epiREPORT

Manitoba Annual Tick-Borne Disease Report

2017

January 1, 2017 to December 31, 2017

Communicable Disease Control

Active Living, Population and Public Health Branch

Active Living, Indigenous Relations, Population & Public Health Division

Manitoba Health, Seniors and Active Living

Released: January 2019

Manitoba

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Abbreviations

BLT	Blacklegged tick (*Ixodes scapularis*)
MHSAL	Manitoba Health, Seniors and Active Living
MIR	Minimum Infection Rate
NML	National Microbiology Laboratory
NNDSS	National Notifiable Disease Surveillance System
PHAC	*the* Public Health Agency of Canada
RHA	Regional Health Authority
TBD	Tick-borne disease(s)

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 (2017)* 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, epidemiology & surveillance staff and 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.

Methodology Note

Detailed information outlining the methodology used herein, as well as surveillance case definitions for the three reportable TBDs, can be found by consulting the ***Manitoba Annual Tick-Borne Disease Report 2016***. The report can be found at www.gov.mb.ca/health/publichealth/cdc/tickborne/index.html

Citation

Government of Manitoba, Manitoba Health, Seniors and Active Living, Active Living, Indigenous Relations, Population and Public Health Division, Active Living, Population and Public Health Branch, Communicable Disease Control (2018). *Manitoba Annual Tick-Borne Disease Report 2017.*

Let us know what you think. We appreciate your feedback! If you would like to comment on any aspect of this new report please send an email to: ticks@gov.mb.ca. Include '2017 *TBD report*' in the subject heading.

Executive Summary

The public health impact posed by tick-borne diseases (TBDs), most notably Anaplasmosis and Lyme disease, continues to increase in Manitoba. This increase can largely be attributed to both increased awareness among health care providers and continued range expansion of the vector, the blacklegged tick (*Ixodes scapularis*) throughout southern Manitoba.

BLT risk areas now extend west from the Ontario border to the Saskatchewan border and north from the United States of America (USA) border to areas north of Dauphin. Coupled with this continued range expansion, is a similar rise in infection rates among field collected BLT specimens. For instance, the minimum infection rate (MIR) for *Borrelia burgdorferi*, the causative agent of Lyme disease, currently ranges between 17 and 41%, while the MIR for *Anaplasma phagocytophilum*, the causative agent of Anaplasmosis, ranges between 4 and 14% depending on surveillance data type (i.e. passive or active).

The number of Anaplasmosis and Lyme disease cases reported in 2017 represented a decrease from the current high-water mark set in 2016. The highest incidence rates (per 100,000) for both Anaplasmosis and Lyme disease cases, based on either health region of residence or likely exposure, are found in the Interlake-Eastern and Southern Health – Santé Sud Health Regions where there is a longer history of BLT establishment. Overall, males accounted for the majority of Anaplasmosis and Lyme disease cases, and the incidence rates for both were highest among individuals 60 years of age and older. In 2017, only one Anaplasmosis and one Lyme disease case reported likely exposure outside of the province. As in previous seasons few cases recalled a tick bite (~ 4 in 10), however cases were more likely to report either contact with suitable tick habitat and/ or a history of outdoor recreation as key risk factors.

MHSAL continues to monitor the distribution and infection rates of BLTs to identify new risk areas. Moreover, MHSAL has refined guidance and communications for both health care professionals and the public to emphasize the importance of suitable habitat as a key risk factor. Further, MHSAL continues to work with public health colleagues provincially and nationally to assess the human burden of known and emerging TBDs.

Tick Surveillance

Passive Surveillance - 2017

Highlights of 2017 Passive Surveillance

- Number of submissions received in 2017 equal to 2016, however far fewer *Ix. scapularis* specimens received.
- Approximately 98% of the *Ix. scapularis* specimens were collected in Manitoba, most in close proximity to known Blacklegged Tick Risk areas.
- Slightly more than half of all *Ix. scapularis* submissions were collected between September and November.
- In 2017 BLT minimum infection rates for the agents of Anaplasmosis and Lyme disease were 4.0% and 16.7% respectively.
- Most infected BLTs were collected from locations within the Interlake-Eastern and Southern Health Regions.

In 2017, MHSAL received a total of 662 submissions[2]. From these a total of 259 submissions were identified as ticks in the genus *Ixodes* (257 *Ix. scapularis, 1 Ix. muris* and 1 *Ix. cookei*) and submitted to PHAC's National Microbiology Laboratory for pathogen testing (Table 1). The majority of submissions received were *Dermacentor variabilis*, the American dog tick (also commonly referred to as the 'wood tick'), while a small number of other species such as *D. albipictus* (the 'winter' or 'moose' tick), *Ambloymma americanum* (the 'Lone Star tick'), *Am. cajannese* (acquired via travel to Central America) and *Am. maculatum* (the 'Gulf Coast tick') were also found[3]. Overall, the number of *Ix. scapularis* specimens received via the passive surveillance program was far less than the nearly 500 annual average observed previously between 2013 and 2016 (Figure 1).

Table 1: Overview of submissions containing *Ixodes* species received as part of the 2017 passive surveillance program

	In Province		Out of Province		Unknown	
Species	**# Submissions**	**# Specimens**	**# Submissions**	**# Specimens**	**# Submissions**	**# Specimens**
Ix. cookei	1	1	0	0	0	0
Ix. muris	0	0	0	0	1	1
Ix. scapularis	230	347	7	7	20	21
	231	**348**	**7**	**7**	**21**	**22**

[2] Includes specimens received at Cadham Provincial Laboratory and through the tick-checker program. Not all specimens identified using images submitted to the tick-checker program were received, hence the testing results are based on a slightly lower overall number of *Ix. scapularis*. A summary of the tick-checker program can be found in Appendix B.

[3] In 2017, three *Am. americanum* submissions and one submission each of *Am. cajannese*, *Am. maculatum* and *D. albipictus* were received.

Ix. scapularis specimens were collected between late March and early November in 2017 (Figure 2). The majority (n = 189, or 53%) of the *Ix. scapularis* specimens were collected in the fall between mid-September and early November, which corresponds to the primary activity peak observed historically among adult specimens. A secondary, albeit smaller, peak in *Ix. scapularis* activity was observed in the spring, April through June (n = 152 or 43%). In addition, 75% (n = 12/16) of the nymphs collected in Manitoba were collected between May and July. The majority of specimens were collected from dogs (~36.4%), however, this proportion was far less than that previously observed (~50.7%). Moreover, humans were again the second most common host (~30.4%).

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.

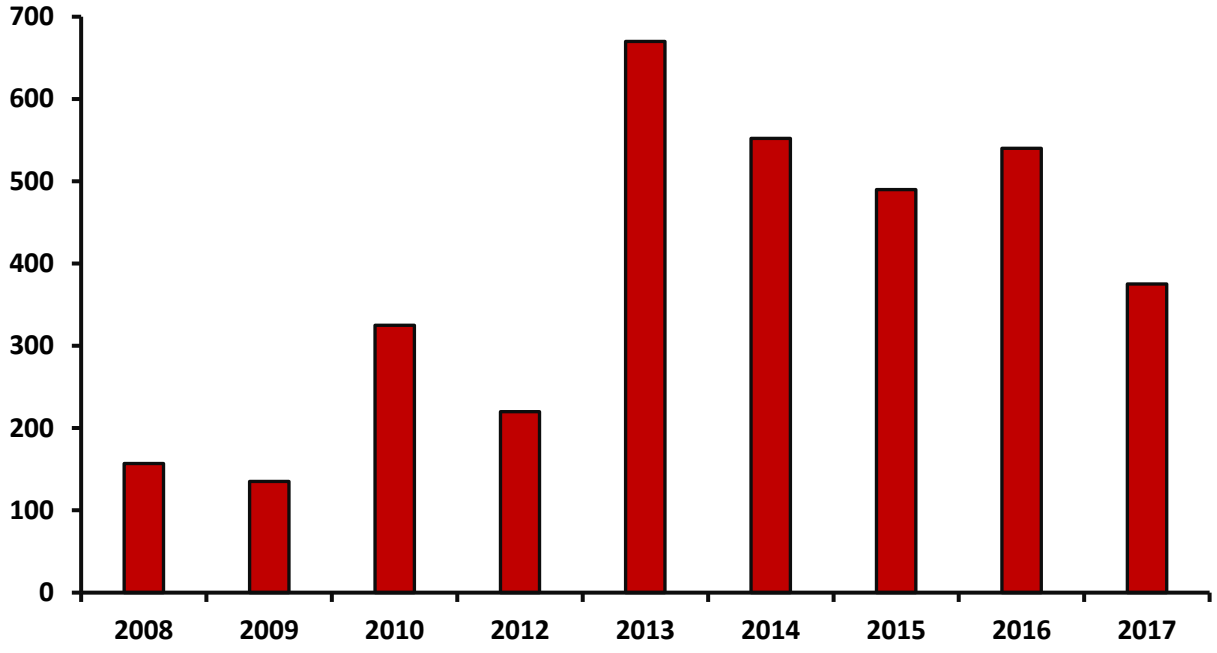

Figure 1: Number of BLT specimens received annually as part of the passive surveillance program since 2008.

