epiREPORT

Manitoba Annual Tick-Borne Disease Report

2015

January 1, 2008 to December 31, 2015

Communicable Disease Control
Public Health Branch
Public Health and Primary Health Care Division
Manitoba Health, Seniors and Active Living

Released: November 2016 (*revised December 2017*)

Manitoba

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Abbreviations

BLT	Blacklegged tick (*Ixodes scapularis*)
MHSAL	Manitoba Health, Seniors and Active Living
NNDSS	National Notifiable Disease Surveillance System
PHAC	*the* Public Health Agency of Canada
RHA	Regional Health Authority

Regional Health Authorities

Winnipeg RHA	Winnipeg Regional Health Authority[1]
Southern Health – Santé Sud	Southern Health – Santé Sud
Interlake-Eastern RHA	Interlake-Eastern Regional Health Authority
Prairie Mountain Health	Prairie Mountain Health
Northern RHA	Northern Regional Health Authority

[1] Note that reference to the Winnipeg RHA in this report does not include the community of Churchill. Rather reference to the Winnipeg RHA in this report refers only to the City of Winnipeg and the Rural Municipalities of East and West St Paul.

Acknowledgments

The *Manitoba Annual Tick-Borne Disease Report (2015)* is the result of the efforts of dedicated individuals throughout the province of Manitoba, including health care providers, laboratory personnel, central and regional public health employees (i.e. Medical Officers of Health, public health nurses, seasonal field surveillance staff), external stakeholders (i.e. the Public Health Agency of Canada (PHAC) staff) and members of the public who have submitted blacklegged tick specimens.

The historical passive surveillance program (2008 – 2015) was a collaborative effort between Manitoba Health, Seniors and Active Living (MHSAL), PHAC and researchers and students at the University of Manitoba.

Citation

Government of Manitoba, Manitoba Health, Seniors and Active Living, Public Health and Primary Health Care Division, Public Health Branch, Communicable Disease Control (2015). *Manitoba Annual Tick-Borne Disease Report 2015.*

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Executive Summary

The public health impact posed by tick-borne diseases such as Anaplasmosis, Babesiosis, and most notably Lyme disease, continues to increase in Manitoba. This increase has been largely attributed to the continued range expansion of the vector, the blacklegged tick (*Ixodes scapularis*). This rapid expansion has allowed for the establishment of populations in areas once thought inhospitable for blacklegged ticks (BLT).

Since the identification of the first BLT risk area in 2006, the number and distribution of said risk areas has steadily increased. Risk areas now extend from the Ontario border to the Brandon area and from the United States of America (USA) border to the southern edge of Interlake-Eastern Regional Health Authority (RHA). The minimum infection rates (MIR) for *Anaplasma phagocytophilum the causative agent of Anaplasmosis continues to exceed 5.0%, whereas the MIR* for *Borrelia burgdorferi*, the causative agent of Lyme disease, continues to hover around 20.0% based on passive surveillance data.

The impact of tick-borne diseases on humans, in particular the impact of Lyme disease, has also steadily risen over the previous seven years. The number of confirmed and probable Lyme disease cases (as per PHAC's National surveillance case definitions), reported annually in Manitoba increased significantly, from 5 in 2009 to 37 in 2014 and 29 in 2015. Of *all* the confirmed and probable Lyme disease cases reported to MHSAL since Lyme disease became nationally reportable in 2009, nearly two-thirds were reported between 2013 and 2015. Further, in 2009 approximately 40.0% of all confirmed and probable Lyme disease cases had likely exposure outside of Manitoba; by 2015 this number has dropped to approximately 13.0%. Southern Health – Santé Sud, an area with a long history of established BLT populations, had the highest incidence rates for Lyme disease based on both region of residence and likely exposure location.

MHSAL continues to monitor the distribution and infection rates of BLTs to identify new risk areas and develop and refine guidance and communications for both health care professionals and the public. In addition, MHSAL continues to monitor BLT populations for evidence of emerging pathogens of public health concern.

What to Expect in This Report

The aim of this report is to summarize the burden posed by the three provincially reportable tick-borne diseases in Manitoba (Anaplasmosis, Babesiosis and Lyme disease), in a user-friendly manner that will allow the reader to quickly access the information. This report will present both tick and human data to illustrate the increasing impact posed by tick-borne diseases. Further, the *Manitoba Annual Tick-Borne Disease Report (2015)* will focus on historical data (2008 – 2014 for tick surveillance and 2009 – 2014 for human data) to provide context to the emerging tick-borne disease issue but will also highlight the most recent surveillance data from 2015. It should be cautioned that the data presented in this report may differ from data presented on the MHSAL tick-borne disease website (www.gov.mb.ca/health/publichealth/cdc/tickborne/index.html). Any differences in the counts of human cases are likely due to the availability of new information (e.g. new laboratory results, or additional travel or clinical information) that may allow for subsequent reclassification (e.g. from a "probable" case to a "confirmed" case) or additional tick identification results, that may allow for changes to the BLT risk area map.

The '**burden**' of disease refers to the number of people living with a disease. The more people that have a disease, the larger the '**burden**' on public health is.

What you will see in this report:

- Maps outlining the continued range expansion of BLTs in Manitoba,
- Maps and tables highlighting BLT surveillance efforts and detailing infection rates,
- Tables, figures and maps illustrating the human impact posed by tick-borne diseases,
- Text boxes that elaborate on key concepts and quickly highlight important surveillance findings.
- Supporting text to provide context to the data.

Note that the data presented in this report only addresses the three provincially reportable tick-borne diseases. MHSAL continues to work with various stakeholders, including PHAC, to monitor for emerging tick-borne diseases that may pose a public health burden. Should surveillance detect an increasing risk posed by other tick-borne diseases MHSAL may consider revising reporting procedures. For instance, in 2015, following increasing human and tick surveillance signals Anaplasmsosis and Babesiosis were made provincially reportable under the *Public Health Act* (*Reporting of Diseases and Conditions*

Regulation – Schedule B http://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=37/2009).

Blacklegged Ticks, Surveillance and Tick-Borne Diseases

Blacklegged tick biology

BLTs are parasitic animals which are related to spiders. BLTs cannot jump or fly. Instead, they seek hosts by climbing on vegetation such as grasses or shrubs and waiting for a host to rub against them. When this occurs, they climb onto the host's body and eventually attempt to attach and feed.

BLTs feed by attaching their mouth parts to the skin of an animal (including humans) and drinking blood very slowly over a period of days. A tick bite is generally painless. As ticks feed, their bodies expand to accommodate the blood meal. This is called engorgement. If a BLT is infected with a tick-borne disease causing agent, it can pass this infection along to its host during feeding.

Tick-borne diseases naturally circulate between BLTs and wild animals. Animals such as rodents, small mammals and white-tailed deer are the **reservoirs** (the source) of the tick-borne disease causing agents and the BLT is the **vector** (the vehicle) which moves the disease agents between animals. Most wild animals do not become ill from these agents, nor can you become infected with tick-borne diseases by consuming meat or handling the pelt from a wild animal. However, there is a risk for these ticks to transfer to you when handling the animal. Humans and some domestic animals are **accidental hosts** and may become ill when they are fed upon by an infected BLT and exposed to the disease causing agent.

Even if you are bitten by a BLT, it does not mean that it will transmit a disease to you. First, not all BLTs are infected with disease causing agents. Second, only nymph and adult stages can transmit infection (larvae need to acquire the disease agent(s) when feeding). And third, BLTs need time to prepare their bodies to significantly expand with blood and often do not start to feed for the first 24 hours after attaching themselves to a host. Because of this, BLTs typically need to be attached to a host for at least 24 hours in order to transmit the disease causing agents of Anaplasmosis, Babesiosis and Lyme disease. **This is why performing a tick check is so important.**

BLTs exist in three life stages: larva, nymph and adult. The life cycle of BLTs takes at least three years to complete and each stage usually survives for up to one year. Blood is

required by the tick to move to the next stage. Unfed larvae and nymphs are light in color and very difficult to see.

Passive Surveillance

Passive surveillance is when health care providers, veterinarians, or members of the public send ticks to MHSAL, in order for the species to be identified. Suitable specimens are then tested for tick-borne diseases. Results of the passive surveillance program are used to identify locations for active surveillance.

For information on how to submit ticks to the passive surveillance program, please visit www.gov.mb.ca/health/publichealth/cdc/tickborne/about.html.

The passive BLT surveillance program was formally launched in Manitoba in 1996 and continued until 2002, when stable submission numbers coupled with low and consistent infection rates led to its termination. The program was renewed in 2008 following an investigation into a cluster of human cases with common exposure history which identified the first established BLT population in the extreme southeast corner of the province in 2006. Since the renewal in 2008, the program has been a collaborative effort between MHSAL, the University of Manitoba and PHAC. As of the fall of 2015 the program is now a sole collaboration between MHSAL and PHAC.

Data from the passive surveillance program provide invaluable information regarding the potential distribution of BLTs and their associated pathogens. Blacklegged tick specimens are submitted by health care providers, veterinarians and members of the public on a voluntary basis throughout the year, with a targeted fall advertising campaign. Suitable specimens are tested for *Anaplasma phagocytophilum*, *Babesia microti* (the causative agent of Babesiosis) and *Borrelia burgdorferi* to determine and compare infection rates. Moreover data such as locations with multiple submissions and/or locations from which more than one specimen was submitted, are used to guide and prioritize the active surveillance program. Sites warranting active surveillance correspond to areas where the passive program has identified clusters and/ or high numbers of BLT submissions and/ or infection rates.

Testing for additional tick-borne pathogens such as *Borrelia miyamotoi* and *Borrelia mayonii* is also conducted. However, as these pathogens are currently not reportable in Manitoba, the results are not considered in this report. MHSAL continues to work with PHAC to monitor the impact of these and other emerging pathogens of public health importance.

Active Surveillance

Active surveillance is when MHSAL staff go out into the field to find BLTs in the environment. Active surveillance is necessary to identify risk areas.

Active surveillance is a vital component of the overall BLT surveillance program for two reasons. Firstly, it is required to demonstrate evidence of a reproducing (established) population of BLTs which is defined as an area where all life stages are found over repeated visits. Secondly, it is used to demonstrate evidence of the circulation of tick-borne pathogens within both BLTs and within the surveyed environment. The combination of this evidence allows an area to be classified as having an established BLT population.

Criteria for identifying a blacklegged tick risk area

A region will be classified as a risk area when active surveillance, conducted over 2km, detects a minimum of one BLT provided that the surveillance efforts were triggered by one of the following:

1) It represents an extension of a previously identified BLT risk area, **OR**
2) Positive passive surveillance results (i.e. multiple submissions and/ or multiple specimens in a submission), **OR**
3) A cluster of human cases with likely exposure within the area, **OR**
4) The area is in close proximity, and has suitable habitat to support establishment, of a known BLT risk area.

Identifying BLT risk areas is critical for risk assessment, risk communication and is valuable for the classification of human cases. The risk of encountering BLTs, and any associated pathogens, is greater in regions where BLT populations are known to be established. MHSAL recommends that visitors and residents of BLT risk areas adopt personal protective measures to minimize their risk of tick-borne disease transmission (for more information see the tick-borne disease website: www.gov.mb.ca/health/publichealth/cdc/tickborne/prevention.html). Further, MHSAL encourages physicians to consider tick-borne diseases in their differential diagnosis when seeing patients with compatible clinical symptoms and travel history to, or residence within, a risk area or region with suitable BLT habitat.

Reportable Tick-Borne Diseases

While the signs and symptoms of each tick-borne disease may vary, they each share two common features; the vector (BLTs) and prevention measures. The key prevention measure to reduce the risk of transmission is to minimize the risk of exposure to BLTs. Thus, the adoption of frequent tick-checks and other prevention measures can greatly reduce the probability of disease transmission when traveling or residing within BLT risk areas, or regions with suitable habitat. For more prevention information see the MHSAL tick borne-disease website.

Anaplasmosis

Anaplasmosis, formerly known as Human Granulocytic Anaplasmosis, is caused by the bacteria *Anaplasma phagocytophilum*. The most common route of transmission is via the bite of an infected blacklegged tick. Common symptoms include fever, plus one or more of the following: chills, headache, muscle aches and joint pain. While most cases of Anaplasmosis are mild and self-limiting, older individuals and those with compromised immune systems can develop severe illness that often requires hospitalization. Antibiotic treatment is started based on a physician's suspicion of infection with most symptoms. Treatment is typically successful, with symptoms resolving within 30 days of onset, although resolution may be slightly longer for those with more severe illness.

