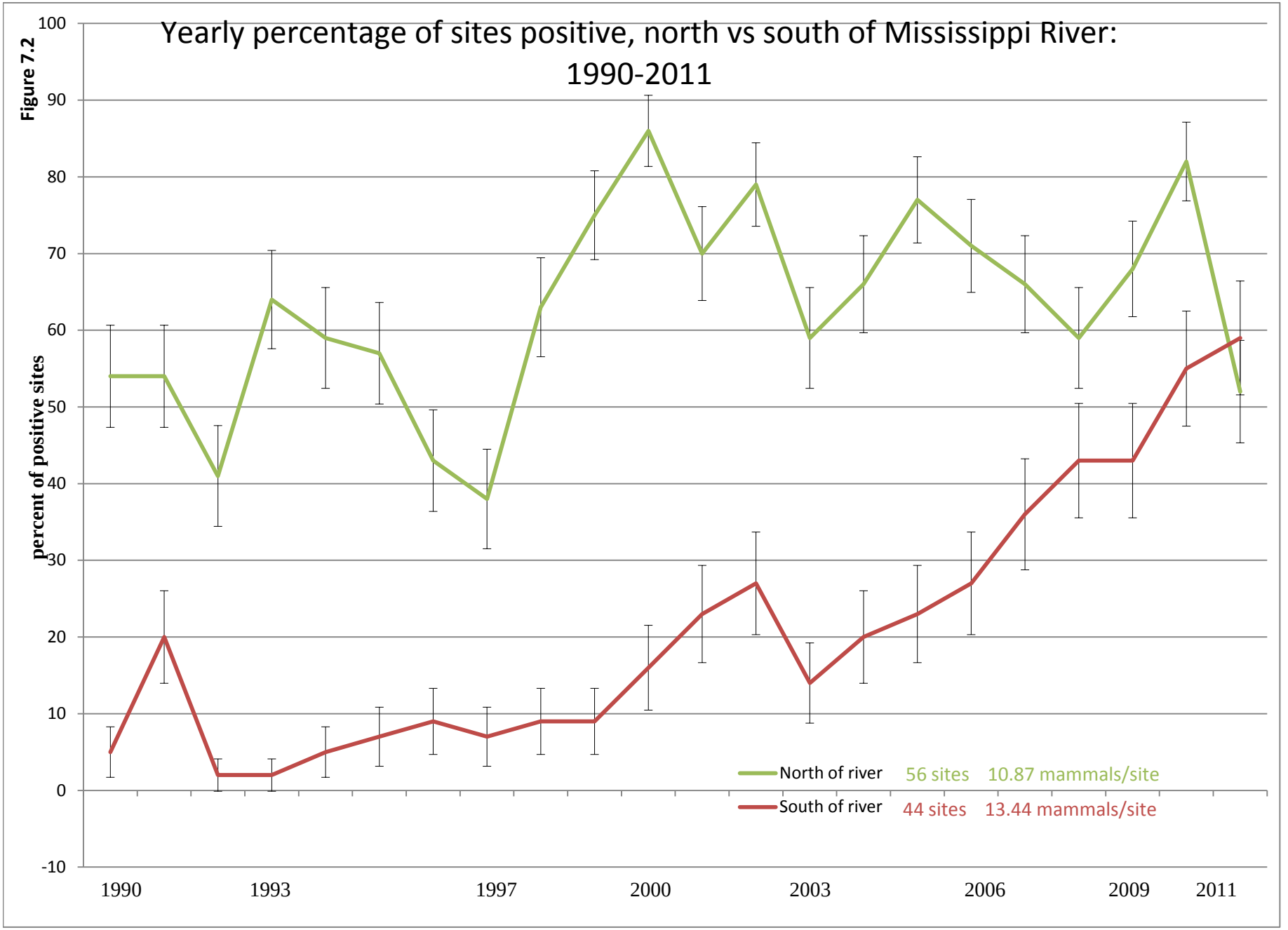


Figure 7.1
Yearly Positive Site Totals, 1990-2011: Overall, Positive Sites North of the Mississippi River Only, and Positive Sites South of the Mississippi River Only
number of sites
0
10
20
30
40
50
60
70
1990
1993
1997
2000
2003
2006
2009
2011
32
39
24
37
35
35
30
24
39
46
55
49
56
39
46
53
52
53
52
57
70
55
yearly average 10.87 mammals/site
29
26
yearly average 13.44 mammals/site
Overall Yearly Positive Site Total (of 100)
Positive Sites North of Mississippi River Only (of 56)
Positive sites South of Mississippi River Only (of 44)

Figure 7.2



Error bars equal ±1 SE of a proportion.

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

No. sites	1992	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
changing status	26	38	47	58	61	66	69	72	75	76	78	80	81	83	88	90
Ticks found:																
all years	21	17	11	5	5	5	4	3	1	1	1	1	1	1	1	1
most years	5	15	19	27	31	34	35	37	38	41	41	45	42	44	44	44
least	21	23	28	31	30	32	34	35	37	35	37	35	39	39	44	46
(not found)	53	45	42	37	34	29	27	25	24	23	21	19	18	16	11	9

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	2010	2011
Total sites south of river	*1	2	4	4	7	10	12	6	9	10	12	16	19	19	24	26
By county:																
Dakota	*1	2	4	2	6	7	8	6	8	7	9	10	12	11	10	11
Hennepin	*0	0	0	1	1	2	3	0	0	1	2	3	3	3	6	9
Scott	*0	0	0	1	0	1	1	0	1	2	1	2	2	3	6	6
Carver	*0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	0

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

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]	*Peromyscus leucopus* percent (n)	*Tamias striatus* percent (n)	*Clethrionomys gapperi* percent (n)	*Blarina brevicauda* 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)	2% (34)
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% (20)
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)	2% (16)
2009	100	941	[9.41]	86% (809)	4% (40)	5% (47)	1% (14)	3% (31)
2010	100	1320	[13.20]	82% (1084)	4% (55)	6% (78)	5% (70)	3% (33)
2011	100	756	[7.56]	73% (549)	8% (62)	11% (81)	6% (43)	3% (21)

*Other includes *Microtus pennsylvanicus, Spermophilus tridecemlineatus, Zapus hudsonius, Mustela erminea, Tamiasciurus hudsonicus, Glaucomys volans, Sorex articus, Sorex cinereus , Mus musculus* 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	*Dermacentor variabilis* L[b] percent (n)	*Dermacentor variabilis* N[c] percent (n)	*Ixodes scapularis* L[b] percent (n)	*Ixodes scapularis* 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)
2010	100	1553	21% (330)	7% (101)	65% (1009)	7% (107)	0% (6)
2011	100	938	40% (373)	10% (97)	28% (261)	22% (205)	0% (2)

[a] 1990 data exludes 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