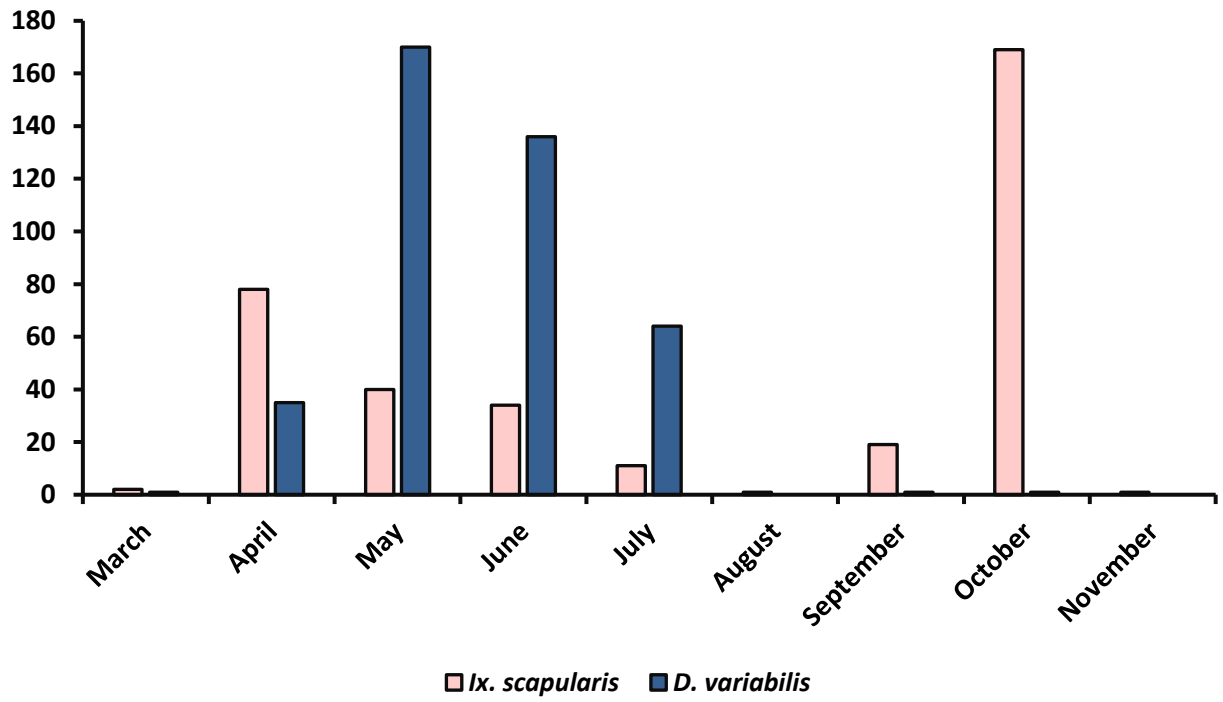

Figure 2: Comparison of seasonal trend in submissions of *Ix. scapularis* and *D. variabilis* based on month of collection.

BLT specimens were again collected from sites in all four southern Manitoba Health Regions. In 2017 submissions were received from 101 localities, 95 of which were distributed within southern Manitoba. Nearly 95% of the local submission sites were associated with previously identified blacklegged tick risk areas (Figure 3). Submission sites stretched from the US border as far north as Bellsite, and from the Ontario border as far west as Lake Audy (Riding Mountain National Park).

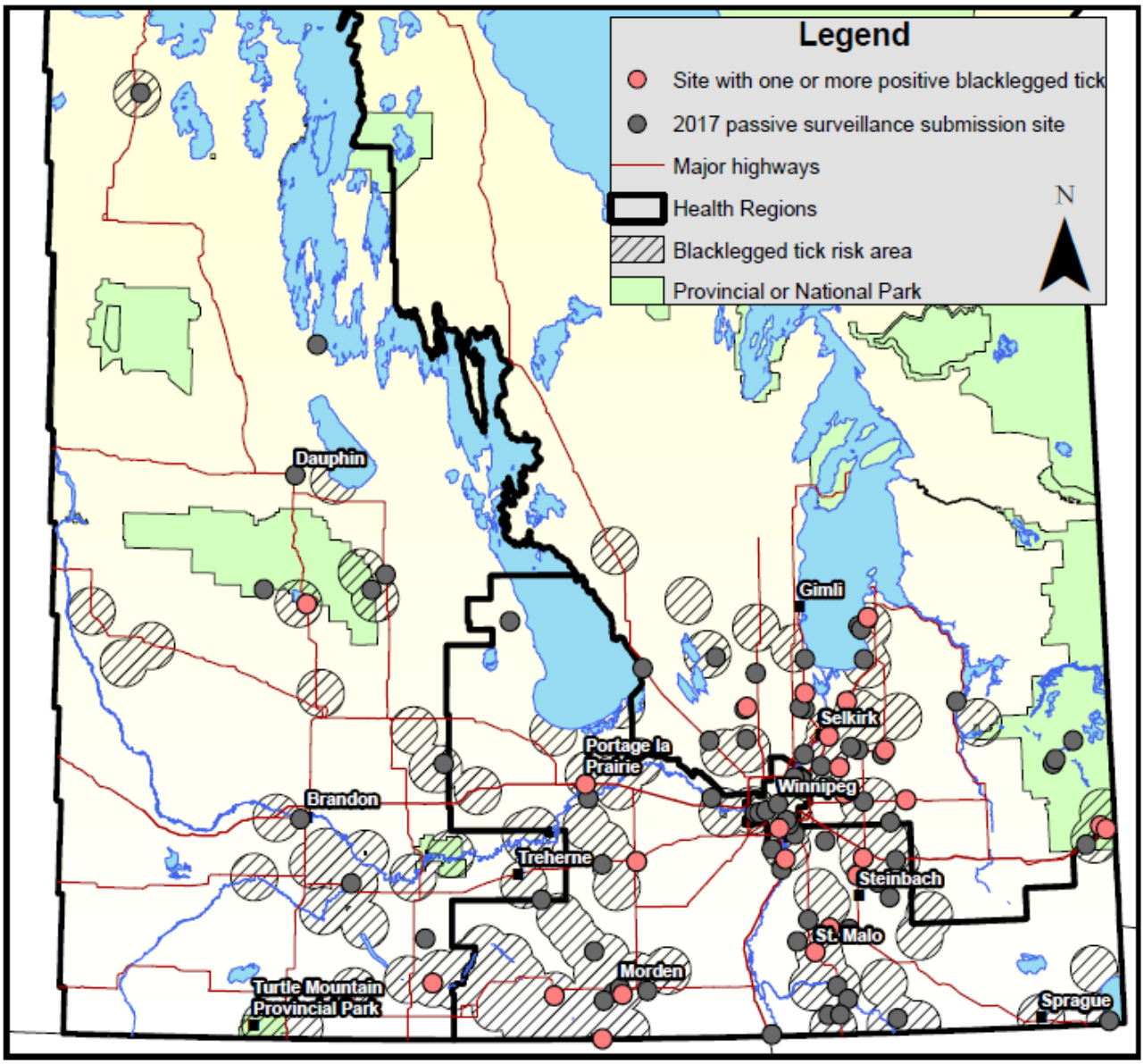

Figure 3: Distribution of BLT passive surveillance submission sites, known BLT risk areas and sites where a BLT specimen was infected with one or more pathogen (i.e. *A. phagocytophilum*, *B. microti* and/ or *B. burgdorferi*).

Anaplasma phagocytophilum

Anaplasmosis phagocytophilum was the second most common pathogen detected among BLTs submitted as part of the passive surveillance program (Table 2). Since 2013 the MIR associated with *A. phagocytophilum* have typically exceeded 5.0%. In 2017 specimens infected with *A. phagocytophilum* were collected from 9 locations across southern Manitoba (Figure 4), all of which were situated within, or in close proximity, to known BLT risk areas.

The minimum infection rate in 2017 was slightly lower than that observed in 2016 and no evidence of *A. phagocytophilum* was again detected in nymphs (Table 2).

