Metropolitan Mosquito Control District
IXODES SCAPULARIS DISTRIBUTION STUDY
2010

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 4th 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 70 positive sites (at least one *I. scapularis* collected), a new record and surpassing the previous high of 57 from 2009. We also continued to tabulate higher than typical number of positive sites from counties south of the Mississippi River and our 2010 total of 24 (10 Dakota, 6 Hennepin, 6 Scott, and 2 Carver) is also a new record. A total of 1116 *I. scapularis* were removed from 1320 mammals for an overall season mean of .845 *I. scapularis* per mammal; comparable to our elevated averages of 2000 – 2002, 2004, 2005, 2007, and 2009 (all ≥ .806). The majority of *I. scapularis* collected in our study had been from our Anoka County sites from 1998-2009 but in a break from tradition, our Washington County sites accounted for the majority (35%) of our 2010 collections with an additional 29% (296L; 29N) from our Dakota County sites. Anoka County accounted for another 28% of our 2010 collections. Townships maintaining *I. scapularis* per mammal averages ≥ 1.0 included May, Lakeland, Lake Elmo, Hugo, Afton, and Grant of Washington County (range 1.154 – 4.775), Coon Rapids, Ham Lake, East Bethel and Lino Lakes of Anoka County (range 1.714– 5.333), as well as Hastings (3.152), Rosemount (1.944) and Inver Grove Heights (1.690) of Dakota County. Linwood, Blaine, Nowthen (Anoka), Cottage Grove, Stillwater (Washington), Shoreview (Ramsey), Eden Prairie, Hassan (Hennepin), Saint Lawrence (Scott), Burnsville and Vermilion (Dakota) townships all averaged ≥ .500 *I. scapularis* per mammal. Anoka County maintained the highest 1990-2010 overall season mean (.958), followed by Washington County (.809). Our compiled 1990-2010 township averages (all > 1.0) include May, Hugo, New Scandia, and Grant of Washington County, and Coon Rapids, Blaine, Saint Francis, Ham Lake, East Bethel, and Lino Lakes of Anoka County. South of the Mississippi River, the highest 1991-2010 averages (> .500 *I. scapularis* per mammal) occurred in Inver Grove Heights (1.077), Vermillion (.662), and Ravenna (.511) townships of Dakota County. Both small mammal and immature tick species diversity in 2010 appeared comparable to past years, although *I. scapularis* comprised a much higher percentage (72%) of our overall collections compared to past years. As in past years, *Peromyscus leucopus* was the predominant mammal species collected. The 2010 average number of mammals collected per site (13.20) appears to represent a higher than typical yearly small mammal collection level and it is the highest we have tabulated since 1999. Examining human data, as of April 18, 2011, final tallies for 2010 were not yet available from the MN Dept Health (MDH). The MDH, however, suspects that their 2010 case tallies will be at new record highs. Although our 2010 average number of *I. scapularis* collected per mammal (.845) was not remarkable, we set new records for the number of positive sites, percentage of *I. scapularis* collected and more. 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 now 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 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.

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 26, 2010 and ended on October 28, 2010 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

- **2010 Study (Repeat Sites):**

For the fourth consecutive year we collected *I. scapularis* from at least one site in all seven counties that comprise our service area. Specifically, in 2010 we found at least one *I. scapularis* at 70 of our 100 sampling sites, with 46 of these positive sites located north of the Mississippi River in Anoka (24 sites positive/28 sites sampled), Washington (20 sites positive/25 sites sampled), and Ramsey 2 sites positive/3 sites sampled) counties. Twenty-four additional positive sites were detected south of the river in Dakota (10), Hennepin (6), Scott (6), and Carver (2) counties (Figure 5A).

Overall, 1320 mammals (Figure 1 and 2010 results in Table 2) were inspected: 518 from north of the Mississippi River and 802 from south of the river and a total of 1116 *I. scapularis* (Figure 2 and 2010 results in Table 3) were collected from them. The Washington County sites accounted for 35% of the total *I. scapularis* collections (364L; 29N) with the highest numbers collected in May (178L; 13N) township. Dakota County accounted for an additional 29% of our total *I. scapularis* collections (296L; 29N), with the highest numbers collected in Hastings Township (144L; 1N) in particular. An additional

28% of the total (275L; 34N) were collected from our Anoka County sites, with the highest collections occurring in Coon Rapids (112L; 16N) township.

The overall season mean number of *I. scapularis* collected per mammal in 2010 was .845 (larvae: .764, nymphs: .081). The mean increases to 1.169 (larvae: 1.057, nymphs: .112) when all sites negative for *I. scapularis* are excluded (see 2010 results in Figure 6). The highest average number of *I. scapularis* per mammal was calculated for Washington County, which had a season mean of 1.553 compared with Anoka (1.251), Dakota (.913) and Ramsey (.667) county's season means (see 2010 results in Figure 3). Townships in Anoka County averaging $\geq$ 1.0 *I. scapularis* per mammal in 2010 included Coon Rapids (5.333), Ham Lake (2.300), East Bethel (1.750), and Lino Lakes (1.714), with Linwood (.600), Blaine (.522), and Nowthen (.500) townships averaging $\geq$ .500 *I. scapularis* per mammal. May (4.775), Lakeland (3.857), Lake Elmo (1.733), Hugo (1.500), Afton (1.367), Grant (1.154), Cottage Grove (.760), and Stillwater (.526) townships of Washington County and Shoreview (.800) township of Ramsey County maintained averages $\geq$ .500 *I. scapularis* per mammal (Figure 4), as did Hastings (3.152), Rosemount (1.944), Inver Grove Heights (1.690), Burnsville (.556), and Vermillion (.542) of Dakota County, Saint Lawrence (.706) of Scott County, and Eden Prairie (.923) and Hassan (.571) of Hennepin County, south[1] of the Mississippi River (no figure).

I. scapularis detected at Priory Preserve - zero at Joy Park (both 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, 2009, and 2010. In 2007 we had removed a total of ten *I. scapularis* larvae from two mammals and 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 the park was not 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 those twelve mammals were collected in our third round of sampling. In 2010 we sampled for two rounds and did not collect any *I. scapularis* from the total of four mammals collected.