Babesiosis

Babesiosis is an infection caused by a parasite most commonly transmitted via the bite of an infected blacklegged tick, though transmission through blood and other transfusion products is also possible. There are a number of *Babesia* species worldwide however the most common species in North America and Manitoba is *Babesia microti*. Common symptoms of Babesiosis are often mild, non-specific and flu-like. Symptoms may start with the gradual onset of fatigue and discomfort, followed by one or more of the following: chills, sweats, anorexia, headache, weakness, nausea, non-productive cough and joint pain. The risk of severe illness is greater among older individuals and those with underlying medical conditions. Babesiosis can be successfully treated with anti-parasitic drugs with most symptoms resolving within 1 – 2 weeks.

Lyme Disease

Lyme disease can be caused by one of three species of tick-borne bacterium. In Manitoba, as in North America, locally acquired cases are associated with *Borrelia*

burgdorferi, which can be transmitted via the bite of an infected blacklegged tick[2]. Common symptoms of Lyme disease include a red-expanding rash (Erythema migrans), headache, fever, fatigue and chills. If left untreated Lyme disease infection can cause joint, heart and nervous system complications. Physicians are encouraged to treat based on clinical symptoms, and the disease can be treated successfully with antibiotics, particularly when diagnosed early.

Introduction

In Manitoba, there are several species of ticks, but this report focuses on *Ixodes scapularis*, which is responsible for spreading tick-borne diseases to humans. This tick is more commonly known as the deer tick or the blacklegged tick. Other tick species, such as the more common wood tick (*Dermacentor variabilis*), are not effective vectors of disease causing agents of human importance in Manitoba.

Tick-borne diseases are recognized as some of the most common vector-borne diseases in North America, and the impact of these diseases, particularly Lyme disease, continues to expand in both Canada and Manitoba. In Manitoba there are three principle tick-borne diseases of public health concern; Anaplasmosis, Babesiosis and Lyme disease. Lyme disease became provincially reportable in 1999 and nationally reportable in 2009. With increasing infection rates among BLT collected via surveillance programs, Anaplasmosis and Babesiosis were made provincially reportable beginning January 1, 2015. This report details activity associated with the three provincially reportable tick-borne diseases, among both humans and BLTs, between January 1, 2008 and December 31, 2015.

The Communicable Disease Control (CDC) unit of MHSAL routinely monitors both human and tick surveillance data in an effort to assess and communicate changes associated with tick-borne disease transmission risk. The risk of exposure to BLTs, and potentially any associated pathogens, is significantly greater in risk areas where surveillance has demonstrated that they are established. These BLT risk areas are identified through passive surveillance data and human case clusters, and subsequently confirmed via active tick surveillance. MHSAL reviews BLT surveillance and human data annually to identify new risk

[2] Note that the western blacklegged tick (*Ixodes pacificus*) can also transmit *Borrelia burgdorferi*, however its range is limited to the Pacific Coast of North America.

areas, assess risk and refine risk messaging and guidance for both health care professionals and the general public.

Methods

Lyme disease data was reported for the period January 1, 2009 to December 31, 2015. Lyme disease data focused primarily on cases that met the confirmed and probable National surveillance case definitions (see Appendix C). In some instances cases classified as 'other' (not meeting the National surveillance case definitions) were included to further illustrate trends. Throughout the report, confirmed and probable Lyme disease cases for 2015 were compared with the data since 2009, when the National surveillance case definition came into effect.

Anaplasmosis and Babesiosis became provincially reportable on January 1, 2015. Consequently, cases of Anaplasmosis and Babesiosis meeting provincial surveillance case definitions (see Appendix A and B) were reported for the period between January 1, 2015 and December 31, 2015.

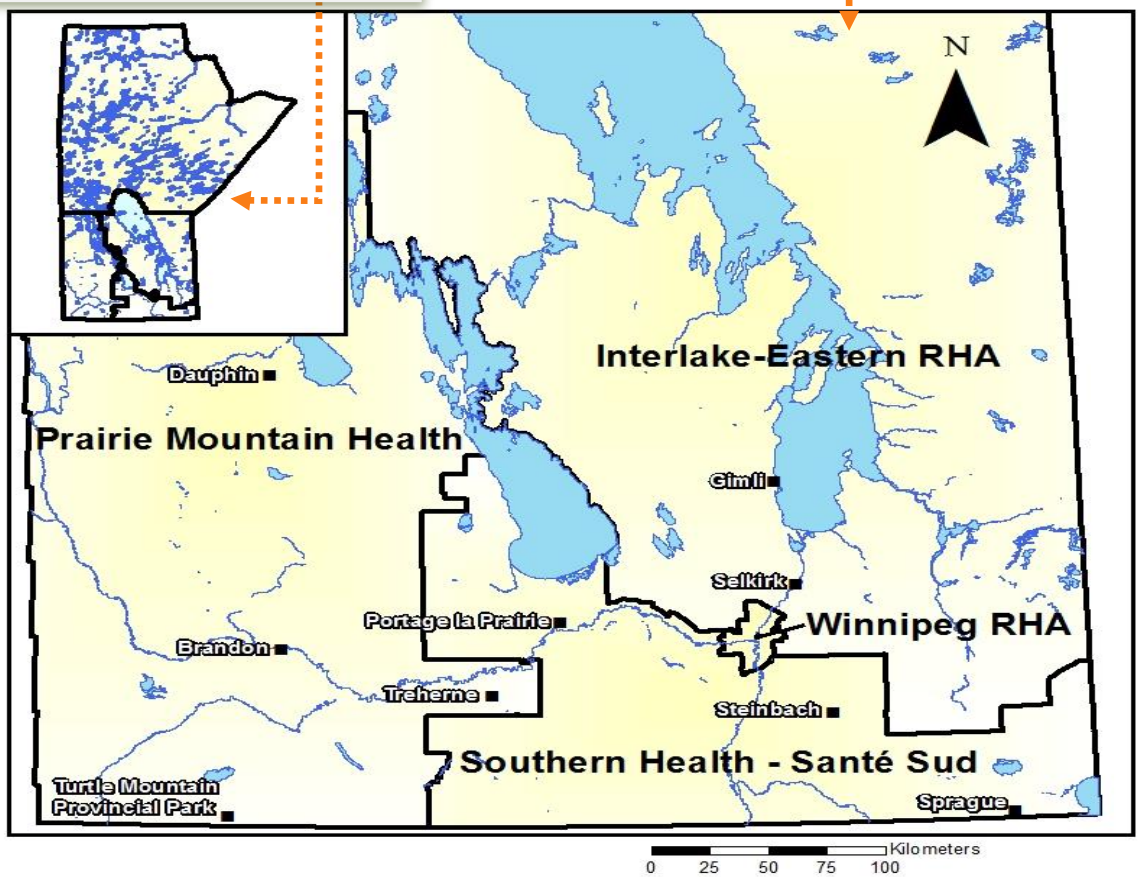
Incidence rates were calculated using the MHSAL population files (www.gov.mb.ca/health/population/index.html) which provide the mid-year population count as of June 1 of the year in question. All rates are crude incidence rates calculated as the number of cases (numerator) divided by the population of the group specified (denominator) and multiplied by 100,000 to produce the number of reported cases per 100,000 persons. That is, the number of cases per 100,000 individuals in that population. For example, the 2015 Lyme disease incidence rate for residents of Southern Health – Santé Sud was calculated with a numerator of the number of Lyme disease cases (meeting National surveillance case definitions), and a denominator of the total population in that RHA as of June of that year. The average incidence rates were calculated with a numerator of the average number of Lyme disease cases from the specified RHA from 2010 to 2014, and a denominator of the average population of the RHA specified, from 2010 to 2014.

When comparing incidence rates, and especially when comparing case counts between RHAs, it is important to keep in mind that the differing population counts between regions can contribute to an incidence rate that looks conspicuously large even when there are only a few cases, or an incidence rate that appears small even when there are many cases. For example, Northern Health Region may experience large changes in incidence when there are small changes in the case count, due to its small population; the opposite goes for the Winnipeg RHA.

Key Elements in Tick Surveillance Maps

Manitoba is divided into 5 Health Regions. Tick surveillance occurs primarily in southern Manitoba. This densely populated region is associated with the majority of tick submissions and most tick-borne disease cases.

Maps display areas of interest: Prairie Mountain Health, Southern Health – Santé Sud, Winnipeg and Interlake Eastern RHA health regions.



LEGEND

- Reference Cities
- Manitoba Lakes
- Health Regions

Projection: UTM Zone 14 NAD83
Basemap data from Manitoba Land Initiative.
Created: October 2016

Tick surveillance is a collaborative project involving the Public Health Agency of Canada, the University of Manitoba and MHSAL.

Active and passive tick surveillance data is current through the 2015 season.

Manitoba
Health, Seniors and Active Living

Health regions, Manitoba lakes and reference cities symbology will not be listed in the legends going forward. Please use this map as a reference.

All maps use the same projection, scale and base map data.

Tick Surveillance

Passive Surveillance, 2008-2015

Highlights

- Since 2008 the number of BLT submissions and infection rates have increased.
- The most common tick-borne pathogens are *Borrelia burgdorferi* the agent of Lyme disease, and *Anaplasma phagocytophilum*, the agent of Anaplasmosis.
- By 2015 the minimum infection rates (MIR) for the agents of Anaplasmosis and Lyme disease were 6.2% and 19.1% respectively.
- In 2015 most infected BLTs were collected from locations within or in close proximity to previously identified risk areas.

Between 2008 and 2015, BLT submissions were received from locations across much of Manitoba (Figure 1). Most submissions have been received from the southern portion of the province, an area that corresponds to higher population densities, and geographic proximity to Minnesota where BLTs have been well established since the early 1980s. Specimens collected from northern areas are thought to be associated with migratory birds, and therefore not suggestive of establishment given the unsuitable habitat and climate.

A BLT specimen refers to a single tick. A submission refers to one or more tick specimens that are submitted at once by one individual.

The number of BLT submissions received as part of the passive surveillance program has steadily increased (Table 1). In 2009 the program received 122 submissions, whereas by 2013 and 2014 there were more than 400 submissions received annually. Coupled with increased submission rates, is an increase in BLT infection rates, particularly for *Anaplasma phagocytophilum* and *Borrelia burgdorferi*, over this time period. Moreover, since 2013 the MIR for *B. burgdorferi* has hovered near and/ or exceeded 20%, while the MIR for *A. phagocytophilum* has exceeded 5.0% (Table 1). Testing for *Babesia microti* only started in 2013, and infection rates remain relatively low, hovering between 0.8 and 1.7% (Table 1).