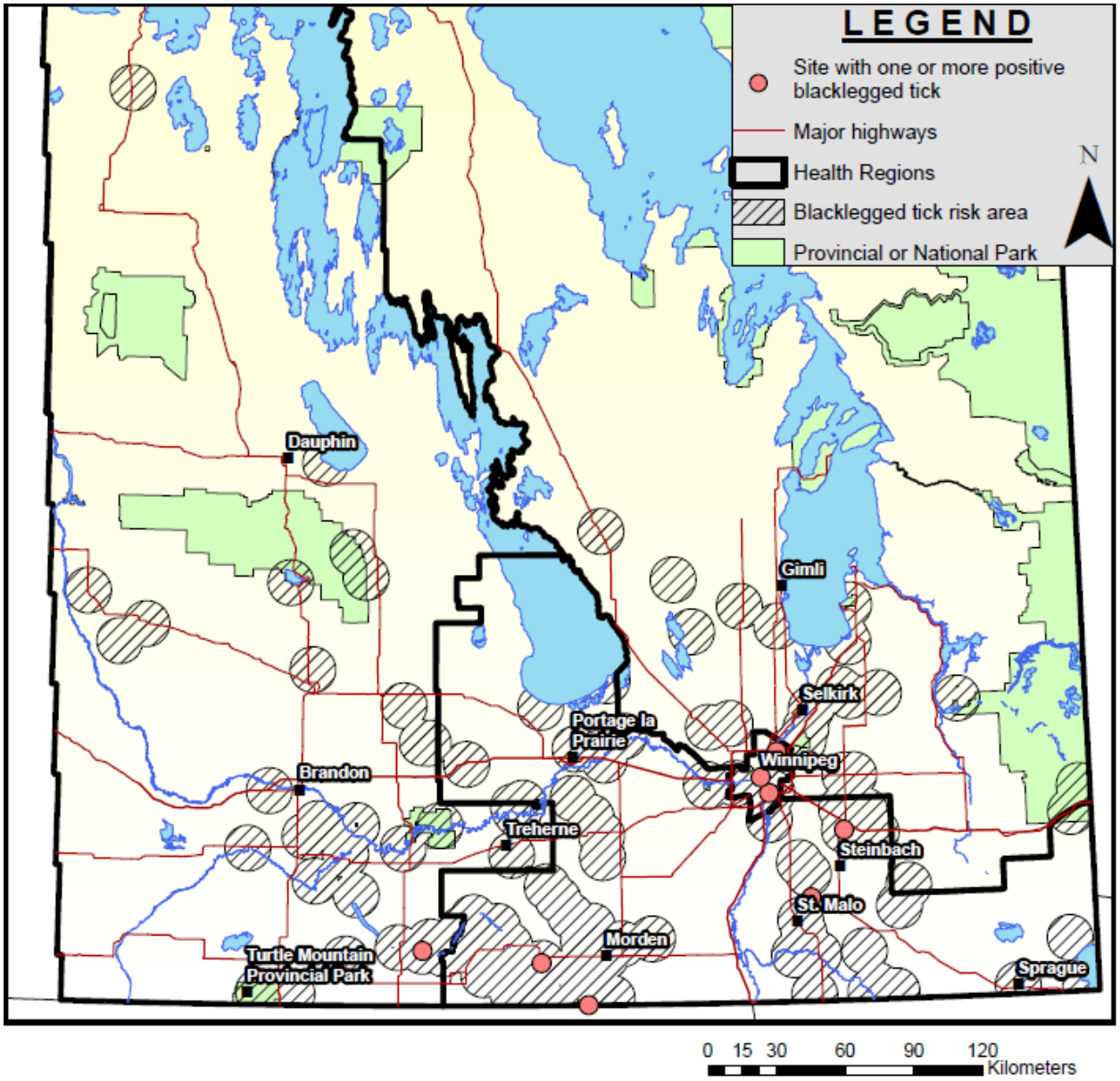

Figure 4: Distribution of collection sites for BLTs submitted as part of the 2017 passive surveillance program that tested positive for *A. phagocytophilum*

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.**

Table 2: Minimum and maximum prevalence of infection rates for *A. phagocytophilum*, *B. mircroti* and *B. burgdorferi* among BLT specimens collected via passive surveillance in 2017

	A. phagocytophilum		***B. microti***		***B. burgdorferi***	
	Min IR	**Max IR**	**Min IR**	**Max IR**	**Min IR**	**Max IR**
Adults	4.2%	8.4%	1.6%	2.0%	16.9%	26.0%
Nymphs	0.0%	0.0%	0.0%	0.0%	12.5%	12.5%
Total	**4.0%**	**8.0%**	**1.5%**	**1.9%**	**16.7%**	**25.3%**

Table 3: Minimum infection rates for *A. phagocytophilum* among BLTs collected as part of the 2017 passive surveillance program with comparison to 2016 data

	Negative	**Positive**	**% Positive (2017)**	**% Positive (2016)**
Adults	295	13	4.2%	5.2%
Nymphs	16	0	0.0%	0.0%
Total	**311**	**13**	**4.0%**	**5.0%**

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, remains the least common pathogen detected among BLTs submitted as part of the passive surveillance program (Table 2). Testing for this pathogen only began in 2013 and until 2015 minimum infection rates have remained relatively low, ranging between 0.8% and 1.7%. In 2017, the MIR was 1.6% (Table 3), a marked decrease from the 4.1% observed in 2016. Specimens infected with *B. microti* were collected from 5 sites. These sites were all associated with regions of long established BLT risk areas in southern and eastern Manitoba (Figure 5).

Table 4: Minimum infection rates for *B. microti* among BLTs collected as part of the 2017 passive surveillance program with comparison to 2016 data.

	Negative	**Positive**	**% Positive (2017)**	**% Positive (2016)**
Adults	303	5	1.6%	3.9%
Nymphs	16	0	0.0%	8.7%
Total	**319**	**5**	**1.5%**	**4.1%**

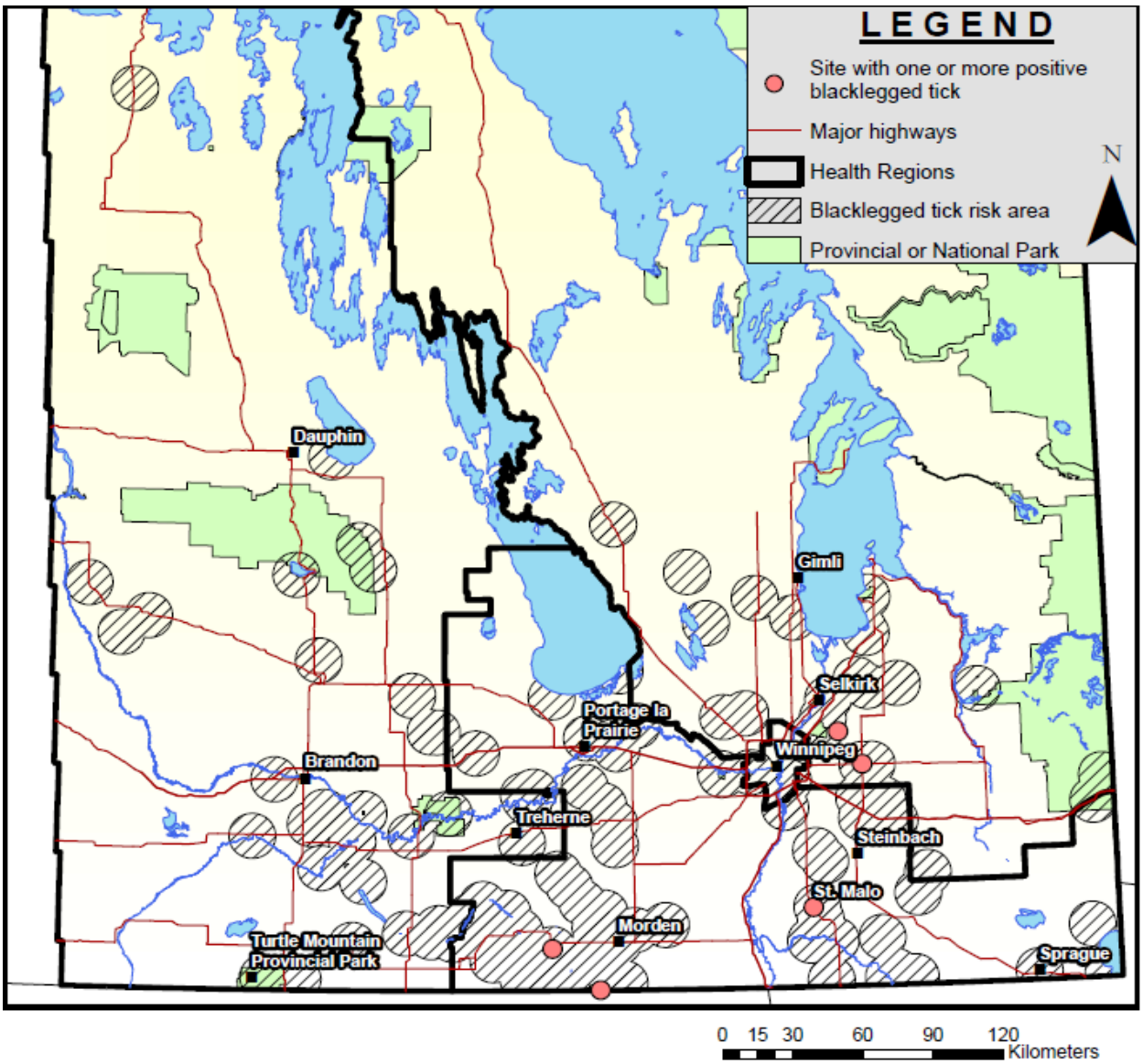

Figure 5: Distribution of collection sites for BLTs submitted as part of the 2017 passive surveillance program that tested positive for *B. microti*.