Priory Preserve (NE corner of Maplewood) was a previously unsampled area of Ramsey County and a trapline was set during all three rounds in 2009. However, zero mammals were collected so any degree of tick establishment remained unknown. In 2010 we sampled the Preserve for two rounds and collected one *I. scapularis* larva, found on one of the nine total mammals collected in the Preserve.

I. scapularis detected in section 18 of Laketown Township (Carver County).
On July 21, 2009 a staff member had turned in an *I. scapularis* that had been collected in Waconia. Because it was unusual to collect an *I. scapularis* from this area we decided to further investigate despite our view that we were likely past peak for *I. scapularis*. A trapline was set at the suspected tick collection location for the week of July 27, 2009 but no ticks of any species were collected. MMCD re-sampled this area for all three rounds in 2010 and were successful in collecting *I. scapularis* (14L; 4N) from five of the twenty-three total mammals collected.

- **Compiled Results (Repeat Sites) from 1990 - 2010 or 1991 - 2010:**

The 1990-2010 mean number of *I. scapularis* collected per mammal is .497, 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 (Figure 3). The highest compiled 1990-2010 overall season mean (north of the Mississippi River) was tabulated for Anoka County (.958), followed closely

[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.

by Washington County (.809). The 1990-2010 township averages (all > 1.0) include May, Hugo, New Scandia, and Grant of Washington County and Coon Rapids, Blaine, Saint Francis, Ham Lake, East Bethel, and Lino Lakes 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 – 2010), Inver Grove Heights (1.077), Vermillion (.662), and Ravenna (.511) townships of Dakota County maintained 1991-2009 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 89 of the sites since 1990 or 1991 (see 2010 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 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 counties[3] and in 2000 we began to tabulate more sites south of the river. Our tabulation of 24 positive sites south of the river in 2010 is a new record total, surpassing the previous high of 19 that had been set in 2008 and equaled in 2009 (Table 1A).

Comparing our 2010 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 although *I. scapularis* comprised a much higher percentage (72%) of our overall collections compared 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, the highest previous percentage of *I. scapularis* in our overall collections had been 58% (2006). In any other year, including 2009, *Dermacentor variabilis* had comprised the majority of our collections (Table 3). Our 2010 overall season mean of .845 *I. scapularis* per mammal is comparable overall to our 2000 – 2002, 2004, 2005, 2007 and 2009'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 collected[4] (Figure 1 and Table 2). The 2010 average number of mammals collected per site (13.20) appears to represent a higher than typical yearly small mammal collection level and it is the highest we have tabulated since 1999 (Table 2). Our compiled average small mammal collection success level per site for 1990 through 2010 is 12.89 (1991-2009 average of 12.17 for100 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.

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[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.

[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 area[5]. 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. Since 2000 we have tabulated new highs in a variety of areas. Our 2010 positive site total of 70 is yet another new record, surpassing our previous high of 57 from 2009 (white boxes in Figure 3 and bottom graph in Figure 7- Additional Updates. This general upward trend over time is also represented in the bottom bar chart of Figure 7, labeled "Number of positive sites per year".) We also detected at least one *I. scapularis* from all seven counties for the 4th consecutive year (1st occurrence was 2007) and in fact, our total of 24 positive sites from counties south of the Mississippi River[6] surpasses our previous record of 19 positive sites (2008 and 2009), as illustrated in Figure 5A and Table 1A. As has been typical in recent years, the majority (10 of 14) of our Dakota County sites were positive in 2010. However, we were surprised to find that the majority (6 of 8) of our Scott County sites (Figure 5A) were positive also, though we have been receiving more *I. scapularis* for tick identification in recent years from Scott and other counties south of the Mississippi River. Sites positive for the first time were all from our counties located south of the Mississippi River and included three Hennepin County parks (all Bloomington Township sites), and one large wooded area each in Scott (Spring Lake Township) and Carver (Chanhassen Township) counties (Figure 5A).

Although our 2010 average number of *I. scapularis* collected per mammal (.845) was not remarkable and in fact, was comparable to our recent elevated averages of 2000 – 2002, 2004, 2005, 2007 and 2009 (all $\geq$ .806), what was notable is that for the first time *I. scapularis* comprised >70% of our overall tick collections (Table 3). Our larval *I. scapularis* collections alone comprised 65% of all of the ticks collected but we also collected 107 nymphs - a nymph count in the 100's for only the 6th time; all since 2000 (Table 3). While we have not found a direct correlation between our tick surveillance results and metro human tick-borne disease cases as compiled by the Minnesota Department of Health (MDH), data from both agencies does seem to indicate a general upward trend in tick-borne disease risk since 2000. In other words, we do not mean to imply that because *I. scapularis* comprised such a high percentage of our overall tick collections in 2010, metro residents will naturally assume higher tick-borne disease risk in 2011 or had in 2010. However, we will continue to track the percentages of *I. scapularis* in our overall tick collections and if it continues to remain quite high, our assessment of risk would obviously change to accommodate that fact.

Examining human data, as of April 18, 2011, statewide tallies for 2010 were not yet available from the MDH. In general, the MDH expects their 2010 tallies to be similar to the high tallies recorded in recent years[7] but at new record highs. Their 2009 totals for Lyme (roughly 1065) and human granulocytic anaplasmosis (317) were 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

[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).

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

[7]personal communication MN Dept Health

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 were similar in count and very high in comparison to prior years.

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 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 1995[8] 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). 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 tallyied[9].

We believe that the risk of tick encounters in the metro is higher than it used to be based on our collections of more *I. scapularis* from a broader geographic area over time. Our 2010 results seem to support this hypothesis rather nicely – the overall average has remained elevated yet flat since 2000 but the numbers of positive sites in our network continues to rise. We believe that a Twin Cities resident's risk of encountering *I. scapularis* locally is now greater than it once was.

[8]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.

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

ADDITIONAL UPDATES/RESEARCH:

2010 UPDATE TO 2009 METRO ROCKY MOUNTAIN SPOTTED FEVER (RMSF) CASE.

To date RMSF is very rarely documented in Minnesota and even more rarely documented as having been acquired in our service area. In July 2009 MMCD was notified by the Minnesota Department of Health (MDH) of a locally-acquired RMSF case. Although it was post peak for the American dog tick vector (*Dermacentor variabilis*), MMCD attempted an aggressive tick collection effort and collected approximately 20 *D. variabilis*. We also provided archived ticks from our tick surveillance efforts to the MDH. In spring 2010 we collected additional ticks for the MDH. We estimated we collected approximately 400 *D. variabilis*. Some *I. scapularis* were collected too. Testing results will not be available for some time.