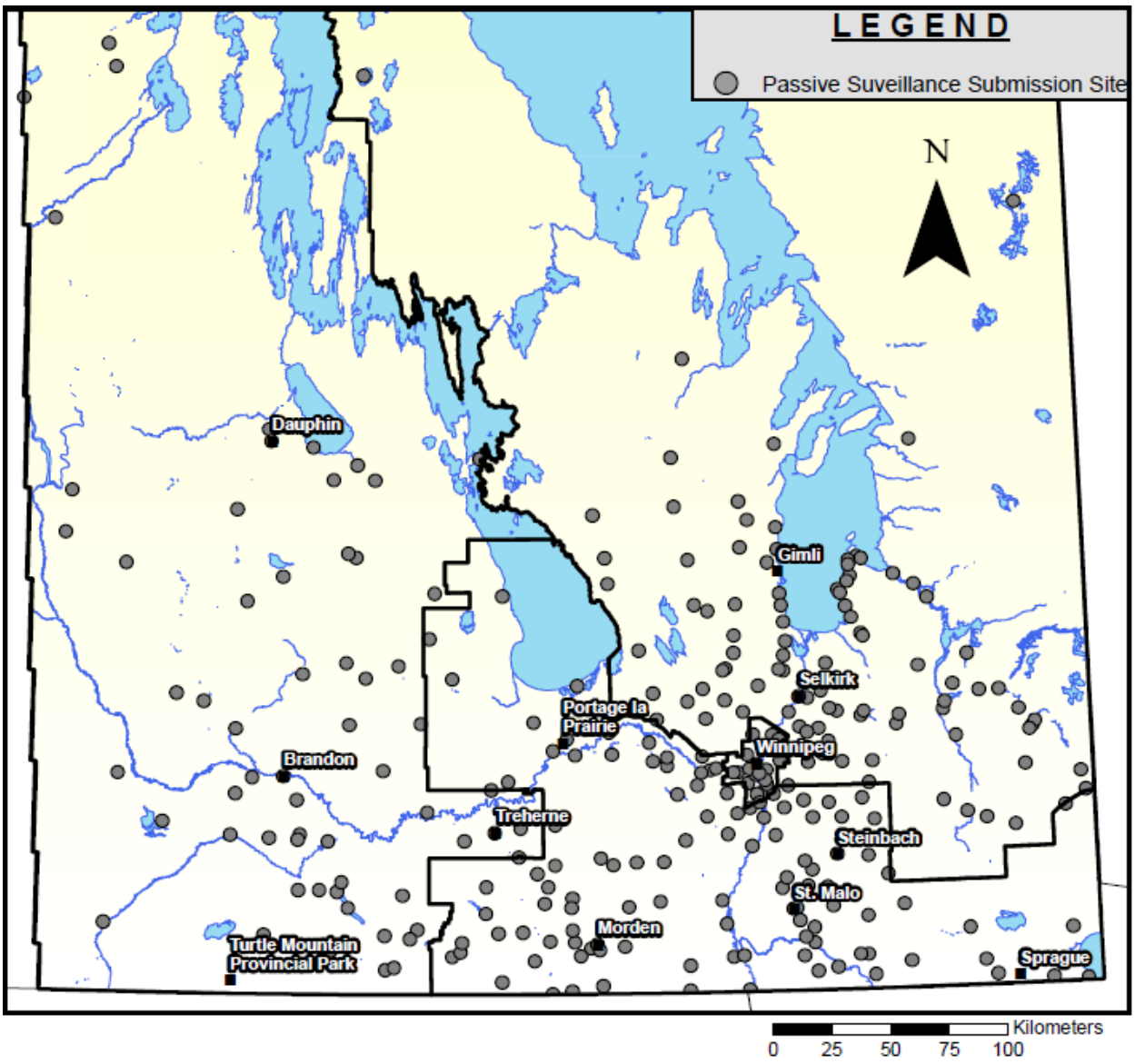


Figure 1: Distribution of sites where BLT specimens were collected as part of the passive surveillance program, 2008 – 2015

Table 1: Minimum infection rate for the causative agents of the three reportable tick-borne diseases, Anaplasmosis, Babesiosis and Lyme disease among BLTs collected as part of the passive surveillance program, 2008 – 2015

	2008	2009	2010	2011	2012	2013	2014	2015
# Tested	151	122	324	310	220	434	417	486
% *A. phagocytophilum* positive	3.3%	4.9%	6.2%	3.1%	3.3%	7.4%	5.8%	6.2%
% *B. microti* positive	N/A	N/A	N/A	N/A	N/A	1.2%	1.7%	0.8%
% *B. burgdorferi* positive	16.3%	12.3%	11.4%	16.3%	10.5%	21.0%	24.7%	19.1%

Where more than one adult BLT is submitted from a non-human host (i.e. dog, cat, etc.), they are placed in pools of up to five ticks for testing. Any adult ticks that are removed from a human host are tested individually. All nymphs are also tested individually. **The data in this report assume that only a single specimen in a pool is positive, so infection rates are presented as a minimum infection rate.**

Passive Surveillance, 2015

In 2015 the passive surveillance program received a total of 687 submissions, from which a total of 389 submissions contained specimens belonging to the genus *Ixodes*, or 'hard ticks'. Two submissions contained *Ixodes cookei*, the groundhog tick, while all others contained *Ixodes scapularis,* the BLT. Nearly 95.0% of the BLT specimens were collected within Manitoba (Table 2). BLT specimens were collected from April through November with a small peak in May/ June and a larger one in October, with the majority coming from dogs.

Table 2: Overview of submissions containing *Ixodes* species received as part of the 2015 passive surveillance program

Species	In Province		Out of Province		Unknown	
	# Submissions	# Specimens	# Submissions	# Specimens	# Submissions	# Specimens
Ixodes scapularis	366	453	12	16	9	9
Ixodes cookei	2	2	0	0	0	0
Total	**368**	**455**	**12**	**16**	**9**	**9**

BLT specimens were collected from southern Manitoba (i.e. from all RHAs, with the exception of Northern Health Region). The collection area stretched from the Ontario border to as far west as Virden, and from the USA border as far north as Bellsite (north of Swan River) (Figure 2). Many submission sites were within previously identified BLT risk areas, while others were in close proximity to these known risk areas. In addition, multiple submissions were received from a handful of locations not previously identified as risk areas, most notably Riding Mountain National Park and Whiteshell Provincial Park. Given these indicators, active surveillance efforts in 2016 will be conducted to determine whether BLT populations have become established, in these regions (Table 2).

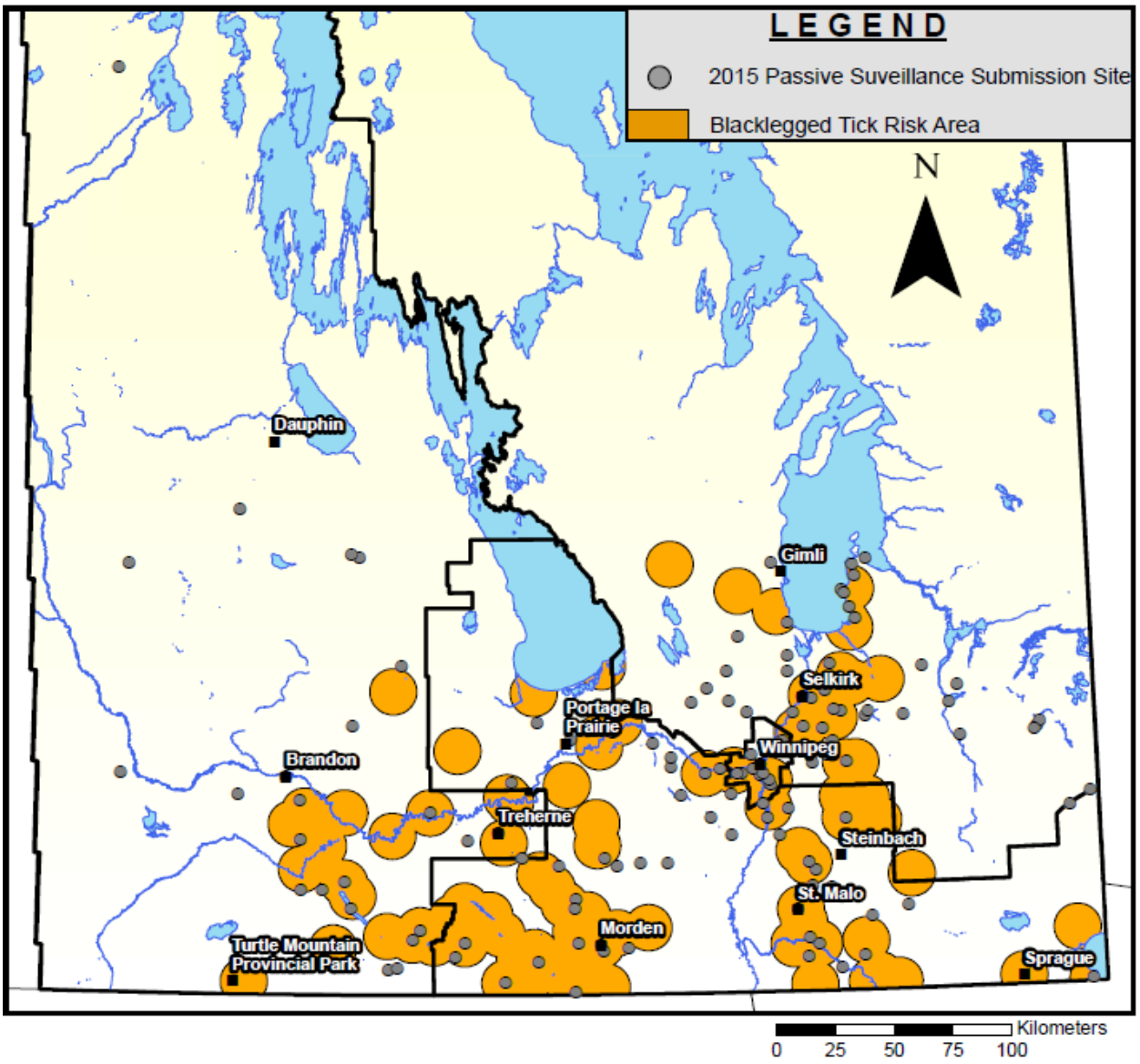


Figure 2: Distribution of BLT submission sites and known BLT risk areas, 2015

Anaplasma phagocytophilum

Anaplasmosis phagocytophilum was the second most common pathogen detected among BLTs submitted as part of the passive surveillance program (Table 1). Between 2008 and 2015 the minimum infection rate among BLTs ranged from 3.1% to 7.4%. In 2015, specimens infected with *A. phagocytophilum* were collected from 18 locations across southern Manitoba (Figure 3), most of which were in or close to known BLT risk areas. The MIR in 2015 was slightly higher than that observed in 2014, 6.2% versus 5.8% (Table 3).

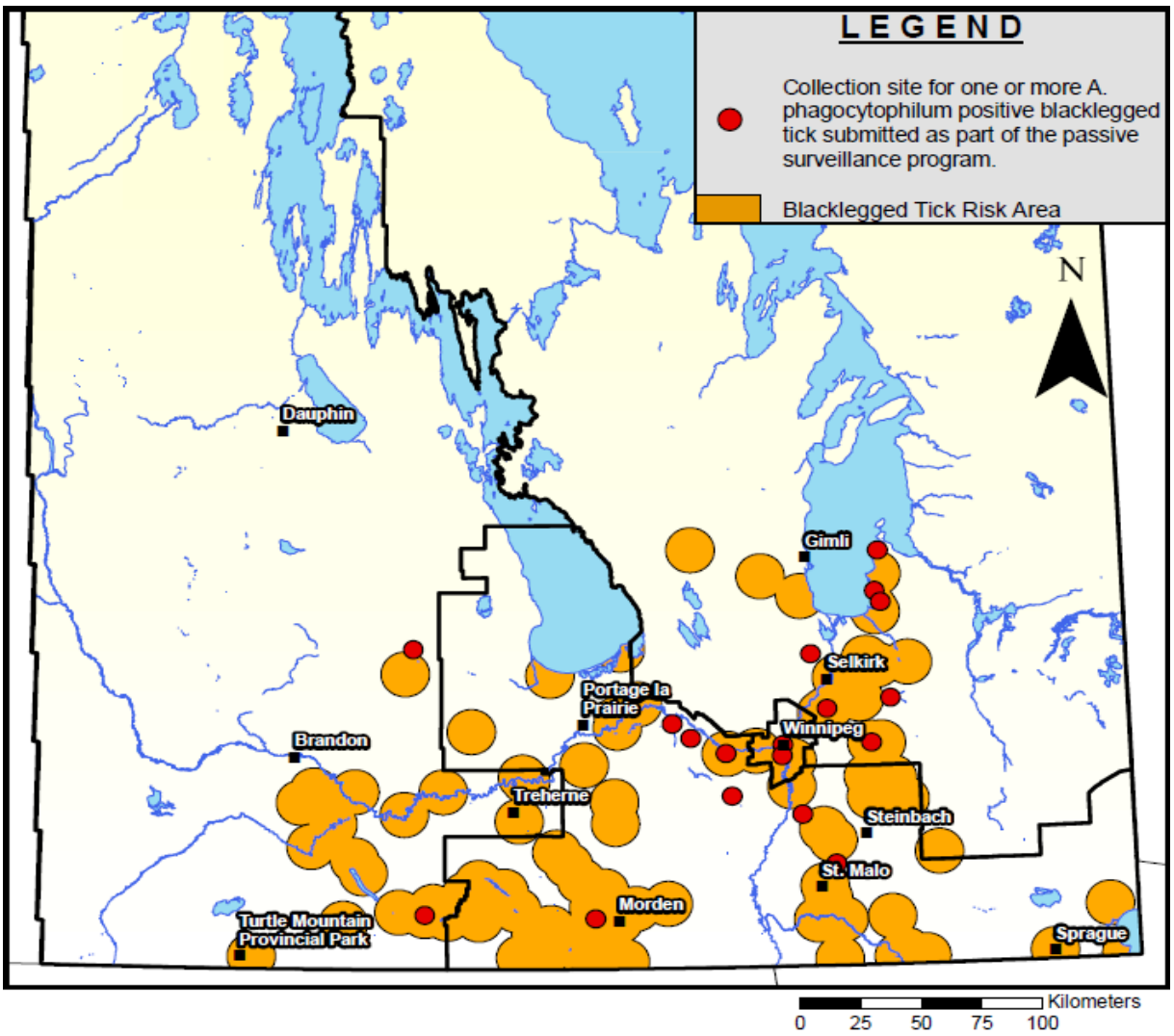


Figure 3: Distribution of collection sites for BLTs submitted as part of the 2015 passive surveillance program that tested positive for *Anaplasma phagocytophilum*

Table 3: Minimum infection rate for *Anaplasma phagocytophilum* among BLTs collected as part of the 2015 passive surveillance program with comparison to 2014 data

	Negative	Positive	% Positive (2015)	% Positive (2014)
Adults	444	30	6.4%	5.7%
Nymphs	12	0	0.0%	9.1%
Total	**456**	**30**	**6.2%**	**5.8%**

Adult male BLTs will attach to a host, but do not take a blood meal, so they cannot transmit disease to humans or other hosts.