Borrelia burgdorferi

Borrelia burgdorferi was the most common tick-borne pathogen detected among BLTs collected in Manitoba in 2017 (Table 2). Since 2013, the MIR has hovered around, and/ or, exceeded 20%. In 2017, the MIR was 16.7%, a slight increase from the 15.7% observed in 2016. The maximum infection rate (assuming all specimens in a pool were positive) in 2017 was 25.3% (Table 2).

In 2017, specimens infected with *B. burgdorferi* were collected from 26 locations across southern Manitoba (Figure 6), all of which were in or close to known BLT risk areas. The

number of locales with positive BLTs in 2017 was less than that observed in 2016 (n = 48). The distribution of these sites in 2017 was, as in previous seasons, predominantly limited to portions of the Interlake-Eastern, Southern and Winnipeg Health Regions.

Table 5: Minimum infection rates for *B. burgdorferi* among BLTs collected as part of the 2017 passive surveillance program with comparison to 2016 data.

	Negative	Positive	% Positive (2017)	% Positive (2016)
Adults	256	52	16.9%	16.0%
Nymphs	14	2	12.5%	8.7%
Total	**270**	**54**	**16.7%**	**15.7%**

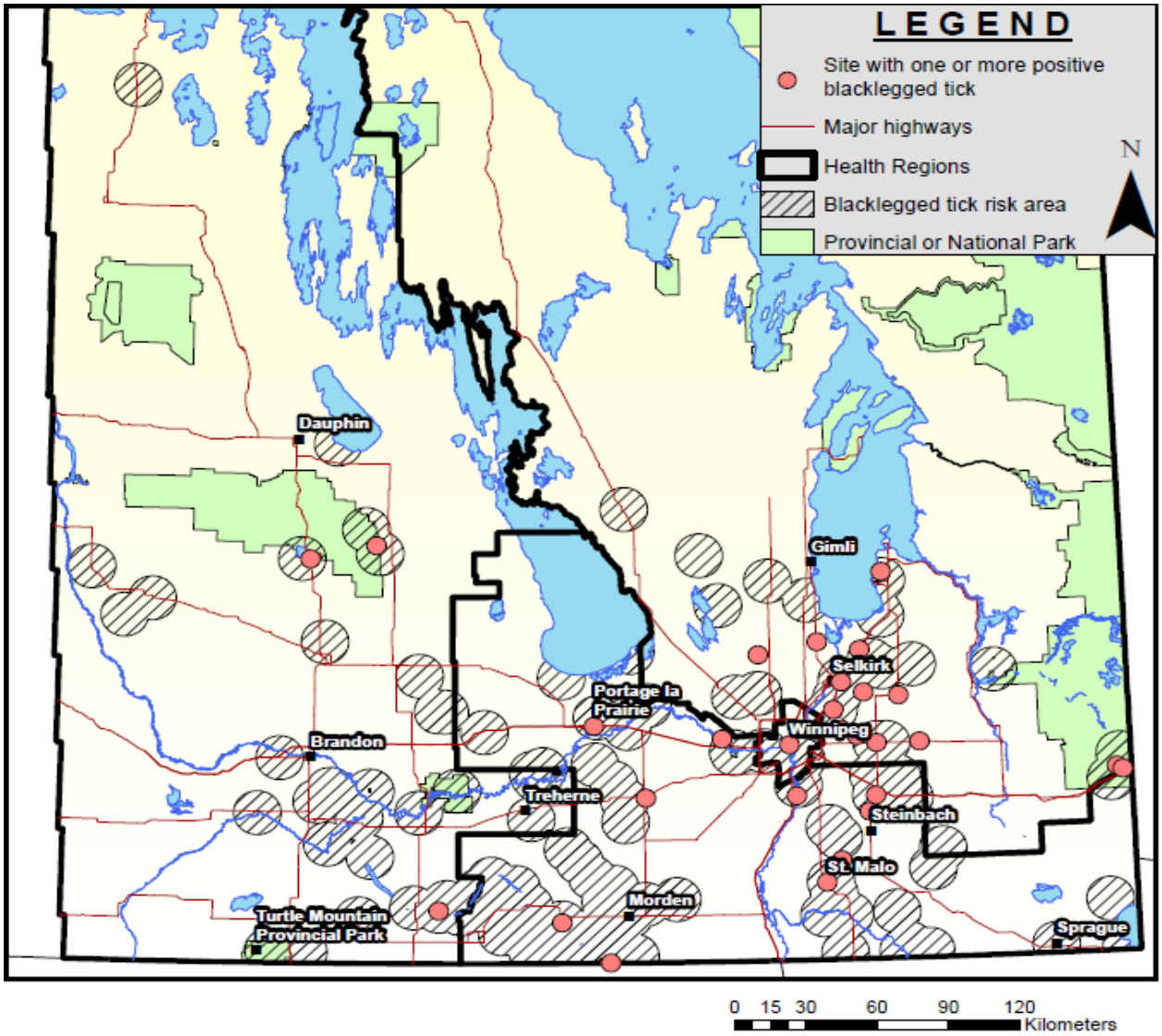

Figure 6: Distribution of collection sites for BLTs submitted as part of the 2017 passive surveillance program that tested positive for *B. burgdorferi*

Active Surveillance - 2017

Highlights of 2017 Active Surveillance

- Approximately 372km^2 surveyed and more than 250 specimens collected (nearly 2.5 times more than in 2016).
- In 2017 active surveillance identified 11 new risk areas, all but one of which were situated in western Manitoba.
- *Borrelia burgdorferi* infection rate increased from ~ 22% in 2016 to ~ 41% in 2017, similarly the *A. phagocytophilum* infection rate jumped from ~11% to ~ 14%.
- Number of specimens infected with more than one pathogen increased nearly 6-fold in 2017 compared to 2016.

In 2017 active surveillance was conducted at 186 sites across southern Manitoba, roughly equal to the 185 sites surveyed in 2016 (Table 6; Figure 7)[4]. In addition, approximately 372 km^2 were surveyed in 2017, again roughly on par with that seen in 2016. A total of 252 BLT specimens were collected, including 122 adult females, 126 adult males and 3 nymphs. The number of BLTs collected in 2017 was more than two and a half times as many as in 2016. Active surveillance identified a total of 11 new risk areas (Figure 7 & 8), all but one of which were situated in western Manitoba. The additional risk areas were situated in or near: Bellsite, Binscarth, Birtle, Minnedosa, Neepawa, Pinawa, Rainbow Beach Provincial Park, Riding Mountain National Park (south of Clear Lake), Solsgirth, Whitemud Watershed Wildlife Management Area and Williams Lake Provincial Park.

Table 6: Summary of active surveillance conducted in Manitoba, 2015 – 2017.

	Distance covered (km)	Number of sites surveyed	Sites w/ BLT	Total # of BLT Collected
2017	372.0	186	26	252
2016	376.4	185	16	104
2015	165.4	86	6	12

[4] MHSAL's surveillance capacity in 2017 was significantly increased through funding received from PHAC. The PHAC contractor was based in Brandon, MB and focused their efforts in the western portion of the province.