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

At the February 2010 TAB meeting we had mentioned that several of our tick records had originated from ticks removed from dogs. The TAB suggested MMCD connect with veterinarians and dog owners to potentially increase tick submissions. Therefore, in 2010 we visited vet offices and dog parks as part of our outreach to collect more unusual tick data (species and atypical locations for ticks). Roughly 86 vet clinics were visited and our interest in obtaining ticks was expressed. Materials were also dropped. A total of 42 dog parks were evaluated for sign potential. Signs were posted in approximately 21 parks and an additional 4 signs were posted in active dog walking areas, including at Stubbs Bay Park Luce Line Trail Entrance. During re-checks of the posted 21 parks we detected the occasional removal of our signs, primarily in Hennepin (probably park staff) and Ramsey (vandals) counties. To compensate for sign removals, staff distributed tick cards at dog park entrance gates on several occasions. Signs at all dog parks were removed in fall 2010. Although we did receive calls inquiring about our signs we did not directly receive ticks from these efforts in 2010.

RE-SAMPLING WACONIA (CARVER COUNTY).

On July 21, 2009 a staff member had turned in an *I. scapularis* that had been collected in Waconia (Carver County). Because it was unusual to collect an *I. scapularis* from this area we decided to further investigate despite our view that we were likely past peak for *I. scapularis*. A trapline was set at the suspected tick collection location for the week of July 27 but no ticks of any species were collected. MMCD re-sampled this area in 2010 and were successful in collecting *I. scapularis* (14L; 4N) even though our results continue to be negative from a distribution study site located approximately 3 miles away. As with our study sites, the Waconia area was sampled for three rounds, as an extra site.

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 continued 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.

STUDIES/PROJECTS FOR 2011.

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

- **Additional projects:**

As we had in 2009 and 2010, MMCD will provide samples to Dr. Roger Moon (UM – St Paul), to further the knowledge of the rodent bot fly (Genus *Cuterebra*).

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

EXTRA 2010 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.

At the December 2008 meeting, the LDTAB had been interested in infested mammal information. I did not compile this information completely in last year's report. Figures 7 and 8 are my attempt to address the request more directly.

Figure 7 is a series of charts that is intended to provide a big picture illustration of the changes in our *I. scapularis* collections over time. The first chart shows the total number of mammals collected each year from 1990 - 2010, the second, only the number of mammals that we removed at least one *I. scapularis* from (infested mammals). The third chart shows our yearly averages of *I. scapularis* collected per mammal and can be compared to the fourth chart, the average number of *I. scapularis* per infested mammals only. All four charts can than be compared with the fifth and final chart which provides the yearly total of sites where at least one *I. scapularis* had been collected (positive sites). All charts contain data from only our repetitive sampling network. All data from 1990 includes only 75 sites as our network had not been fully set, but all data from 1991 forward contains our current network of 100 sites, including our 75 sites from 1990. By examining these charts and comparing 2010 with past years one can see that our *I. scapularis* collections have risen over time but that the rise is most attributable to a geographic component (as evidenced by the rise in the positive site totals in the fifth chart), and not by a massive rise in *I. scapularis* collections on the individual mammals that we collect (as evidenced via the first four charts). The five charts also show the delineation between the data we have collected from 2000 forward compared to the first ten years (1990-1999) of this study.

Figure 8 combines the data from the first two charts of Figure 7 to show the proportion of infested mammals to the number of mammals collected yearly, from 1990-2010.

The table below had been distributed as an added report item for 2009. I have included it again to provide some primitive information on tick loads over time and thought it may evaluate Figures 7 and 8. 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 and 2010.

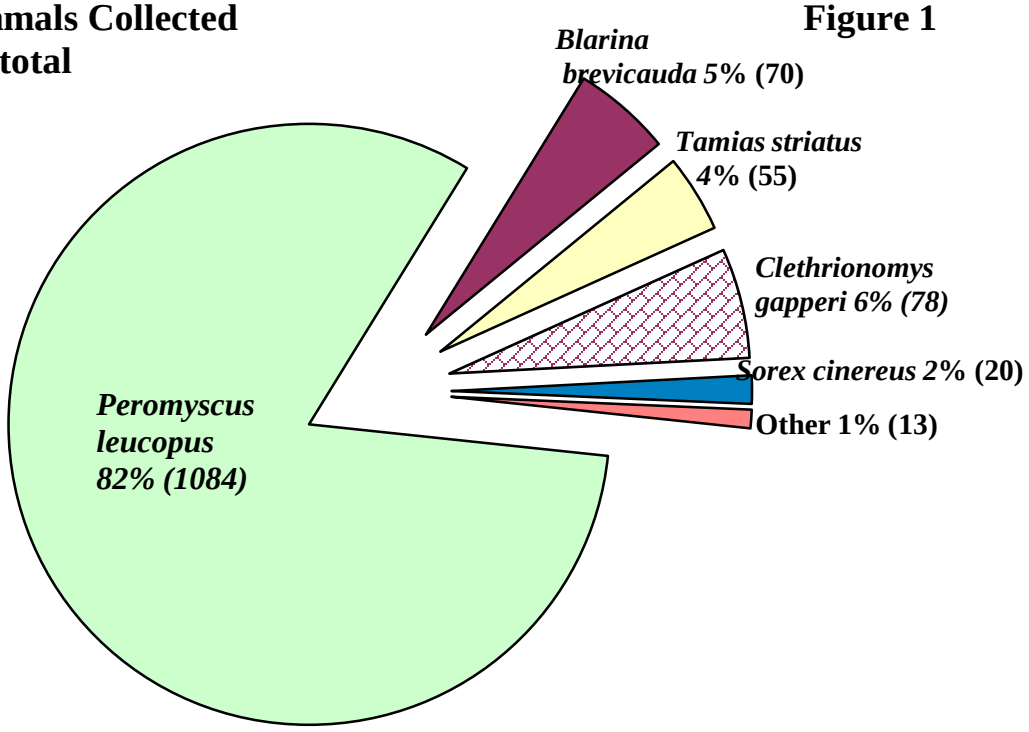
Comparison of tick loads on mammals in three time periods (lower, higher IS collections vs 2009)