Babesia microti

Babesia microti, the causative agent of Babesiosis, was the least common pathogen detected among BLTs submitted as part of the passive surveillance program (Table 1). Testing for this pathogen only began in 2013 and since then MIRs have remained relatively low, ranging between 0.8% and 1.7%. In 2015, specimens infected with *B. microti* were collected from 4 sites, all of which were in previously identified BLT risk areas (Figure 4). In comparison with 2014 minimum infection rates increased among adult males and nymphs, albeit with low overall numbers, while they decreased among adult females (Table 4).

Table 4: Minimum infection rate for *Babesia microti* among BLTs collected as part of the 2015 passive surveillance program with comparison to 2014 data.

	Negative	**Positive**	**% Positive (2015)**	**% Positive (2014)**
Adults	471	3	0.6%	1.7%
Nymphs	11	1	8.3%	0.0%
Total	**482**	**4**	**0.8%**	**1.7%**

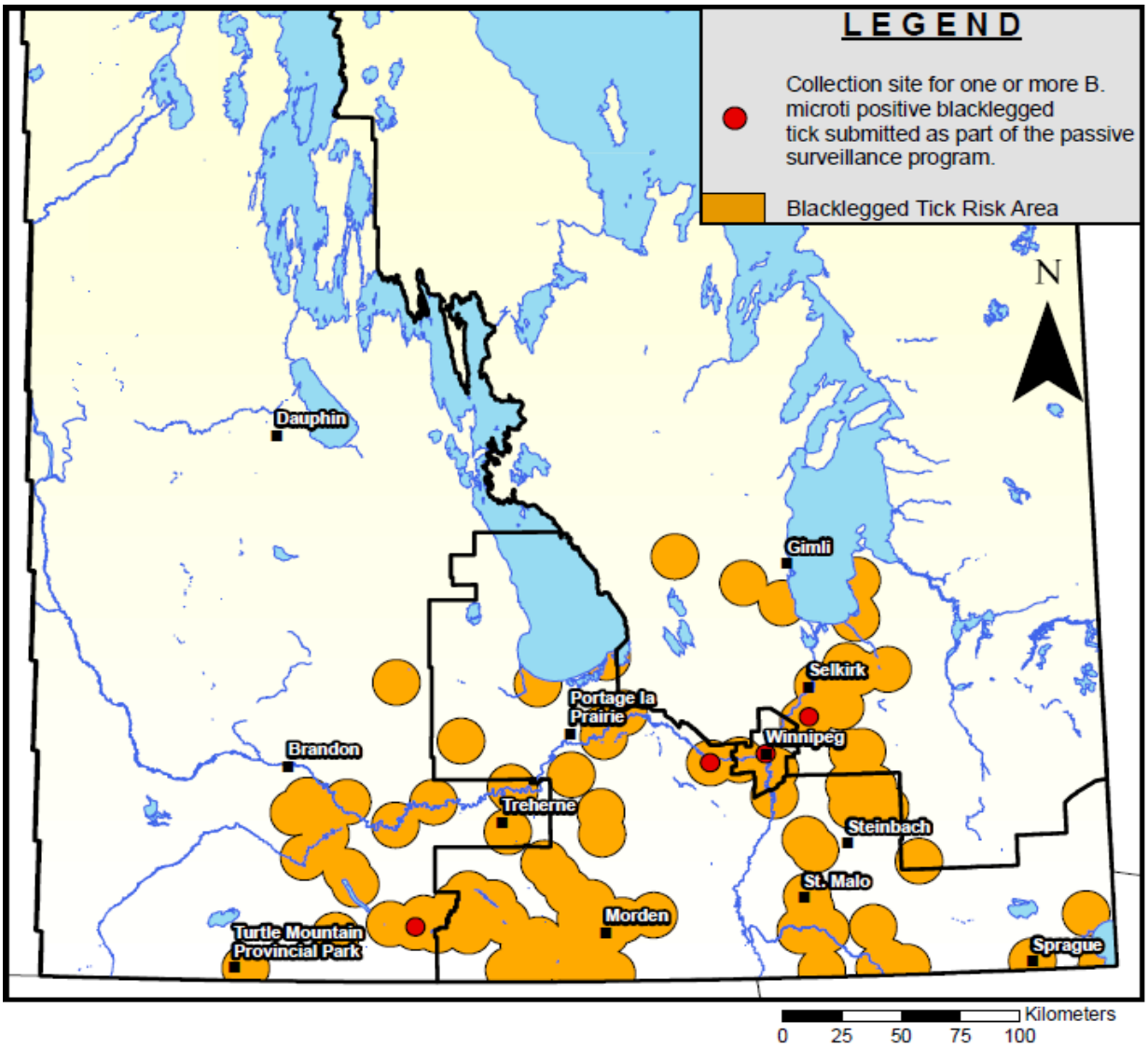


Figure 4: Distribution of collection sites for BLTs submitted as part of the 2015 passive surveillance program that tested positive for *Babesia microti*.

Borrelia burgdorferi

Borrelia burgdorferi was the most common tick-borne pathogen detected among BLTs collected in Manitoba. Between 2008 and 2015 the minimum infection rate ranged between 10.5% and 24.7% (Table 1). Moreover, since 2013 the MIR has hovered around, and/ or exceeded 20.0%. In 2015, specimens infected with *B. burgdorferi* were collected from 60 locations across southern Manitoba (Figure 5), the majority of which were in or clos to known BLT risk areas. The MIR in 2015, 19.1%, was less than that observed in 2014, 24.7% (Table 5).

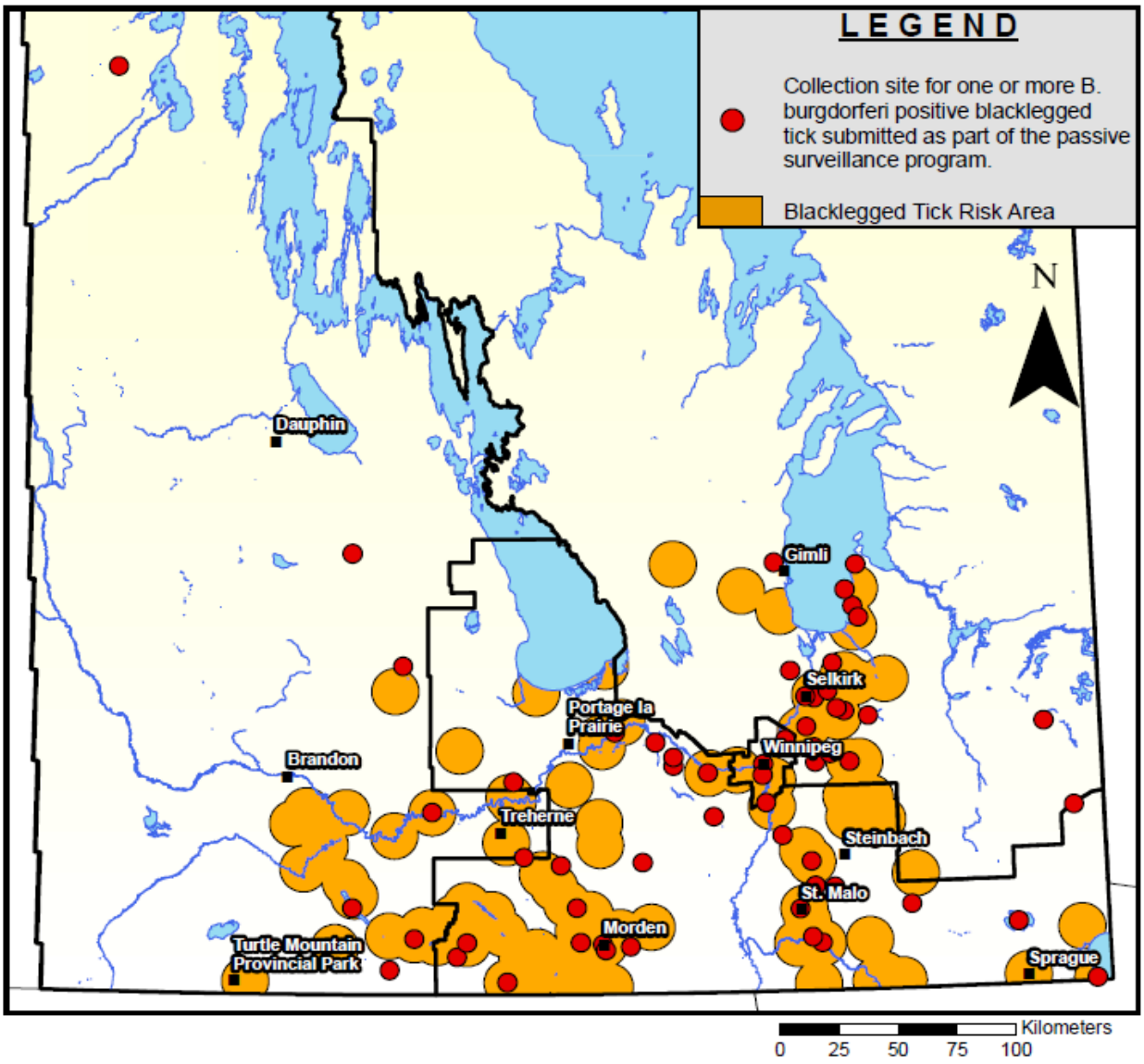


Figure 5: Distribution of collection sites for BLTs submitted as part of the 2015 passive surveillance program that tested positive for *Borrelia burgdorferi*

Table 5: Minimum infection rate for *Borrelia burgdorferi* among BLTs collected as part of the 2015 passive surveillance program with comparison to 2014 data.

	Negative	Positive	% Positive (2015)	% Positive (2014)
Adults	387	87	18.4%	25.2%
Nymphs	6	6	50.0%	9.1%
Total	**393**	**93**	**19.1%**	**24.7%**

Active Surveillance, 2010-2013

Highlights of Active Surveillance

- Since 2006 both the number and distribution of blacklegged tick risk areas have continued to increase in Manitoba.
- In 2015 active surveillance identified 9 new risk areas, most of which were associated with previously known areas.

In 2006 a cluster of human cases with a common exposure locale was noted. Subsequent surveillance efforts identified the first established BLT risk area in the extreme southeast corner of the province (Figure 6). Since this time the number and distribution of these risk areas has expanded considerably throughout much of southern Manitoba (Figure 7). This expansion has been associated with the introduction and establishment of BLT populations into areas with suitable habitat, such as those along river corridors

After the initial identification of the first BLT risk area, surveillance ramped up in 2010. Early efforts (2010 – 2013) identified a number of established BLT populations, many with high infection rates (Table 6). For instance, the *Borrelia burgdorferi* MIR among BLTs collected during this time ranged between 25.7% and 53.2%. The MIR for *Anaplasma phagocytophilum* ranged between 3.6% and 15.3% during the same time period, while for *Babesia microti* the MIR never exceeded 1.4%.

Infection rates in BLTs collected through active surveillance are expected to be higher than those submitted through the passive surveillance program. This is because they represent an established population of ticks, where the pathogens can cycle. BLT populations that have been established for a longer period of time may have higher infection rates than newly established BLT populations.