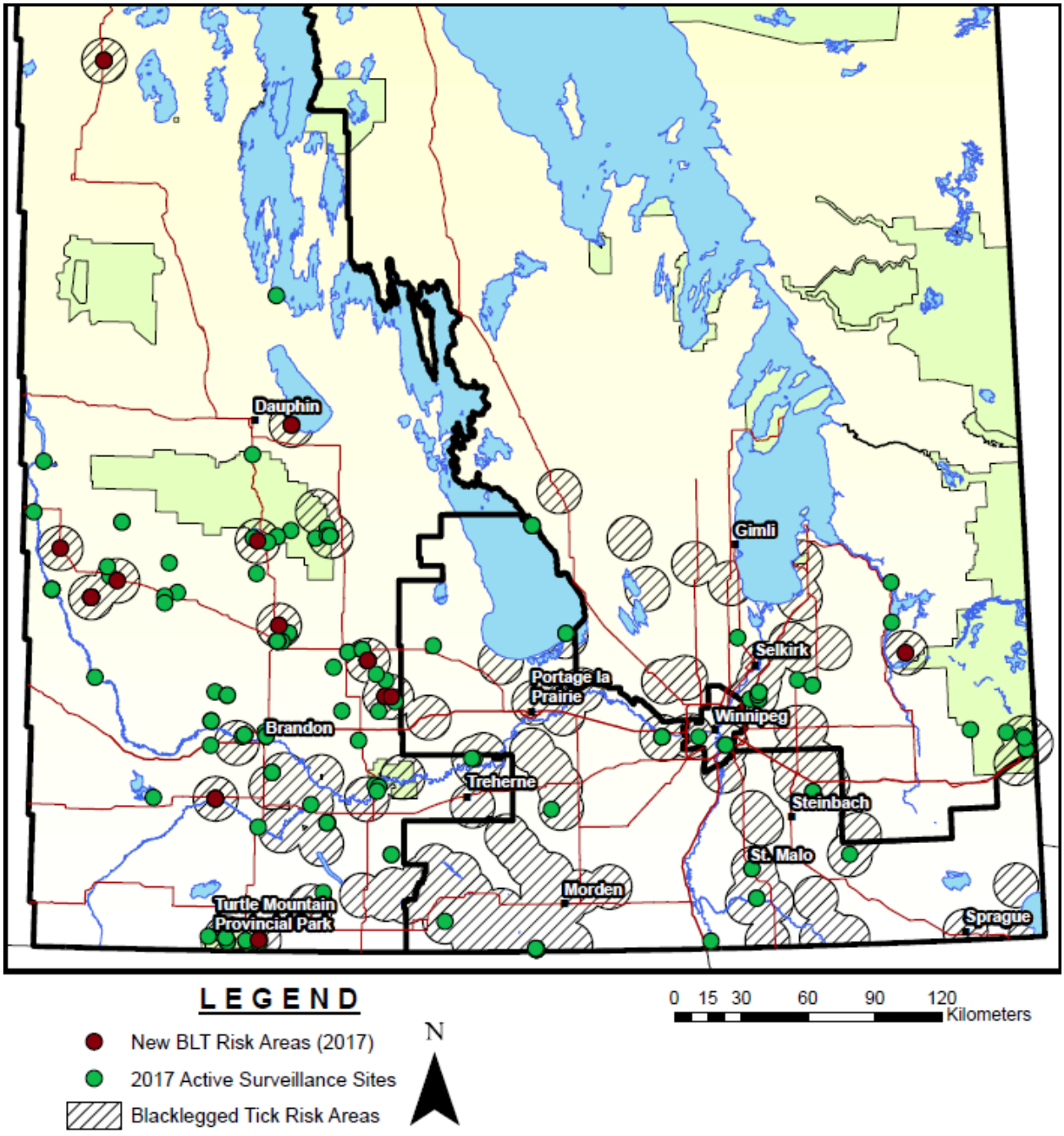

Figure 7: Distribution of active surveillance efforts, and newly identified BLT risk areas in 2017.

All BLT suitable specimens were submitted to PHAC's National Microbiology Laboratory (NML) for pathogen testing. Specimens were screened for the causative agents of Anaplasmosis, Babesiosis and Lyme disease in addition to a broad range of emerging or novel

tick-borne pathogens[5]. In 2017, the infection rate for *B. burgdorferi* was 41.3%, a significant increase from the 22.1% observed in 2016 (Table 7). The Infection rates with *A. phagocytophilum* was 14.3% in 2017, an increase from 2016, while no *B. microti* infected ticks were collected via active surveillance in 2017. A total of 18 BLT specimens were co-infected with more than one pathogen, a more than four-fold increase from 2016. The most common combination was *B. burgdorferi* and *A. phagocytophilum* (Table 8). A single tick was found co-infected with three agents; *B. burgdorferi*, *A. phagocytophilum* and Deer Tick virus).[6]

The elevated infection rates are largely attributable to extensive active surveillance efforts in 2017 to assess the prevalence of novel pathogens. Significant BLT numbers were collected in southwestern Manitoba. For instance, nearly 59% of the specimens were collected in 2017 came from the Turtle Mountain area. Moreover, approximately 52% and 20.3% of the collected specimens were infected with *B. burgdorferi* and *A. phagocytophilum* respectively. In addition, nearly 11% of the BLTs collected from this area were co-infected with both *B. burgdorferi* and *A. phagocytophilum*.

Table 7: Infection rates among BLT specimens collected via active surveillance in 2015 (n = 12), 2016 (n = 104) and 2017 (n = 252).

	Borrelia burgdorferi	***Anaplasma phagocytophilum***	***Babesia microti***
2017	41.3%	14.3%	0.0%
2016	22.1%	10.6%	1.0%
2015	50.0%	8.3%	0.0%

Table 8: Co-infection status of BLTs collected by active surveillance in 2016 and 2017.

	B. burgdorferi* + *A. phagocytophilum	***B. burgdorferi* + *B. microti***	***B. burgdorferi* + *A. phagocytophilum* + Deer tick virus (Powassan lineage II)**
2017	17	0	1
2016	3	1	0

[5] The NML screens all suitable BLT specimens collected as part of the active & passive surveillance programs for a broad range of emerging or novel tick-borne pathogens. This includes a variety of *Borrelia* species (i.e. *B. mayonii, B. hermsii, B. bissettii, B. carolensis* and *B. kurtbacheni*), *Babesia* species, *Ehrlichia chaffensis* and Deer Tick virus.

[6] Deer tick virus was first detected in 2016. Active surveillance efforts were intensified in 2017 to assess the prevalence of infection of Deer Tick virus in Manitoba. Since 2016 the infection rate has ranged between 1.2 and 2.8%. Information regarding the discovery of Deer Tick virus in locally collected *Ix. scapularis* populations was communicated to health care providers in April 2018 (http://www.gov.mb.ca/health/publichealth/cdc/docs/hcp/2018/041818.pdf).