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
	2010	9 of 27	24 of 52	62 of 224	77 of 222	51 of 191	41 of 330	7 of 274	# mammals w/IS vs total mam collected
IS/mammal	0.845	1 to 7	1 to 19	1 to 56	1 to 40	1 to 13	1 to 4	1 to 2	range of IS on infested mammals
		33%	46%	28%	35%	27%	12%	3%	% infested mammals

Small Mammals Collected
2010: 1320 total

Figure 1



Ticks, by Species and Stage, Removed from Small Mammals 2010: 1553 total

Figure 2

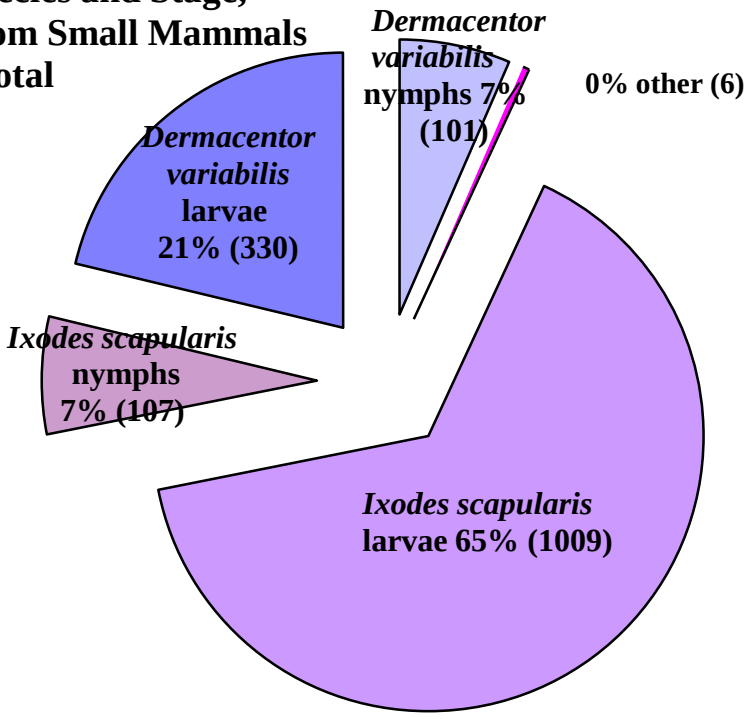
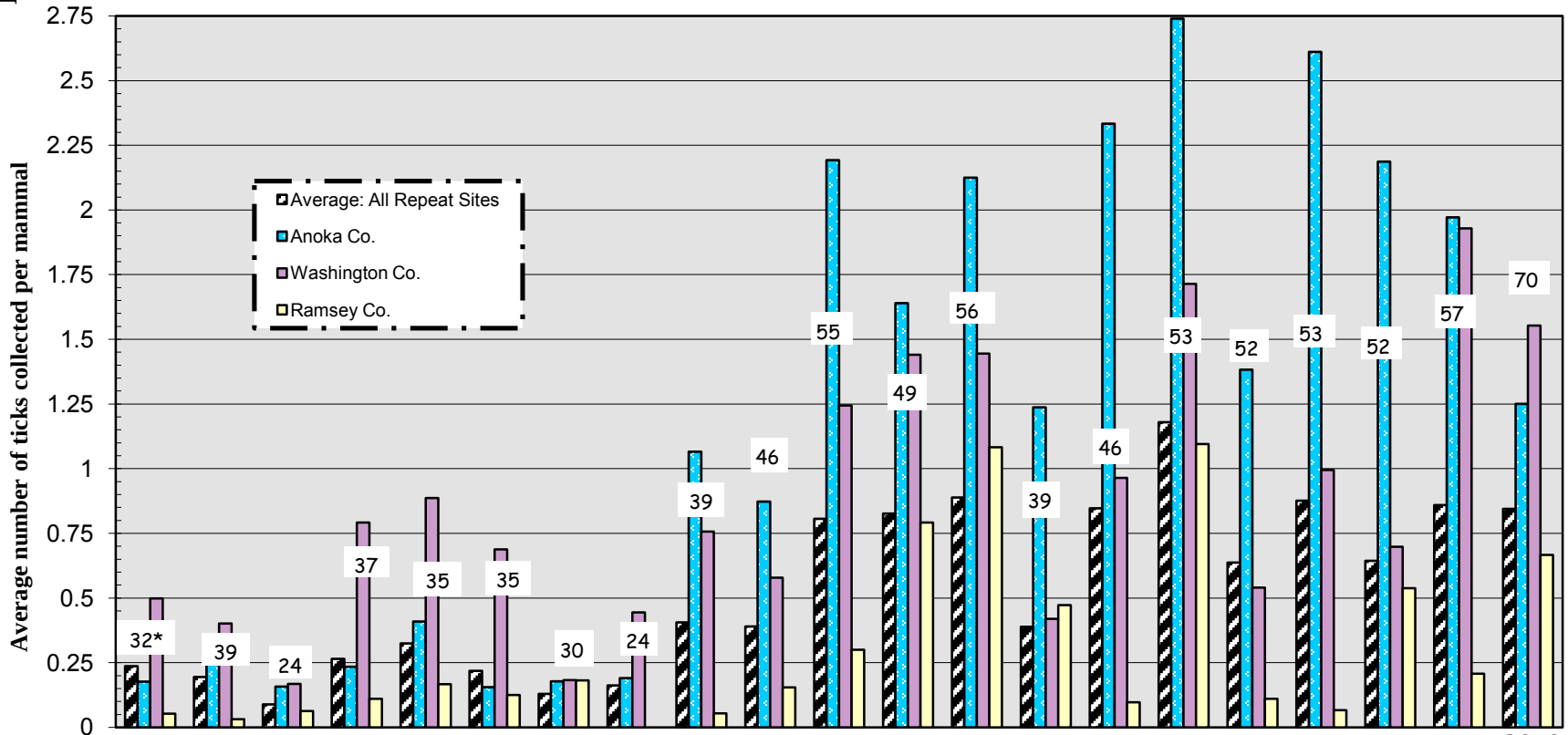