Table 6: Infection rates of BLTs collected as part active surveillance efforts, 2010 – 2013.

			B. burgdorferi		***A. phagocytophilum***		***B. microti***	
Year	**Sites with BLTs**	**Total Number of BLTs Tested**	**Number positive**	**% Positive**	**Number Positive**	**% Positive**	**Number Positive**	**% Positive**
2010	12	196	62	31.6%	30	15.3%	0	0.0%
2011	9	77	41	53.2%	6	7.8%	1	1.3%
2012	10	84	31	36.9%	3	3.6%	1	1.2%
2013	12	70	18	25.7%	9	12.9%	1	1.4%

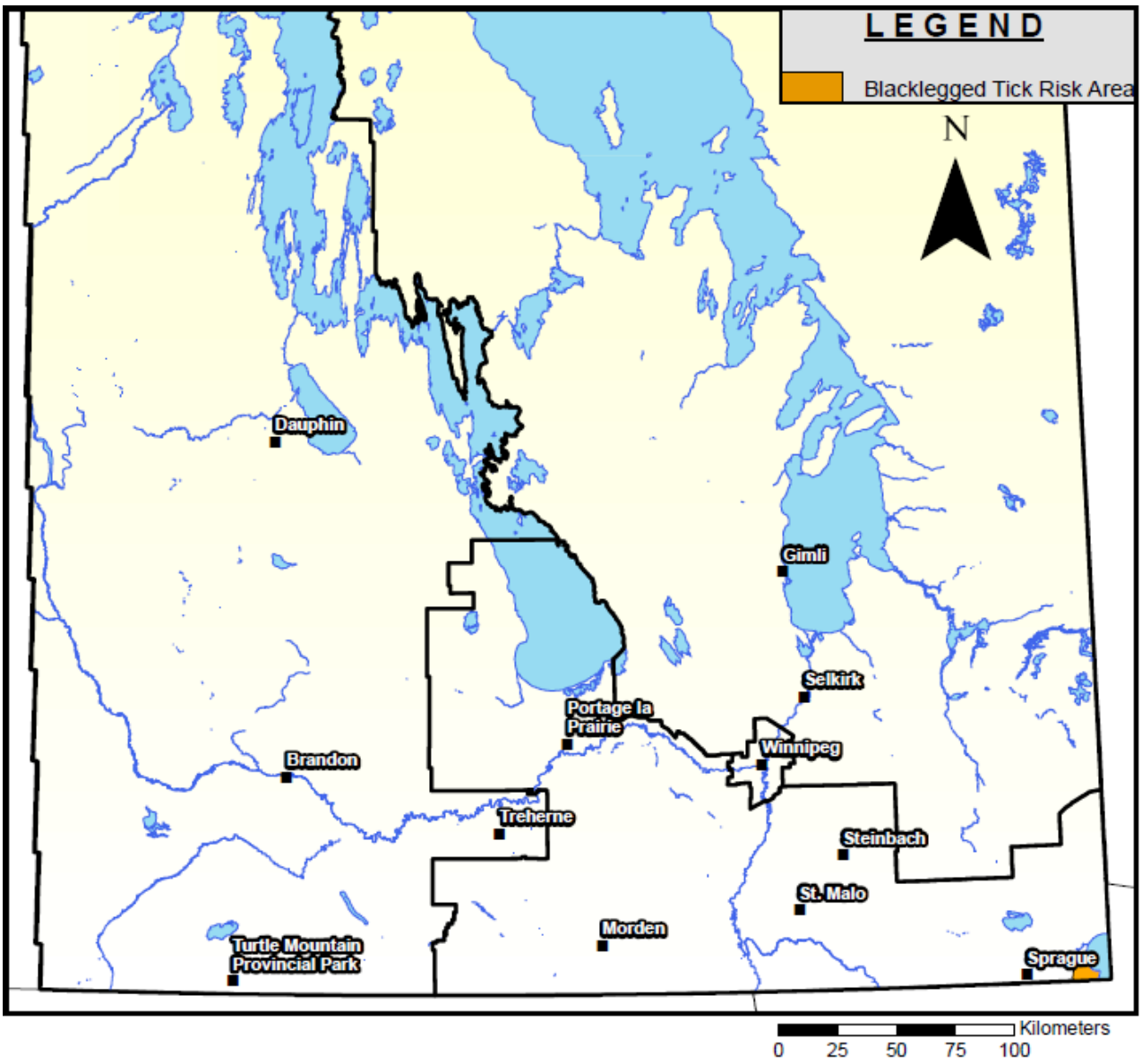


Figure 6: Distribution of BLT risk areas in 2006

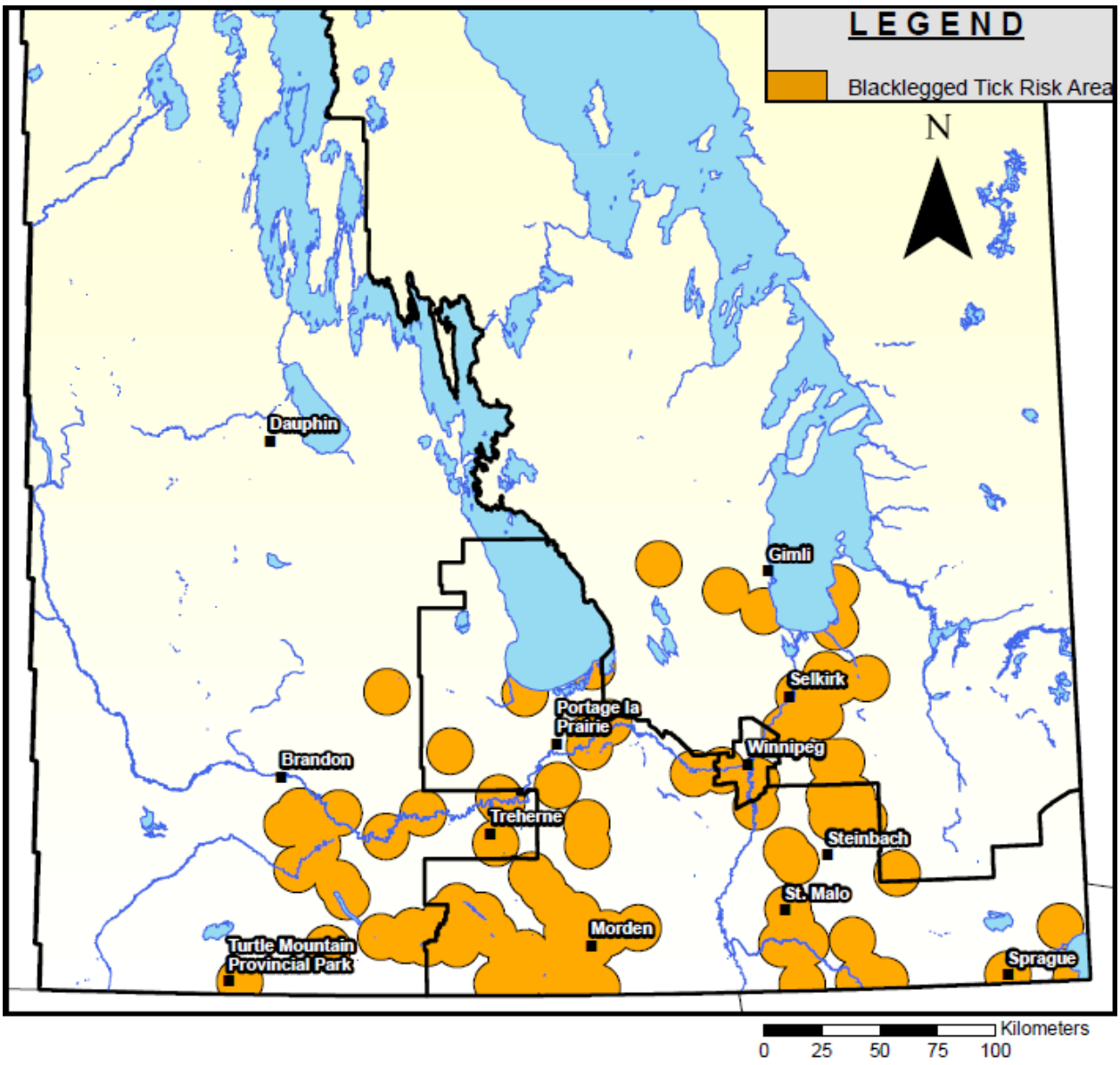


Figure 7: Distribution of BLT risk areas in 2015

Active Surveillance, 2015

In 2015, active surveillance was conducted at a total of 87 sites spread across much of southern Manitoba (Figure 8). Nine new BLT risk areas were identified in 2015, most of which represent natural extensions of previously known risk areas. Within these sites a total of 41 BLTs were collected and infection rate status is pending.

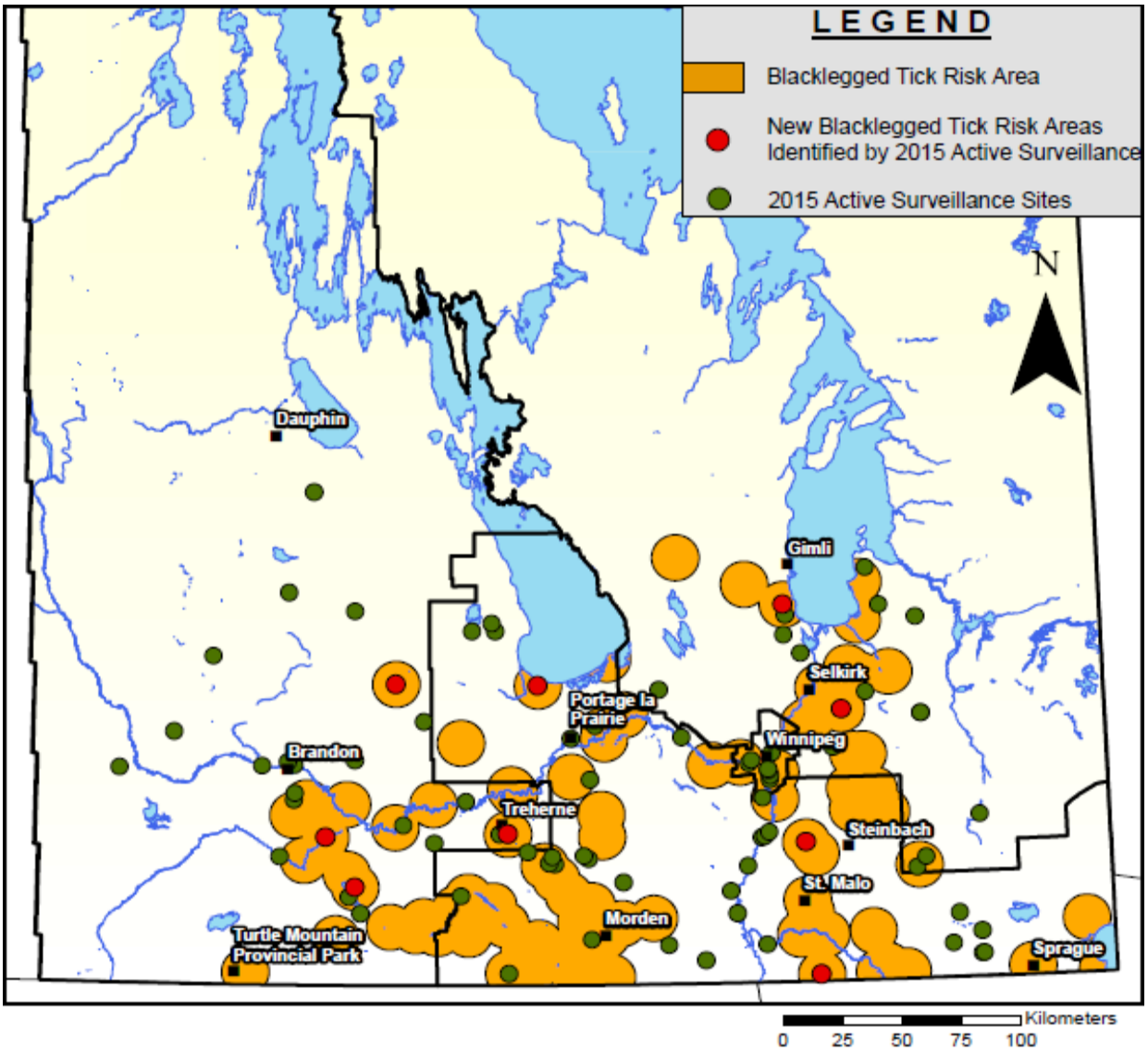


Figure 8: Distribution of active surveillance efforts, and newly identified BLT risk areas in 2015

Tick-Borne Diseases in Humans

Anaplasmosis

On January 1, 2015 Anaplasmosis became provincially reportable. The decision to make it reportable reflected both increasing infection rates among BLT populations and the identification of the first locally acquired human case in Manitoba in 2013.