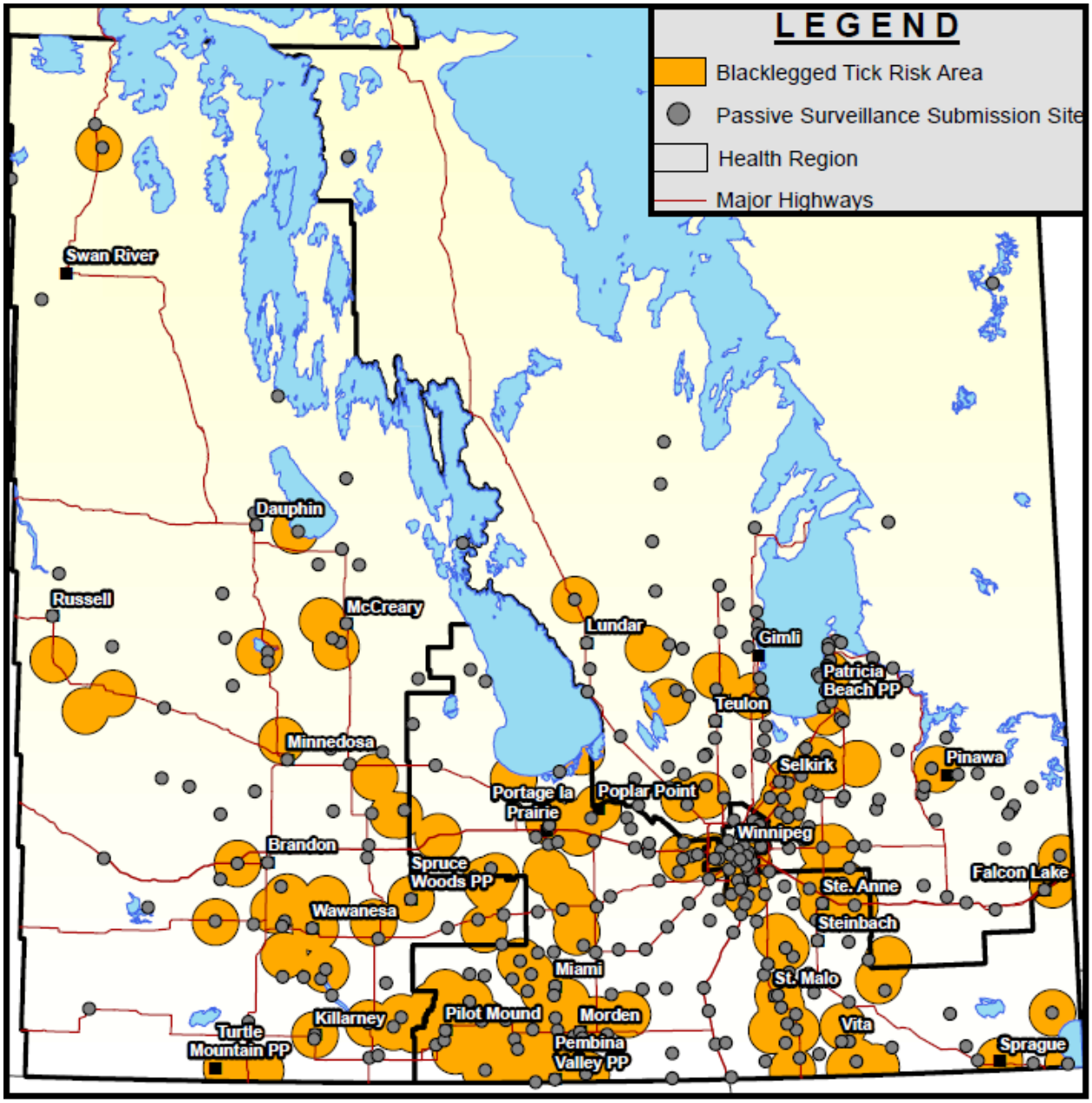

Figure 8: Distribution of BLT risk areas in 2017[7]

[7] Although the risk of encountering a BLT is greater in these risk areas, it should be cautioned that 1) the distribution of blacklegged ticks in these risk areas is not uniform, and 2) BLTs can also be found outside of these risk areas. TBDs can be acquired anywhere in Manitoba, though the risk is greater in known risk areas.

Tick-Borne Diseases in Humans

Anaplasmosis

Highlights – Anaplasmosis 2017

- In 2017, males accounted for approximately 78% of the cases, and the median age was 64.
- Highest incidence rates, based on health region of residence, found in the Interlake-Eastern and Southern Health – Santé Sud.
- Since 2015 the incidence rate (per 100,000) was highest among individuals over 60 years of age.
- Nearly 9 in 10 cases reported since 2015 indicated likely exposure within Manitoba.
- Fever was the most common symptom, followed by non-specific ones.

In 2017 nine Anaplasmosis cases were reported to MHSAL. Six of the cases met the provincial surveillance case definition for a confirmed case, while three were classified as probable (see Appendix A for the provincial surveillance case definitions). Case numbers were nearly half of those observed in 2016 (Table 9).

Table 9: Reported Cases of Anaplasmosis in Manitoba, 2015 - 2017.

Case Classification	2017	2016*	2015	Total
Confirmed Case	6	11	2	19
Probable Case	3	5	2	10
Total Reported	9	16	4	29

* 2016 cases were re-classified based on further review/ information hence the discrepancy between 2016 & 2017 TBD report figures

Since 2015, males have accounted for nearly 2 in 3 Anaplasmosis cases (Table 10). In 2017 males accounted for nearly 78% of the confirmed and probable cases. The median age of cases was 64.0 in 2017, a marked increase from the median of 51.0 for 2015-16 cases. Overall, when all cases were combined the median age was 57.0. All but two of the 29 cases reported since 2015 were in individuals 20 years of age or older, and 72% of the cases were among individuals 40 years or age or older (Figure 9). Incidence rates were highest among the 40 – 59 age group (1.05/ 100,000) and the over 60 age group (1.20/ 100,000).

Table 10: Number of confirmed and probable Anaplasmosis cases and incidence rates (per 100,000) by sex, with age analysis, in Manitoba, 2015 – 2017.

	2017		2015-16 Avg	
	Case Count	**Incidence**	**Case Count**	**Incidence**
Total	9	0.66	10.0	0.38
Female	2	0.29	4.5	0.34
Male	7	1.04	5.5	0.42
	Age Analysis (in years)		**Age Analysis (in years)**	
Average	55.8		48.0	
Median	64.0		51.0	
St. Dev.	20.9		14.5	
Min. Age	12		8	
Max. Age	73		67	

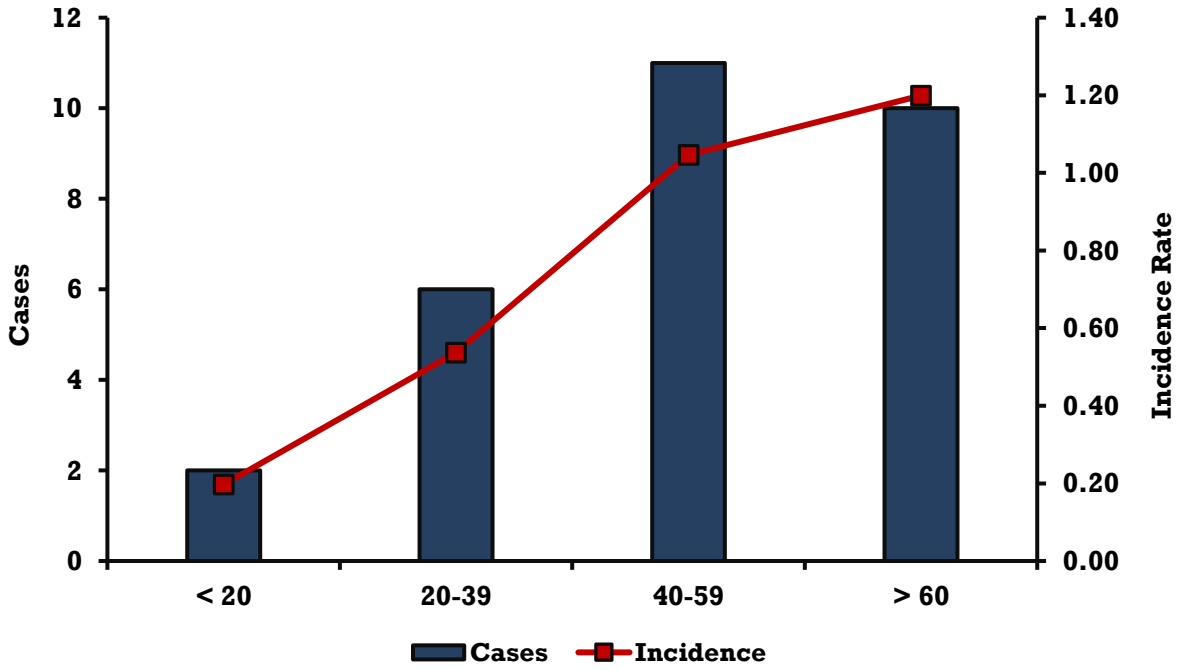

Figure 9: Numbers of confirmed and probable Anaplasmosis cases and incidence rates (per 100,000) by age group recorded in Manitoba since 2015.

At the provincial level the incidence (per 100,000) of Anaplasmosis cases decreased from 1.19 in 2016 to 0.66 in 2017. The incidence rates decreased across all four southern Manitoba Health Regions. While most cases resided in either the Southern Health Region (n = 10) or the Winnipeg Regional Health Authority (n = 11), the incidence rates were greatest in the Interlake-Eastern (1.82) and Southern Health – Santé Sud (1.69) Health Regions (Figure 10).