Figure 3

Average number of *I. scapularis* collected per mammal at 100 sampling locations in Anoka, Washington, and Ramsey counties: 1990 - 2010
(white box shows the total number of sites where at least one *I. scapularis* was found: by year)

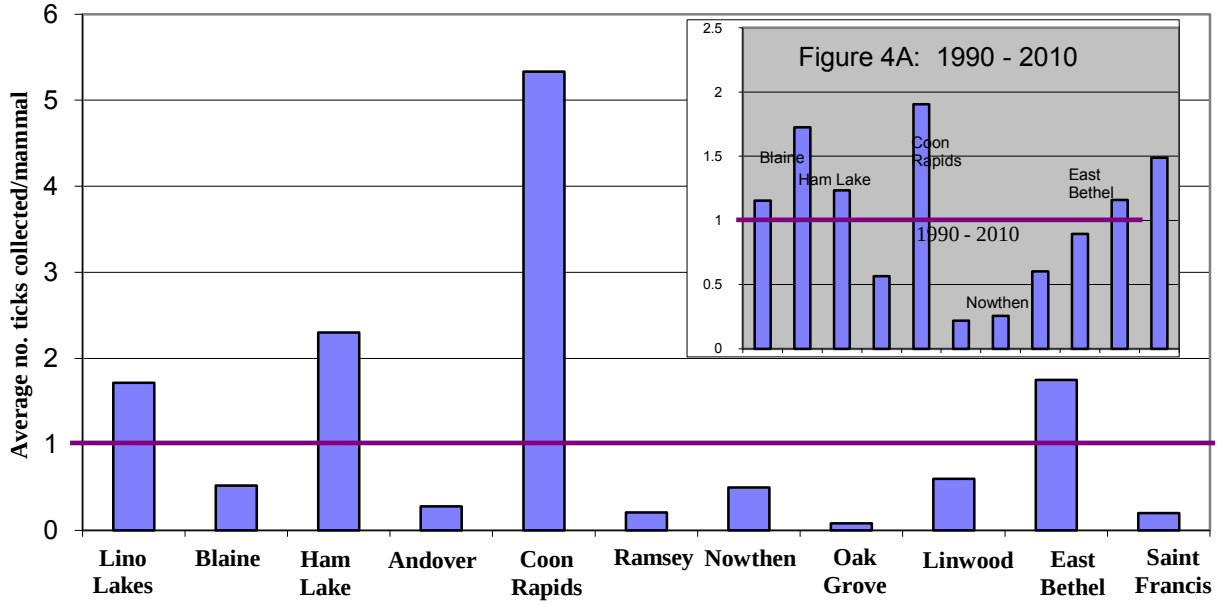


	1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dakota	.006	.066	.005	.004	.057	.097	.177	.078	.094	.163	.148	.171	.079	.078	.367	.355	.468	.799	.459	.489	.913
Scott		.004							.020			.029	.007		.011	.020	.020	.199	.029	.095	.215
Hennepin									.007		.017	.029	.024			.046	.050	.191	.043	.111	.216
Carver		.012																.077	.066	.021	.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): 2010 results



Average number of *I. scapularis*collected per mammal in Washington county (by township): 2010 results