In 2015 four Anaplasmosis cases were reported to MHSAL. Two of the cases met the provincial surveillance case definition for confirmed cases, while two were classified as probable (see Appendix A for the provincial surveillance case definitions). There was an even split between male and female cases, and the age range was 31 to 60. Cases resided in the Interlake-Eastern (n = 2), Southern (n = 1) and Winnipeg Health Region (n = 1). All had likely exposure within Canada, and three had likely exposure within the province. The exposure locations in the province correspond to well-known BLT risk areas situated in eastern and southern Manitoba.

Babesiosis

On January 1, 2015 Babesiosis became provincially reportable (see Appendix B for provincial surveillance case definitions). The decision to make it reportable reflected the continued detection of this pathogen in locally acquired BLT specimens, and the identification of the first locally acquired human case in Manitoba in 2013. Note that the 2013 cases was also the first Babesiosis case with local acquisition in Canada.

In 2015 there were no cases of Babesiosis reported to MHSAL.

Lyme disease

Lyme disease Highlights

- Incidence rates (per 100,000) for confirmed and probable cases have increased significantly since 2009.
- The highest incidence rates, based on region of residence, for confirmed and probable cases are in the Southern Health – Santé Sud RHA (7.21 per 100,000 in 2015).
    - Health Districts with the highest incidence rates for confirmed and probable cases correspond to areas with longer history of established BLT populations.
- Approximately 9 out of 10 confirmed and probable cases reported since 2013 had likely exposure within Manitoba.
- The majority of confirmed and probable cases were males.
- More than half of confirmed and probable cases were 40 years of age or older.

Lyme disease was initially made provincially reportable in 1999. Between 1999 and 2007, MHSAL received a total of 19 clinical and/or laboratory reports of Lyme disease. In 2008

a total of 26 reports were received for cases meeting the provincial case definitions for confirmed, probable or suspected cases. In 2009, PHAC, in consultation with provinces and territories developed National surveillance case definitions (see Appendix C). The National surveillance case definitions were developed to ensure that case data reporting, interpretation and analysis are consistent across the country. Further, these definitions included standard data elements to capture laboratory, clinical and environmental (i.e. exposure to a region with an established BLT population and evidence of pathogen circulation) data to analyze changes in case incidence rates and risk across the country.

Between 2009 and 2015 MHSAL reported 148 confirmed and probable Lyme disease cases (Table 7) to PHAC through the NNDSS. Manitoba has also reported, at the provincial level, 51 'other' cases in this time period. Cases classified as 'other' are those which do not meet the strict National case definition. For instance, 'other' cases typically have supporting clinical or laboratory evidence, which may raise the suspicion of Lyme disease, but when considered independently do not meet the National standards.

Table 7: Reported cases of Lyme disease in Manitoba, 2009 – 2015

Case Classification	2015	2014	2013	2012	2011	2010	2009	Total
Confirmed Case *	11	22	16	9	8	7	1	**74**
Probable Case *	18	15	14	11	6	6	4	**74**
Other Case **	8	11	8	11	2	5	6	**51**
Total Reported ***	**37**	**48**	**38**	**31**	**16**	**18**	**11**	**199**

* National surveillance case definitions are available at:
www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09vol35/35s2/Lyme-eng.php
** Cases listed as 'other' are reported by either physician or lab but fail to meet the classification criteria for 'confirmed' or 'probable'
*** Total cases reported and classified as of September 15, 2016.

In 2009 a total of 144 confirmed and probable Lyme disease cases were reported in Canada through the NNDSS, most of which were from four provinces; Manitoba, Nova Scotia, Ontario and Quebec. Since then the number of confirmed and probable cases reported, as well as the incidence rate (per 100,000) has steadily increased (Figure 9), with 522 reported in 2014 and 917 reported in 2015. The situation in Manitoba mirrors the National trend with a marked increase in both the incidence rate per 100,000 and the number of confirmed and probable cases reported between 2009 (n = 5) and 2015 (n = 29) (Figure 9). Despite the similar trends, Manitoba's case numbers represent a fraction of the total reported nationally.

In 2009 Manitoba accounted for approximately 3.5% of the total confirmed and probable cases, while in 2015 Manitoba's cases accounted for approximately 3.2% of the total reported.

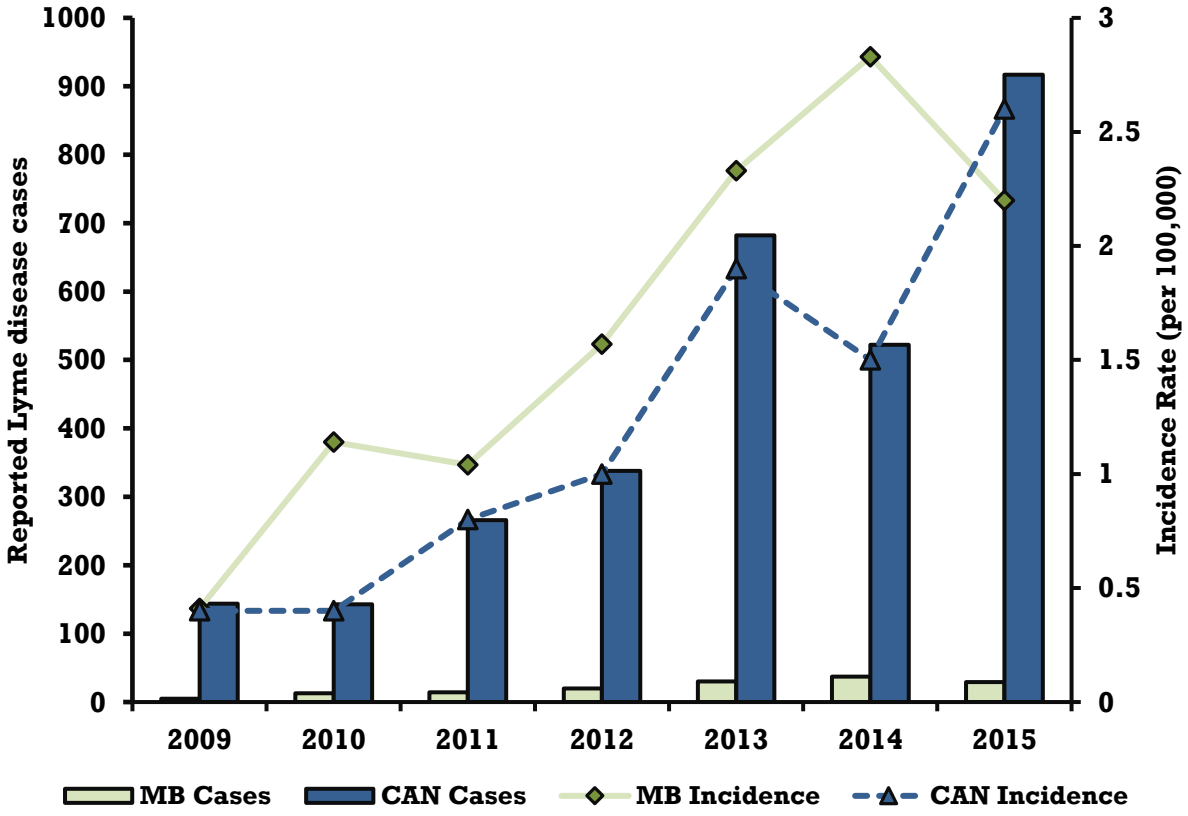


Figure 9: Case numbers and incidence rates of confirmed and probable Lyme disease cases reported per year in Manitoba and Canada, 2009 – 2015 [3] [4] [5]

The number and incidence rate of confirmed and probable Lyme disease cases reported in Manitoba declined from a high of 37 and 2.83 in 2014 to 29 and 2.20 in 2015 (Table 8). However, when compared against the five-year average total case count (22.8) and incidence rate (1.80) the 2015 data were higher. The differences in case count and incidence rate were associated with the marked increase in confirmed and probable Lyme disease cases reported among males. In 2015 there were 21 cases of Lyme disease reported among males with an incidence rate of 3.20, compared to the five year average of 13.2 cases and

[3] Ogden, N. H., Koffi, J. K., Lindsay, L. R., et al. Surveillance for Lyme disease in Canada, 2009 – 2012. CCDR. 2015, 41 (6): 132-145.

[4] Surveillance of Lyme disease. http://healthycanadians.gc.ca/diseases-conditions-maladies-affections/disease-maladie/lyme/surveillance-eng.php (accessed October 5, 2016)

[5] National Lyme disease surveillance in Canada 2013: Web Report. http://www.healthycanadians.gc.ca/publications/diseases-conditions-maladies-affections/lyme-surveillance-2013/index-eng.php (accessed October 5, 2016)

incidence or 2.10. Among females there was a slight decline in the incidence rate (1.20 compared to 1.49) and case count (8 compared to 9.6) when 2015 data was compared with the five year average. Though lower in overall number (n = 51), similar trends were observed for those Lyme disease cases reported provincially as 'other' (Table 9).

In terms of populations most impacted by Lyme disease, the 2015 incidence rate among males is much higher than in females, 3.20 compared to 1.20 (Table 8). The trend is similar for the five-year average, 2.10 compared to 1.49. In 2015 males accounted for 72.0% of the reported confirmed and probable Lyme disease cases. Moreover, the breakdown of male and female Lyme disease cases reported between 2010 and 2015 was 87 and 56 respectively (Figure 10).

The historical age range of confirmed, probable and 'other' cases ranged from 3 to 85 (Tables 8 and 9). The average age of confirmed and probable Lyme disease cases in 2015 was 46.4, which was slightly higher than the five year average of 38.4 (Table 8). However, the median was similar for 2015 compared to the five year average. Nearly three-quarters of the confirmed and probable Lyme disease cases (n = 95) reported in Manitoba occurred in individuals thirty years of age or older (Figure 10). In addition, more than half of the Lyme disease cases (n = 77) reported to MHSAL since 2010 occurred in individuals forty years of age or older.

Table 8: Number of confirmed and probable Lyme disease cases* and incidence rate (per 100,000) by sex, with age analysis, in Manitoba, 2015 and 5 – year average (2010 – 2014)

	2015		2010 - 2014 Average	
	Case Count	Incidence	Case Count	Incidence
Total	29	2.20	22.8	1.80
Female	8	1.20	9.6	1.49
Male	21	3.20	13.2	2.10
	Age Analysis (in years)		Age Analysis (in years)	
Average	46.4		38.4	
Median	42.0		44.0	
St. Dev.	19.7		22.3	
Min. Age	8		3.0	
Max. Age	79		84.0	

* As per the National surveillance case definitions (http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09vol35/35s2/Lyme-eng.php. Accessed September 8, 2016)

Table 9: Number of 'other' Lyme disease cases* and incidence rate (per 100,000) by sex, with age analysis, in Manitoba, 2015 and 5 – year average (2010 – 2014)

	2015		2010 - 2014 Average	
	Case Count	Incidence	Case Count	Incidence
Total	8	0.61	7.4	0.58
Female	2	0.15	2.8	0.22
Male	6	0.45	4.6	0.36
	Age Analysis (in years)		Age Analysis (in years)	
Average	46.4		46.5	
Median	57.0		46.0	
St. Dev.	22.3		21.9	
Min. Age	9		3	
Max. Age	67		85	

* Note that Manitoba records 'other' Lyme disease cases where the data is suggestive of infection, but is not sufficient, more often incomplete, to meet the more stringent requirements of the National surveillance case definition.