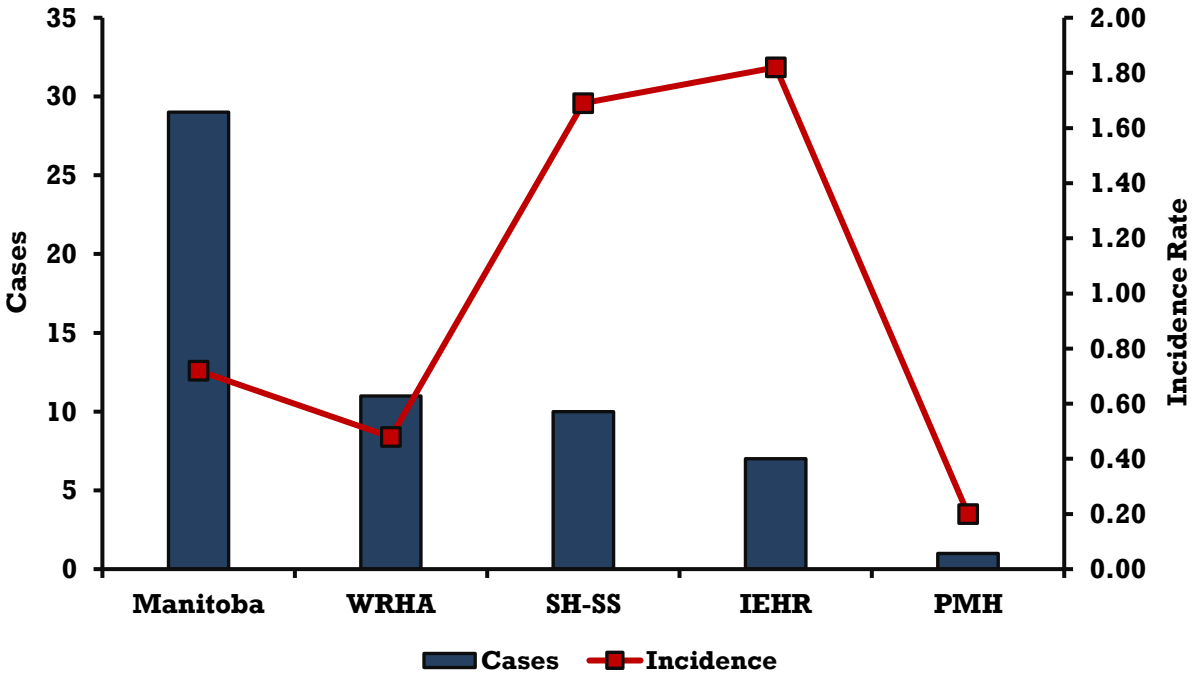

Figure 10: Anaplasmosis incidence rates (per 100,000) and case numbers reported by Health Region of residence since 2015 (n = 29).

Three of the 29 Anaplasmosis cases reported since 2015 indicated likely exposure outside of Manitoba (one each in 2015, 2016 and 2017). Two of these cases indicated likely exposure in North Western Ontario, and one indicated exposure in Minnesota. The likely exposure locations in the province correspond to well-known BLT risk areas situated in eastern and southern Manitoba (Figure 11). Health Districts[8] with the highest average incidence rates (per 100,000), based on likelihood of case exposure, are situated in the southeast portion of the province where surveillance has shown a longer period of BLT establishment (the first risk area was identified in the extreme southeast corner of the province in 2006).

[8] 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.

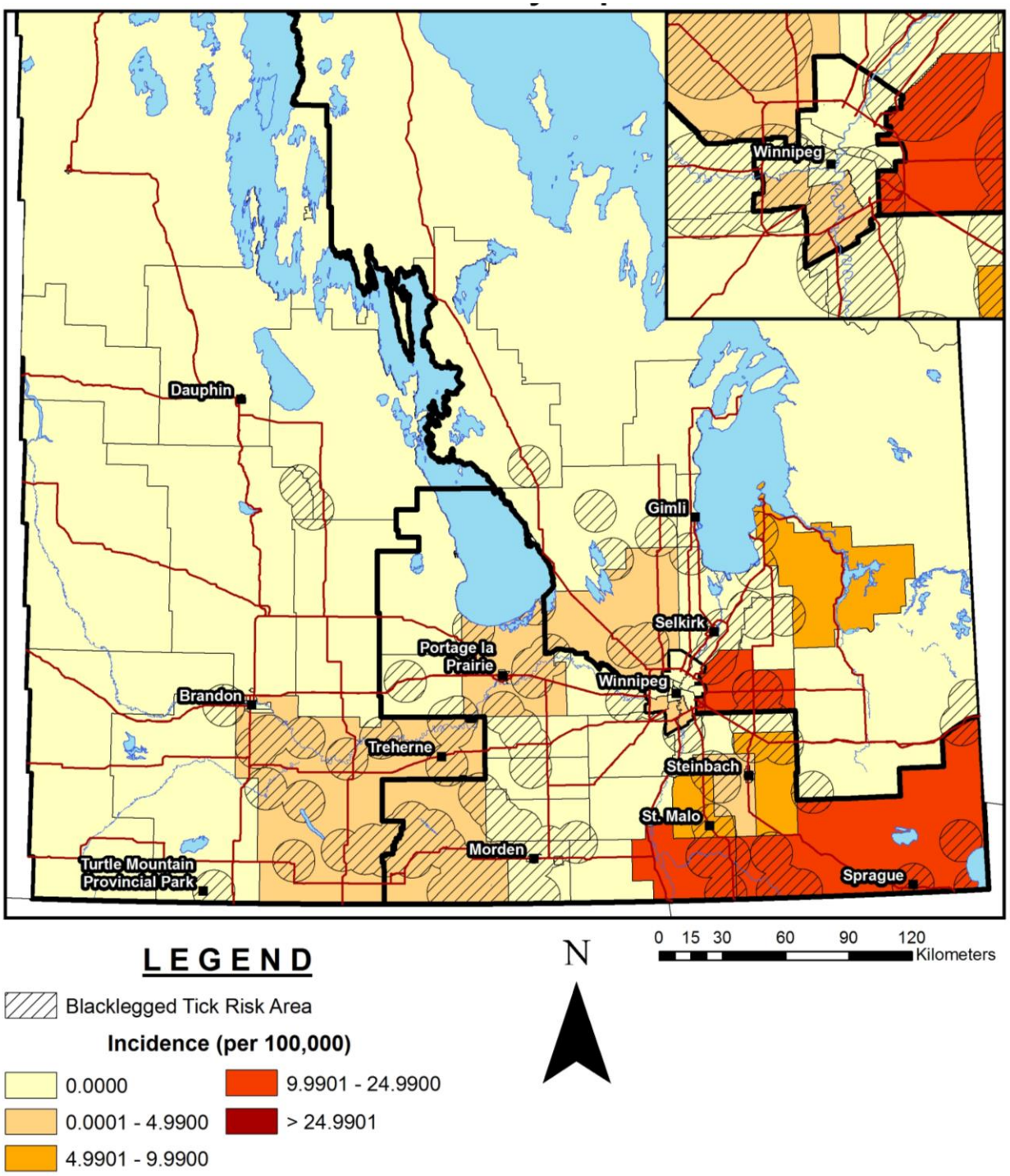

Figure 11: Average incidence, per 100,000, of all confirmed and probable Anaplasmosis cases reported in Manitoba since 2015 based on Health District of likely exposure (n = 26).

All 29 confirmed or probable Anaplasmosis cases reported a fever, making it the most common clinical symptom (Table 11). Most common symptoms could be characterized as non-specific and influenza-like. These common symptoms, all of which were observed in

more than 50% of the cases, included fatigue, headache, sweats or chills, myalgia, generalized weakness, malaise, nausea and stiff neck. Less common symptoms included anorexia, arthralgia, anemia, thrombocytopenia, LFT elevation and recurrent joint brief joint swelling[9]. It should be cautioned that information for anemia, thrombocytopenia and LFT elevation were only available for 11 of the 29 cases. Uncommon symptoms, observed in less than 20% of the Anaplasmosis cases included cough, cardiac symptoms, Bell's palsy and lymphadenopathy.

Table 11 – Clinical symptoms associated with confirmed and probable Anaplasmosis cases reported to Manitoba Health, Seniors and Active Living since 2015

	Symptom	Frequency observed	Cases with symptom	Total cases[10]
Common	Fever	100%	29	29
	Fatigue	96%	25	26
	Headache	86%	24	28
	Sweats/ Chills	85%	23	27
	Myalgia	72%	18	25
	Generalized Weakness	68%	17	25
	Malaise	65%	17	26
	Nausea	62%	16	26
	Stiff Neck	52%	13	25
Less Common	Anorexia	48%	12	25
	Arthralgia	36%	9	25
	Anemia	27%	3	11
	Thrombocytopenia	27%	3	11
	LFT Elevation	27%	3	11
	Recurrent Brief Joint Swelling	24%	6	25
Uncommon	Cough	20%	5	25
	Cardiac Sx	16%	4	25
	Bell's Palsy	12%	3	25
	Lymphadenopathy	8%	2	25

[9] Three of the six cases that listed recurrent brief joint swelling had evidence of current and/ or past infection with *B. burgdorferi*.

[10] General symptom information was only available for 2015, as the case investigation form changed in 2016 to query specific symptoms. A further change was made in 2017 to include additional symptoms (i.e. anemia, thrombocytopenia and Liver Function Test (LFT) elevation). Where queries were absent on the forms, the interpretation was treated as 'unknown' and not included in the denominator.