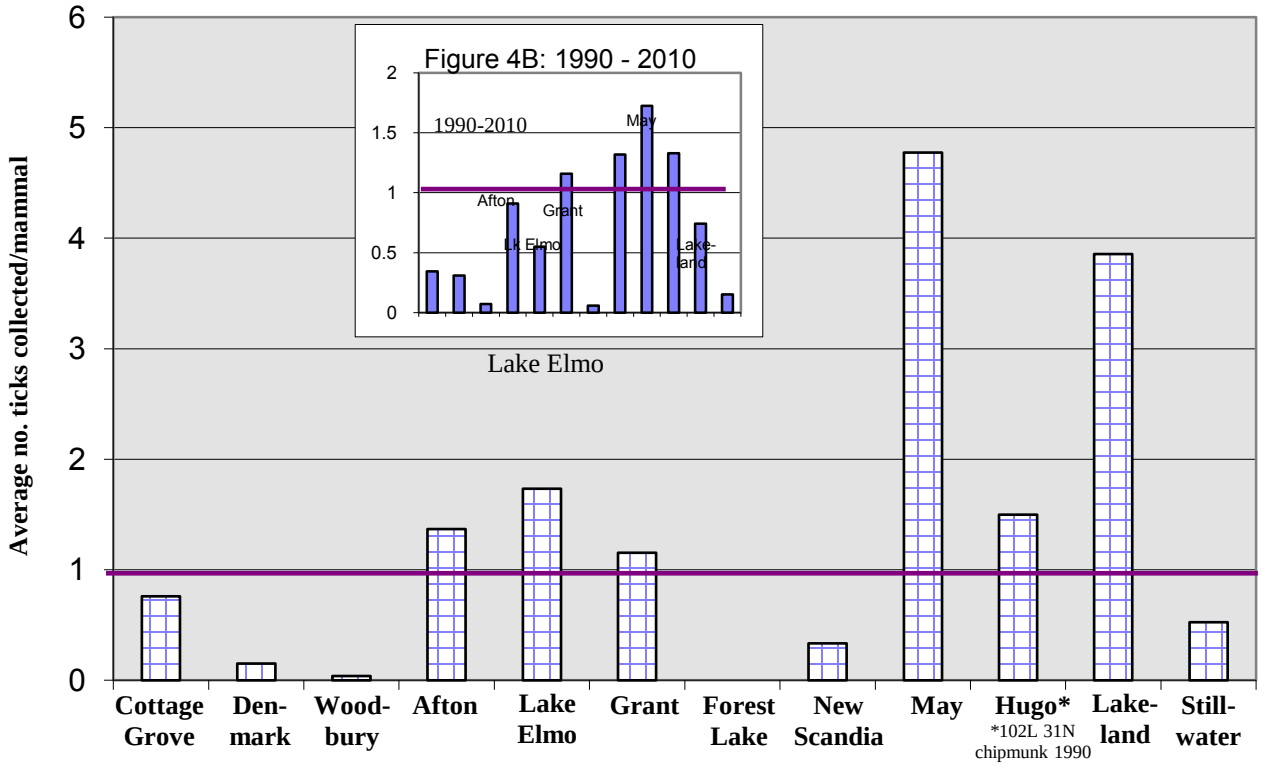
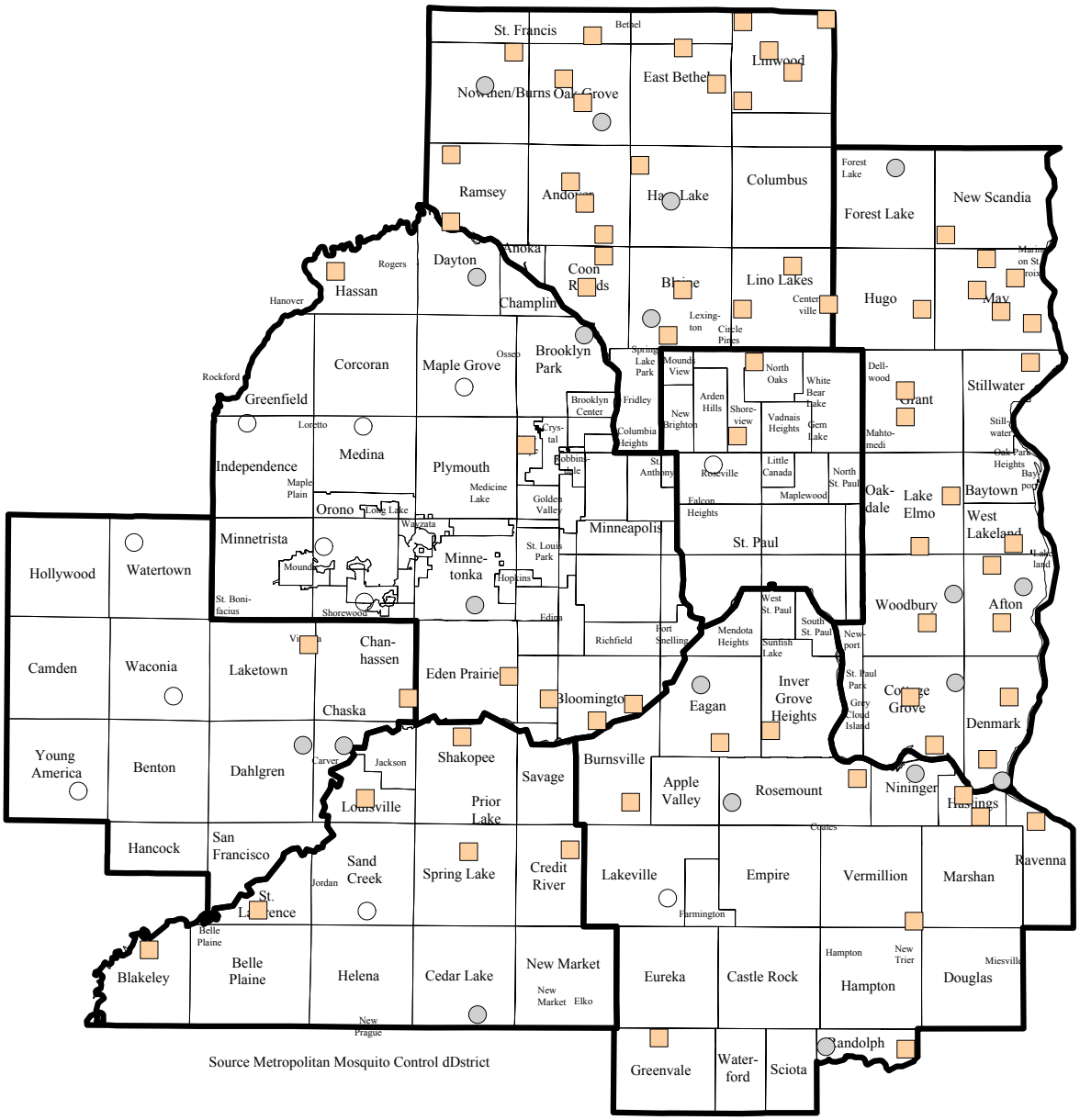