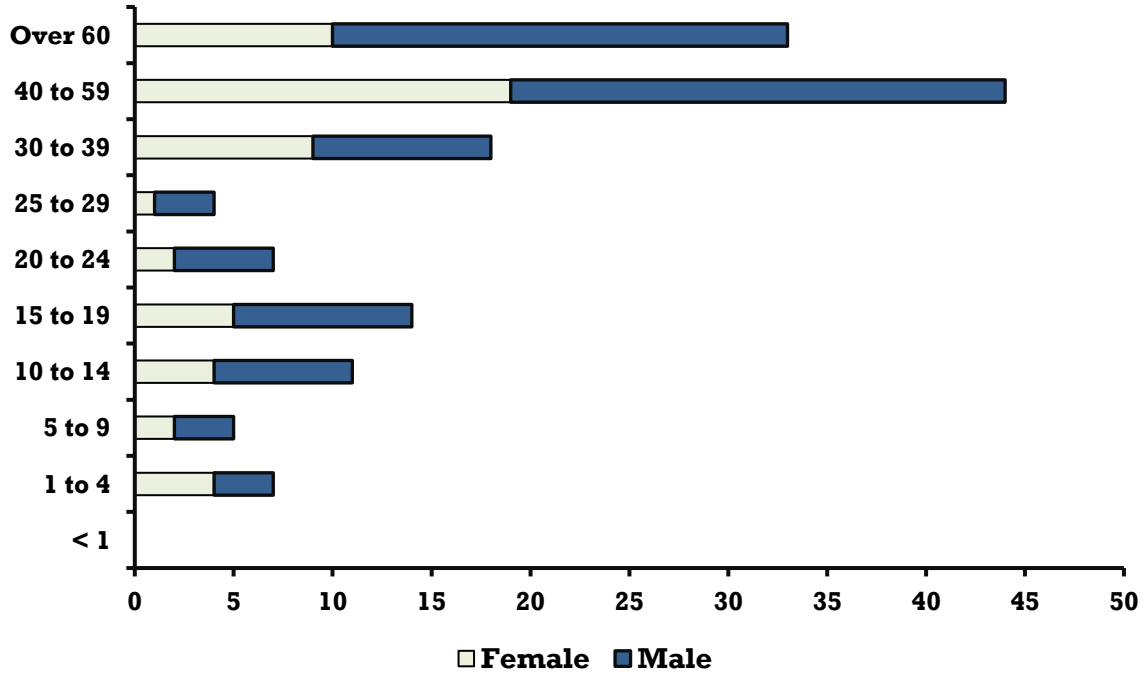


Figure 10: Numbers of confirmed and probable Lyme disease cases by age group and gender in Manitoba, 2010 – 2015

In 2009, approximately 40.0% of the confirmed and probable Lyme disease cases reported to MHSAL had likely acquisition outside of Manitoba. By 2013 this had dropped to

13.3% and the numbers reported remained relatively stable, while the number and proportion of cases with likely exposure history within the province have steadily increased (Figure 11). The increasing trend in local acquisition aligns with that observed nationally where the percentage of cases likely acquired in Canada rose from 65.0% in 2009 to nearly 90.0% in 2013[6]. This increase in locally acquired cases also corresponds to the continued expansion and establishment of BLT populations (Figures 6 and 7). Among those cases with acquisition outside of Manitoba most were associated with travel to endemic areas within the Midwest and Northeast USA, while some were related to travel to Europe.

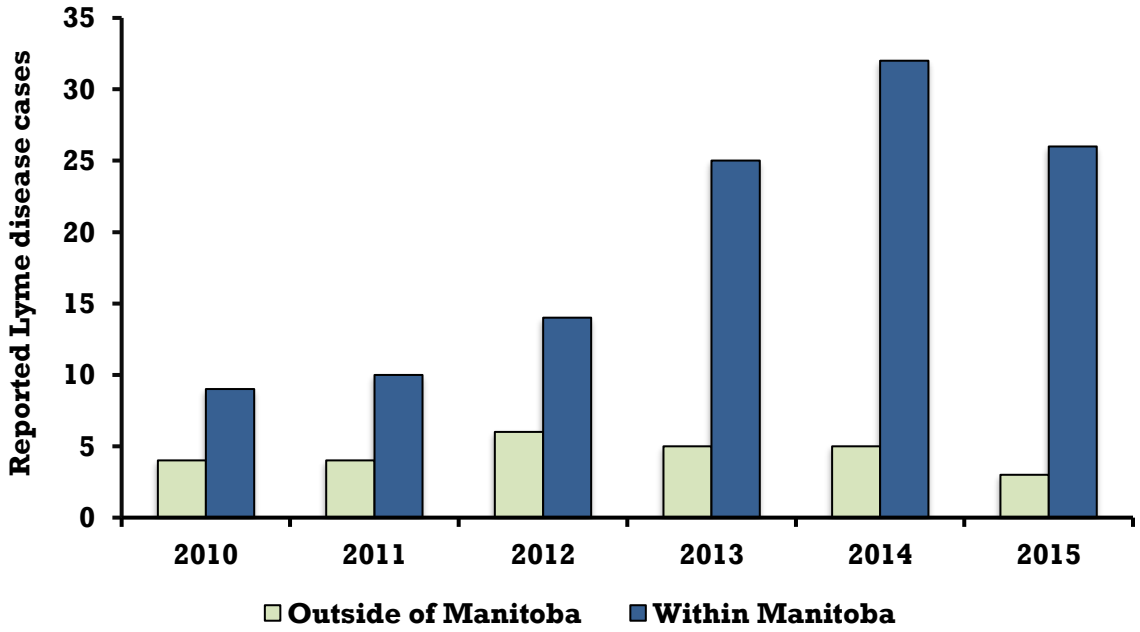


Figure 11: Confirmed and probable Lyme disease cases reported between 2010 and 2015 based on likely exposure, within or outside of the province (n = 143).

Seasonally, the highest risk period, based on likely month of exposure[7], falls between May and July (Figure 12). For confirmed and probable cases with available data, nearly 80.0% (n = 107) reported likely exposure between May and July. The late spring/ early summer exposure period corresponds to the peak activity period of BLT nymphs. Compared to adults, these nymphs are smaller and much harder to see a factor that may account for the observation that only 28.0% (n = 40) of individuals with confirmed or probable Lyme disease

[6] National Lyme disease surveillance in Canada 2013: Web Report. http://www.healthycanadians.gc.ca/publications/diseases-conditions-maladies-affections/lyme-surveillance-2013/index-eng.php (accessed October 5, 2016)

[7] Month of exposure was determined by subtracting 30 days from the earliest epi-date (i.e. symptom onset, specimen collection date, lab reporting date, etc) to account for the maximum incubation period.

recall a tick bite. The provincial observation is similar to that seen at the National level, where symptom onset among reported cases peaked between June and August[8].

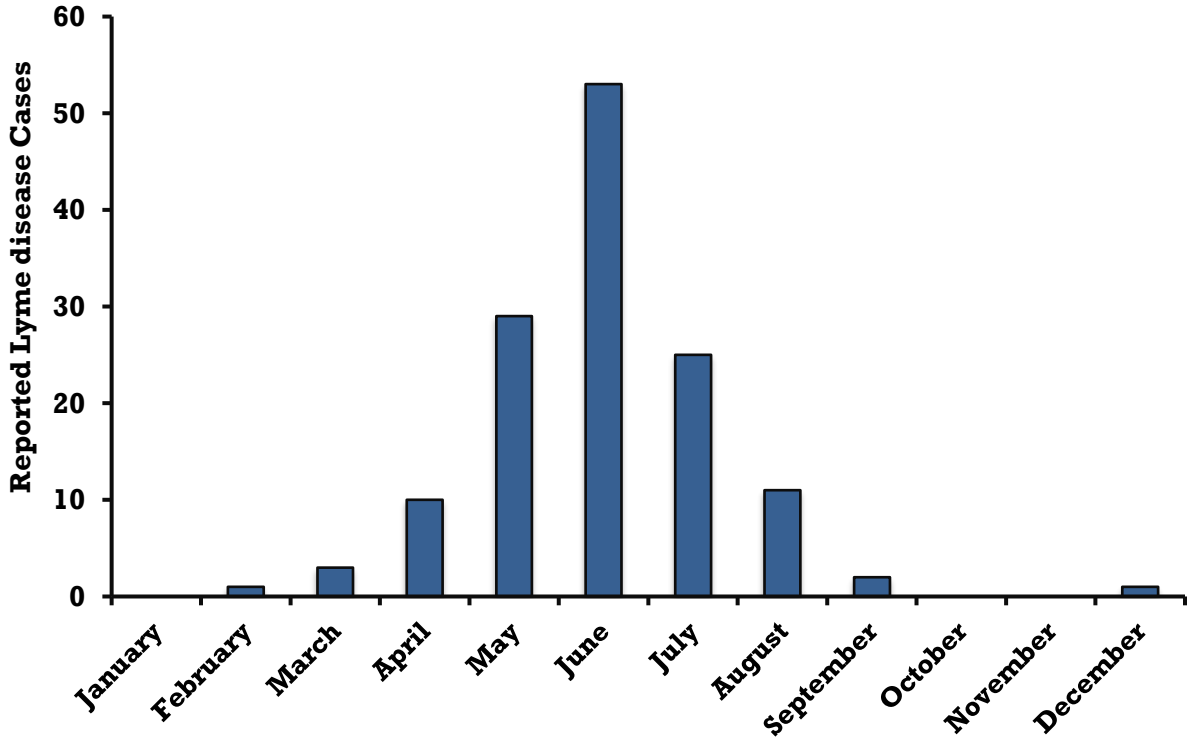


Figure 12: Confirmed and probable Lyme disease cases reported between 2010 and 2015 based on likely month of exposure (n = 135) [9]

The risk of Lyme disease exposure varies across the province, and is associated with the distribution of BLT risk areas, as well as how long these BLT populations have been established. Historically the highest incidence rate based on region of residence has been in the Southern Health – Santé Sud RHA, where the five-year average was 7.41 per 100,000 (Figure 13 and Table 10). Moreover, the Southern Health – Santé Sud RHA has typically accounted for approximately half of all confirmed and probable Lyme disease cases. The Interlake-Eastern RHA has the next highest average incidence rate with 1.13 per 100,000. With the exception of the Southern Health – Santé Sud RHA where the rate stayed relatively static,

[8] National Lyme disease surveillance in Canada 2013: Web Report. http://www.healthycanadians.gc.ca/publications/diseases-conditions-maladies-affections/lyme-surveillance-2013/index-eng.php (accessed October 5, 2016)

[9] Data presented in Figure 12 includes data from cases with exposure histories within and outside of the province. Likely exposure information was unavailable for eight confirmed and probable cases between 2010 and 2015.

the incidence rates, based on region of residence, increased in all three other southern RHAs in 2015[10]. The rates and case numbers are strongly associated with the distribution and length of establishment of BLT populations. In other words the rates and risk are higher in the Southern Health – Santé Sud, given the higher number of BLT risk areas and the longer history of BLT population establishment in this region.

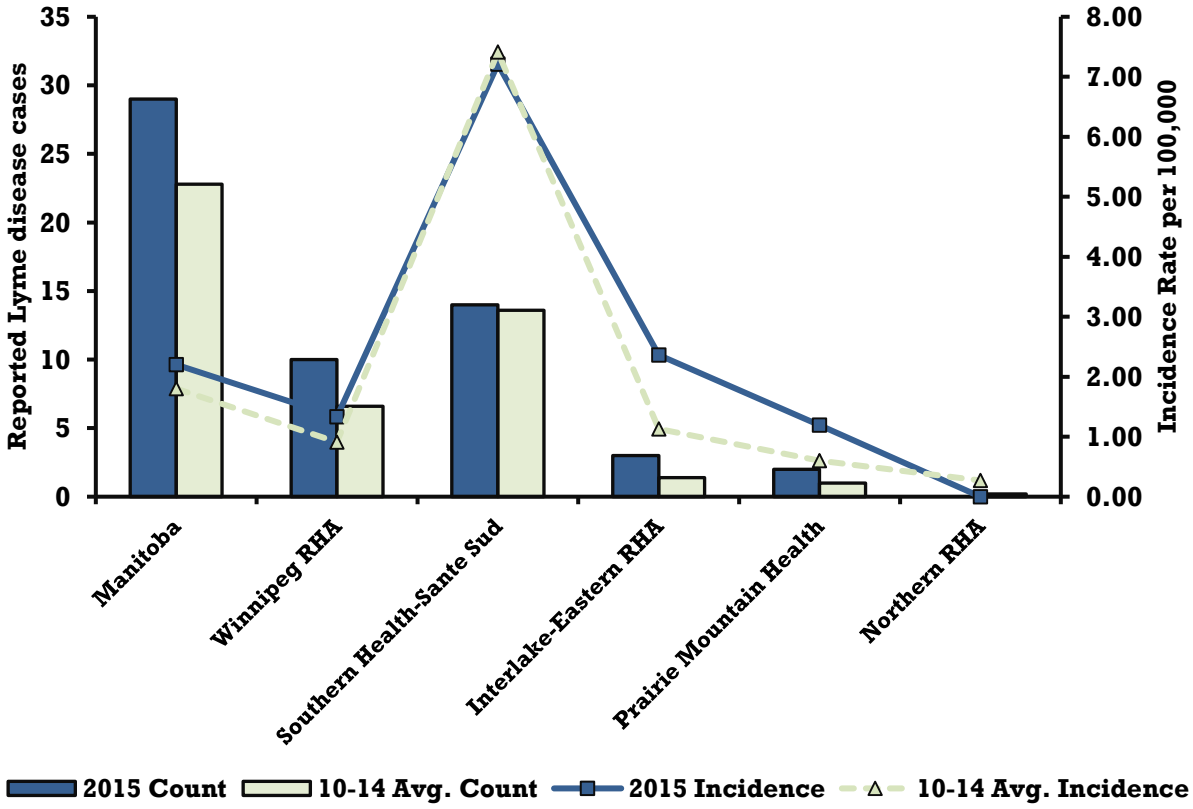


Figure 13: Lyme disease incidence, per 100,000 for confirmed and probable cases reported by RHA of residence between 2010 and 2015.