Figure 5A

Ixodes scapularis Presence / Absence status: 2010

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



Source Metropolitan Mosquito Control dDstrict

Status 2010

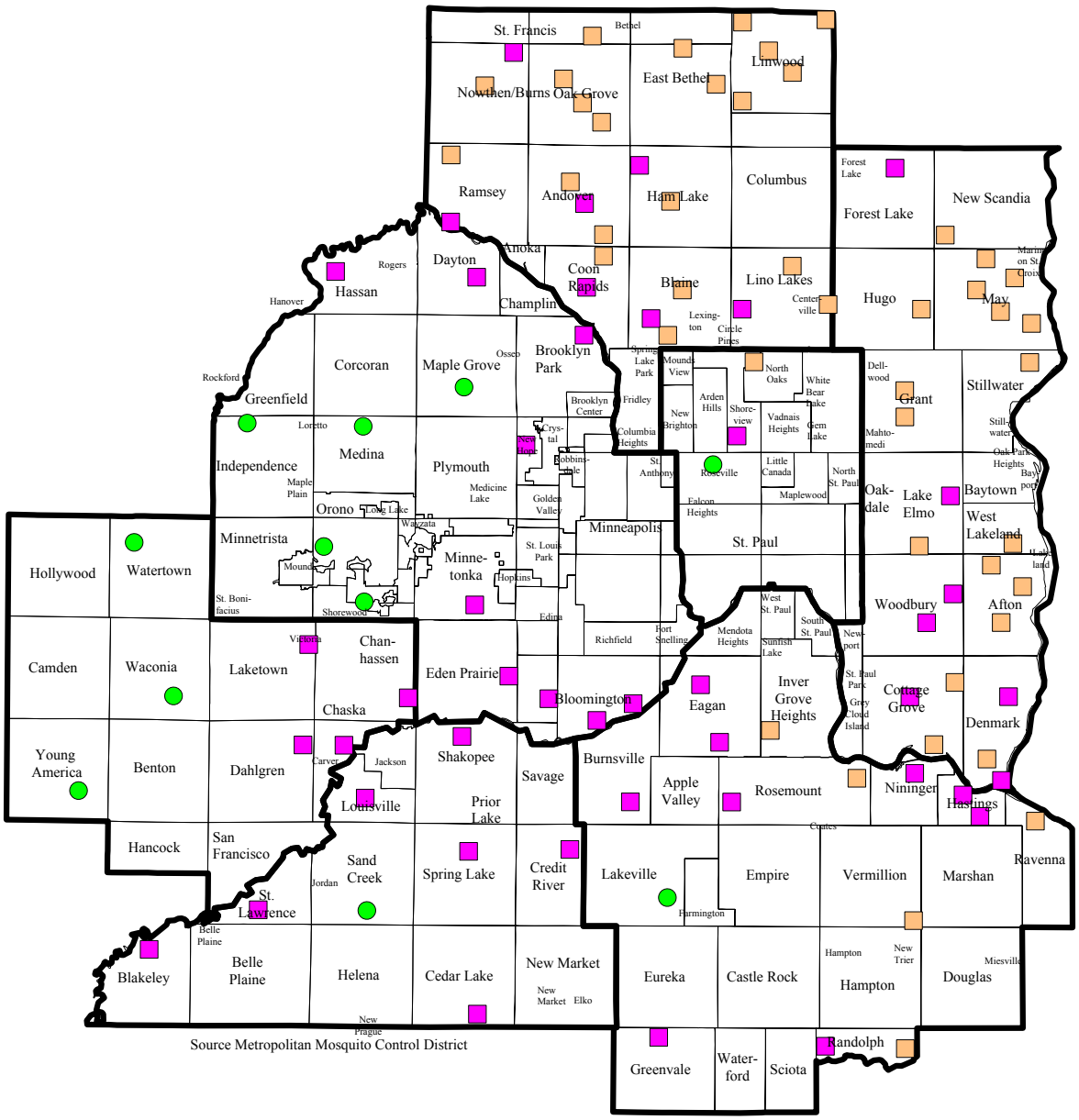
present	(70)
absent this year	(19)
not found 1990-2010	(11)

2010 Ixodes scapularis Distribution Study Report-
Metropolitan Mosquito Control District

Figure 5

Ixodes scapularis Presence/Absence status: 1990 - 2010

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



Source Metropolitan Mosquito Control District

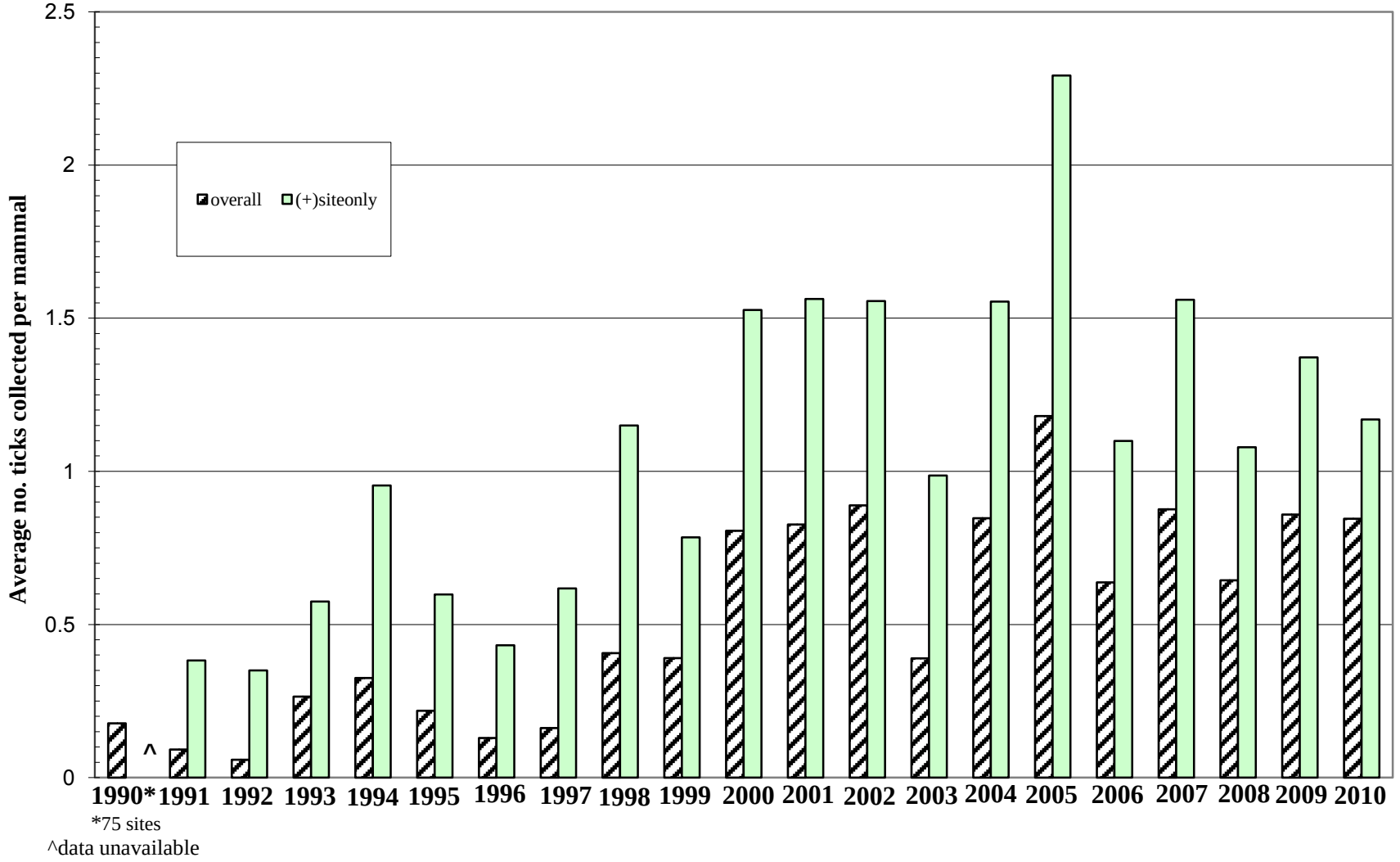
At least one tick found during:

- all/most years (45)
- at least one year (44)
- (not found) (11)

2010 Ixodes scapularis Distribution Study Report-
Metropolitan Mosquito Control District

Figure 6

Average number of *I. scapularis* collected per mammal at 100 repeat sampling locations 1990-2010 overall vs. sites where at least one *I. scapularis* was collected (positive sites)



*75 sites

^data unavailable

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
changing status	26	38	47	58	61	66	69	72	75	76	78	80	81	83	89
Ticks found:															
all years	21	17	11	5	5	5	4	3	1	1	1	1	1	1	1
most years	5	15	19	27	31	34	35	37	38	41	41	45	42	44	45
least	21	23	28	31	30	32	34	35	37	35	37	35	39	39	44
(not found)	53	45	42	37	34	29	27	25	24	23	21	19	18	16	11

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

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)	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)
2010	100	1320	[13.20]	82% (1084)	4% (55)	6% (78)	5% (70)	3% (33)

*Other includes *Microtus pennsylvanicus, Spermophilus tridecemlineatus, Zapus hudsonius, Mustela erminea, Tamiasciurus hudsonicus, Glaucomys volans, Sorex articus, 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	*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)

[a] 1990 data exludes one *Tamias striatus* with 102 larval & 31 nymphal *I. scapularis*

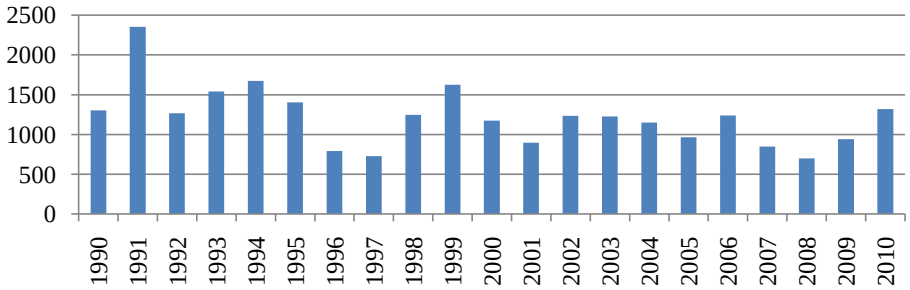
[b] L = larvae

[c] N = nymphs

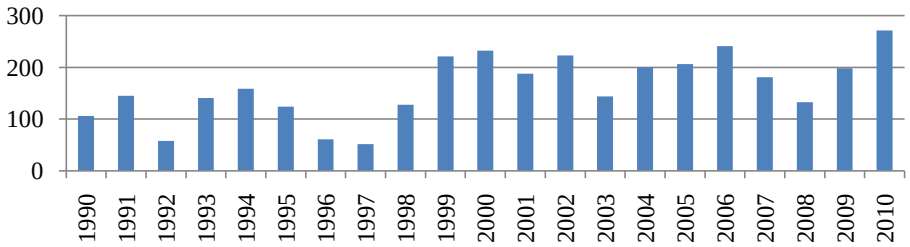
[d] Other species mostly *Ixodes muris* 1999-2nd adult *I. muris* collected 2007-collected 7 *I. marxi* nymphs

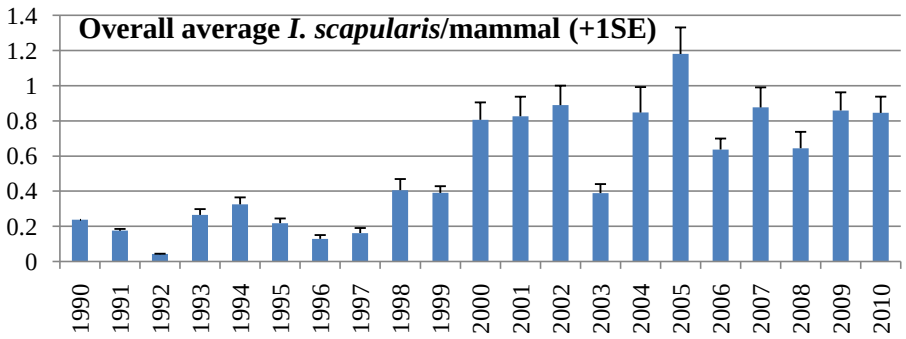
Figure 7-extra report item

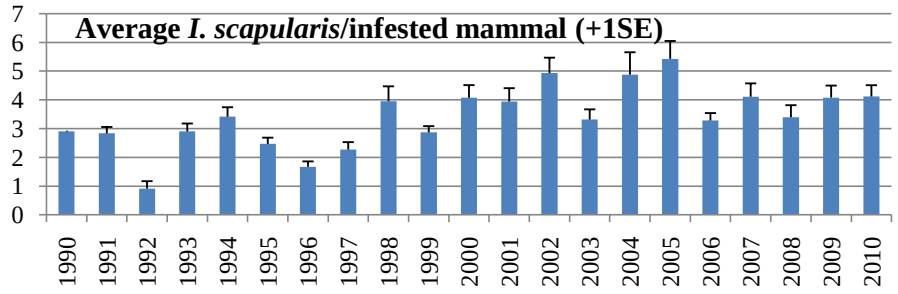
Overall number of mammals collected per year

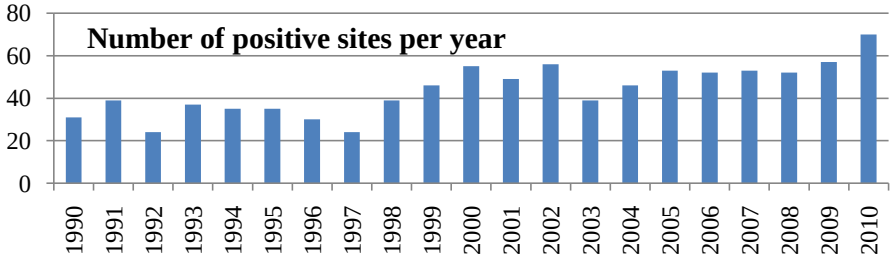


Number of infested mammals per year









Number of mammals with at least one *I. scapularis* , of overall mammals collected 1990-2010

Figure 8 -extra report item