[10] Data for the Northern Health Region reflects the area of residence for an individual with likely exposure having occurred in southern Manitoba. Given the non-suitable habitat and cooler temperatures is unlikely that blacklegged tick populations would become established in this RHA.

Table 10: Lyme disease incidence, per 100,000 for confirmed and probable cases, reported by RHA of residence between 2010 and 2015.

	Manitoba	Winnipeg	Southern Health – Santé Sud	Interlake-Eastern RHA	Prairie Mountain Health	Northern Health Region
2015 Count	29	10	14	3	2	0
2010-14 Avg. Count	22.6	6.6	13.6	1.4	1	0.2
2015 Incidence	2.20	1.33	7.21	2.36	1.19	0
2010-14 Avg. Incidence	1.80	0.91	7.41	1.13	0.60	0.27

When the incidence rates (per 100,000) are examined based on likely exposure location at the health district[11] level two distinct observations are apparent (Figure 14). First, with one exception, all health districts with a minimum of one confirmed or probable Lyme disease case contain a BLT risk area. Second, health districts with the highest incidence rates based on likely exposure locations (i.e. greater than 24.99) correspond to regions with a lengthy history of BLT establishment. The map highlights the greater exposure risk in health districts within the Southern Health – Santé Sud, which is unsurprising given that the first BLT risk areas were identified within this RHA (Figure 6).

[11] Health Districts are groupings of populations with approximately 10,000 to allow for analysis to be conducted at a smaller scale than possible when using the larger Regional Health Authority or Health Zone level.

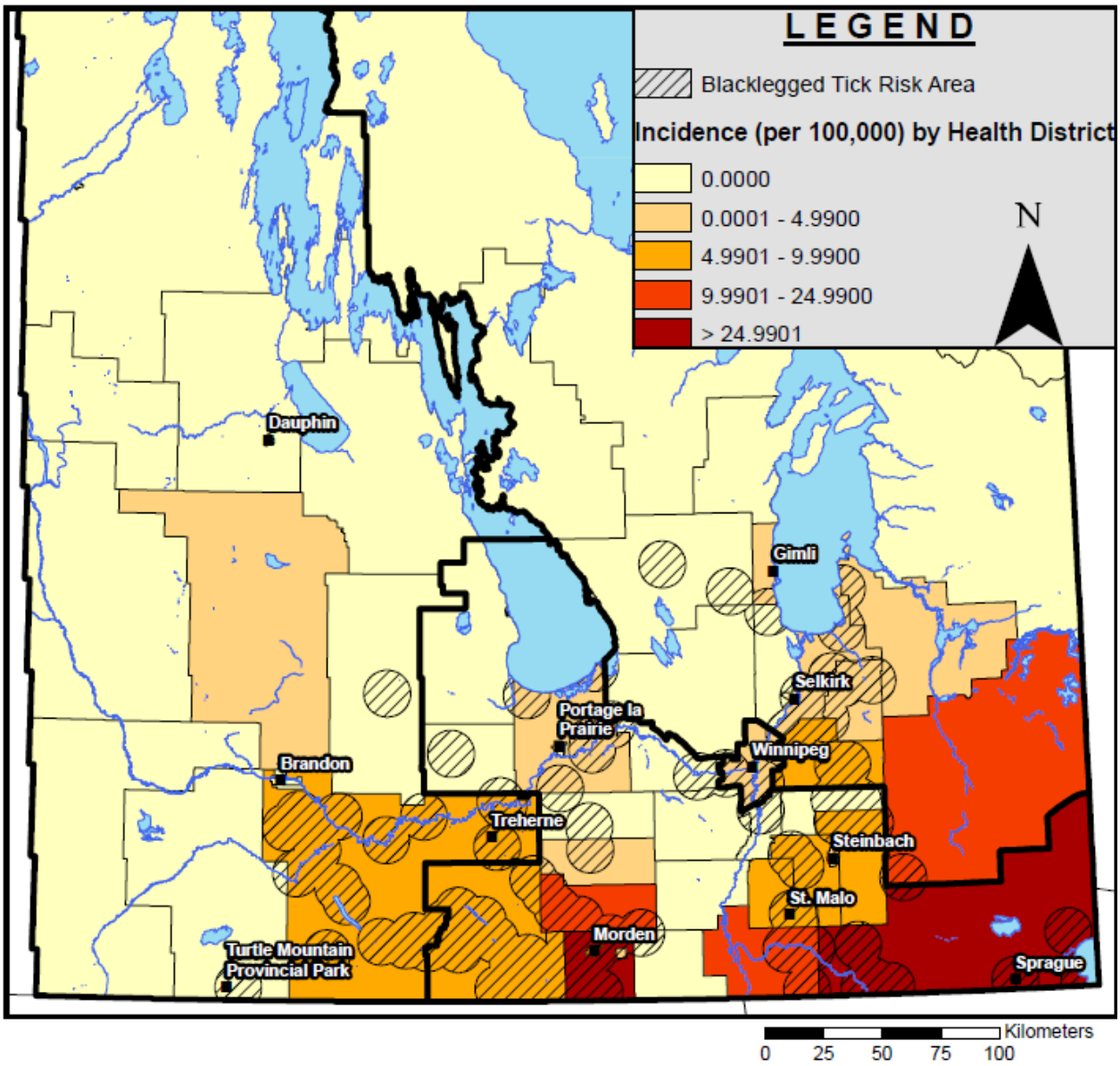


Figure 14: Incidence, per 100,000, of all confirmed and probable Lyme disease cases reported in Manitoba between 2010 and 2015 based on Health District of likely exposure (n = 115).

Discussion

Although initially detected in Manitoba in 1989, the numbers and infection rates of BLTs remained relatively low and stable for a number of years. It wasn't until 2006, following the investigation into a cluster of human cases with a common exposure, that the first established population of BLTs was identified in the extreme southeast corner of the province. Since the identification of this first BLT risk area a number of observations can be noted:

- The number and distribution of BLT risk areas has steadily increased in the province.

- The MIR among BLTs for agents of tick-borne diseases has steadily increased. Since 2013, the MIR for *B. burgdorferi* has hovered around and/ or exceeded 20.0%, while the MIR for *A. phagocytophilum* has exceed 5.0%.
- Anaplasmosis and Babesiosis were made provincially reportable in 2015, in response to increased infection rates in BLTs and evidence of human infections.
- The numbers of Lyme disease cases meeting PHAC's National surveillance definitions for confirmed and probable cases increased from 5 in 2009, to 29 in 2015.
- The highest incidence of Lyme disease cases, based on both area of residence and are of likely exposure, is found in the Southern Health – Santé Sud RHA.
- There is an association between length of BLT establishment and increased infection rates among BLTs and potential exposure among human cases.

In Manitoba, as in Canada, the impact posed by tick-borne diseases continues to increase. MHSAL continues to survey the expansion of BLT risk areas and monitor infection rates to guide critical risk communication messaging aimed at both the public and health care professionals. Further, MHSAL continues to monitor BLT specimens for emerging pathogens (i.e. *Borrelia miyamotoi* and *Borrelia mayonii*) of potential human health importance to guide further messaging and intervention efforts.

Appendix A (Provincial Surveillance Case Definitions – Anaplasmosis)

Provincial surveillance case definitions for confirmed and probable Anaplasmosis cases:

Confirmed Anaplasmosis case:

A clinically compatible[12] case that is laboratory confirmed[13].

Probable Anaplasmosis case:

A clinically compatible case with non-confirmatory laboratory results[14].

[12] Clinical evidence includes, fever plus one or more of the following: headache, myalgia, anemia, leukopenia, thrombocytopenia or any elevation of hepatic transaminase concentrations.

[13] Laboratory confirmation requires one of:

a. Serological evidence of a four-fold change in IgG specific antibody titre by indirect IFA assay between paired serum specimens (one taken during the first week of illness and a second 2 – 4 weeks later), OR by specific nucleic acid amplification test of blood specimen during acute phase of illness, **OR**
b. Detection of *Anaplasma phagocytophilum* DNA in a clinical specimen via amplification of a specific target by polymerase chain reaction (PCR) assay, **OR**
c. Demonstration of anaplasmal antigen in a biopsy/ autopsy sample by immunohistochemical methods, **OR**
d. Isolation of *A. phagocytophilum* from a clinical specimen in cell culture.

[14] Non Confirmatory laboratory results include:

a. Identification of morulae in the cytoplasm of neutrophils or eosinophils by microscopic examination, **OR**
b. Single *A. phagocytophilum* IgG antibody titre of 128 or greater plus *A. phagocytophilum* IgM antibody titre of 20 or greater.

Appendix B (Provincial Surveillance Case Definitions – Babesiosis)

Provincial surveillance case definitions for confirmed and probable Babesiosis cases:

Confirmed Babesiosis case:

Has confirmatory laboratory[15] results AND meets at least one of the objective or subjective clinical evidence criteria[16], regardless of mode of transmission.

Probable Babesiosis case:

Has supportive laboratory[17] results and meets at least one of the objective clinical evidence criteria; **OR**

A case that is in a blood donor or recipient epidemiologically linked to a confirmed or probable Babesiosis case, **AND**

Has confirmatory laboratory evidence but does not meet any objective or subjective clinical evidence criteria.

[15] Confirmatory laboratory evidence includes one of the following:

- Identification of intraerythrocytic *Babesia* organisms by light microscopy in a Giemsa, Wright or Wright-Giemsa stained blood smear; **OR**
- Detection of *Babesia species* DNA in a whole blood specimen by PCR; **OR**
- Isolation of *B. microti* organisms from a whole blood specimen by animal inoculation.

[16] Objective clinical evidence includes one or more of fever, anemia or thrombocytopenia. Subjective clinical evidence includes one or more of chills, sweats, headache, myalgia or arthralgia.

[17] Supportive laboratory evidence includes demonstration of Babesia species by IFA with specific IgG antibody titre greater than or equal to 1:256.

Appendix C (National Surveillance Case Definitions – Lyme Disease)

National surveillance case definitions for confirmed and probable Lyme disease[18]:

Confirmed Lyme disease case:

1) Clinical evidence of illness with laboratory information:
   - Isolation of *Borrelia burgdorferi* from an appropriate clinical specimen, OR
   - Detection of *B. burgdorferi* DNA by PCR
2) Clinical evidence of illness with a history of residence, or visit to, an endemic area and with laboratory evidence of infection:
   - Positive serological test using the two-tiered ELISA and Western Blot criteria

Probable Lyme disease case:

1) Clinical evidence of illness without a history of residence, or visit to, an endemic area and with laboratory evidence of infection:
   - Positive serological test using the two-tier ELISA and Western Blot criteria
2) Clinician-observed Erythema migrans without laboratory evidence but with history of residence in, or visit to, an endemic area.

[18] Note that the surveillance case definitions are currently being revised. For more detailed information please see PHAC's '*Case definitions for communicable diseases under national surveillance – 2009*' at http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09vol35/35s2/index-eng.php