Lyme disease

Highlights - 2017

- Males continued to account for a majority of the cases, and the incidence rate was highest for both genders among individuals 60 years of age and older.
- All but one case reported in 2017 had likely exposure within Manitoba.
- Approximately 83% of the cases reported likely exposure between May and July.
- Highest incidence rate, based on region of residence, was the Southern Health – Santé Sud RHA (10.45 per 100,000 in 2017).
- Tick bite recollection has historically been low (~1 in 3), however since 2015 this proportion has increased to approximately 42.1%.
- Contact with suitable tick habitat and/ or history of outdoor recreation were the most common risk factors identified among cases since 2015.
- Clinical symptoms observed in more than 50% of the cases were associated with early localized Lyme disease. Physician observed Erythema migrans was recorded in approximately 60% of the cases.

The number of confirmed and probable Lyme disease cases reported in 2017 decreased from the record high reported in 2016 (Table 12). A total of 43 confirmed or probable Lyme disease cases were reported in Manitoba in 2017, representing an incidence rate of 3.17 (Table 13). This represents a decline from 2016 where 52 confirmed and probable Lyme disease cases were reported and the incidence was 3.88. However, the 2017 case numbers follows a similar increasing trend in both case numbers and incidence rates when compared to the five year average (2012 – 2016). A similar increase, though lower in magnitude, in case numbers and incidence rate was observed for those Lyme disease cases reported provincially as 'other' in 2017 compared to the five year average (Table 14).

Table 12: Reported cases of Lyme disease in Manitoba, 2009 – 2017

	2017	2016	2015	2014	2013	2012	2011	2010	2009	Total
Confirmed Case *	29	24	12	23	16	9	8	7	1	**129**
Probable Case *	14	28	20	15	15	11	6	6	4	**119**
Other Case **	13	12	9	11	8	11	2	5	6	**77**
Total Reported ***	**56**	**64**	**41**	**49**	**39**	**31**	**16**	**18**	**11**	**325**

* National surveillance case definitions are available at:
https://www.canada.ca/en/public-health/services/diseases/lyme-disease/surveillance-lyme-disease/case-definition.htm
** 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 July 25, 2018.

Table 13: Number of confirmed and probable Lyme disease cases* and incidence rates (per 100,000) by sex, with age analysis, in Manitoba, 2017 and 5 year average (2012 – 2016)

	2017		2012 - 2016 Average	
	Case Count	**Incidence**	**Case Count**	**Incidence**
Total	43	3.17	34.4	2.64
Female	20	2.93	13.0	1.98
Male	23	3.41	21.4	3.31
	Age Analysis (in years)		**Age Analysis (in years)**	
Average	41.3		41.1	
Median	43.0		44.0	
St. Dev.	23.3		22.0	
Min. Age	5		1	
Max. Age	81		86	

* As per the National surveillance case definitions (https://www.canada.ca/en/public-health/services/diseases/lyme-disease/surveillance-lyme-disease/case-definition.html. Accessed August 28, 2018)

Table 14: Number of '*other*' Lyme disease cases* and incidence rates (per 100,000) by sex, with age analysis, in Manitoba, 2017 and 5 year average (2012 – 2016)

	2017		2012 - 2016 Average	
	Case Count	**Incidence**	**Case Count**	**Incidence**
Total	13	0.96	10.2	0.78
Female	5	0.74	4.2	0.64
Male	8	1.19	6.0	0.93
	Age Analysis (in years)		**Age Analysis (in years)**	
Average	41.1		48.5	
Median	44.0		53.5	
St. Dev.	22.0		21.2	
Min. Age	1		3	
Max. Age	86		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.

In 2017, as in previous seasons, more cases of Lyme disease were reported among males than females (Table 13). However, unlike in 2016 where males accounted for approximately 2 in 3 confirmed or probable Lyme disease cases, in 2017 they accounted for slightly more than half (~53.5%). The incidence rate in males was 3.41 in 2017 compared to 2.93 for females, both of which were lower than in 2016 (4.81 and 2.97 respectively). Though the majority of cases were still recorded in males, the proportion observed in 2017 was lower than the 5 year average where males accounted for approximately 63% of all confirmed and probable cases reported to MHSAL (n = 107). Moreover the male case count increased

slightly in 2017 compared to the five year average (23 vs. 21.4), whereas the case count among females increased by substantially (20 vs. 13). Additionally, among cases classified as 'other' there was a slight increase in 2017 case numbers and incidence rates compared to the five year average (Table 14). In 2017 males accounted for approximately 62% of the 'other' cases.

The age range of confirmed and probable Lyme disease cases remained relatively unchanged from the five year average, with the youngest case in a 5 year old and the oldest in an 81 year old (Table 13). The average age for confirmed and probable Lyme disease cases in 2017 was virtually equal to the five year average (41.3 compared to 41.1). The average age for 'other' Lyme disease cases was markedly lower in 2017 compared to the five year average (41.1 vs. 48.5).

In 2017, Lyme disease incidence rates peaked for both males (4.53 per 100,000) and females (3.91 per 100,000) in individuals 60 years of age an older (Figure 12). Confirmed and probable Lyme disease cases reported in 2017 were more common among individuals, regardless of gender, 60 years of age or older. A secondary peak in incidence rate among males was observed in the 20 to 39 year age group (4.20 per 100,000), while the secondary peak in females was among individuals younger than 20 years of age (3.61 per 100,000). The peaks align with the five year average for males (Figure 13), where individuals 60 years of age and older had the highest incidence rate (5.16 per 100,000). However, the peak incidence rate for females between 2012 and 2016 was among individuals less than 20 years of age (2.66 per 100,000), while a secondary peak was recorded among those between 40 and 59 years of age (2.29 per 100,000). More than half of the total confirmed and probable Lyme disease cases reported in 2017 (n = 24; ~55.8%) and between 2012 and 2016 (n = 94; ~54.7%) were recorded among males and females 40 years of age or older.

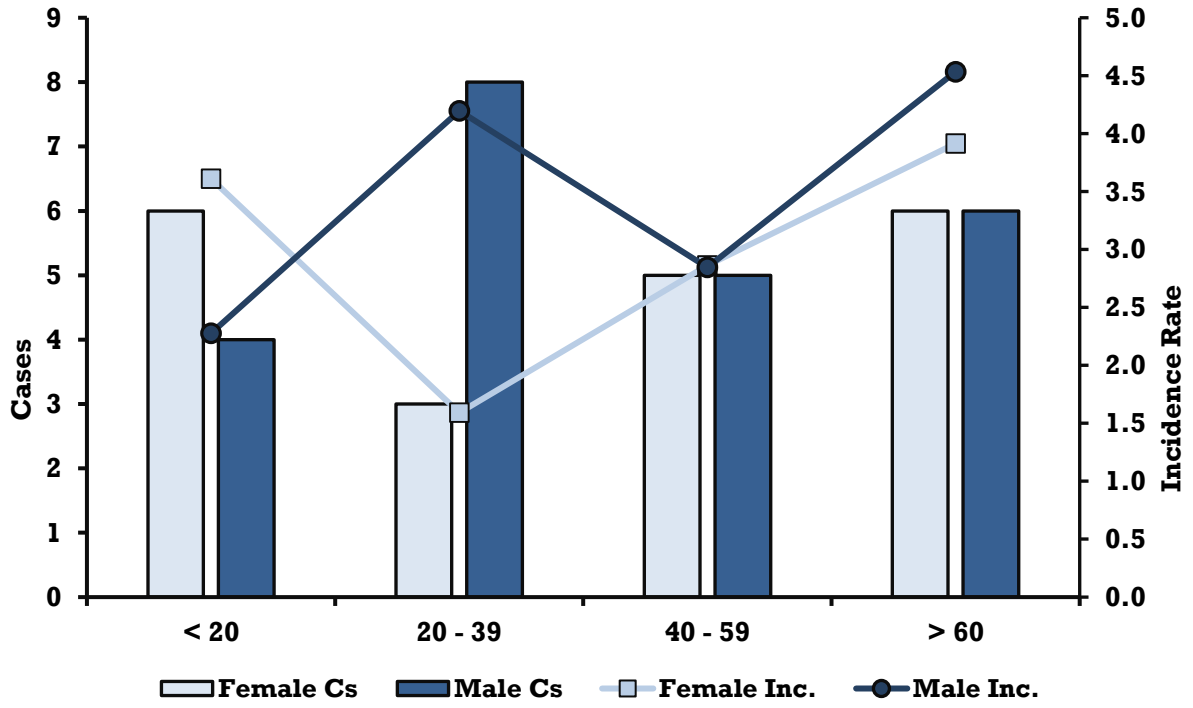

Figure 12: Number and incidence rate (per 100,000) of confirmed and probable Lyme disease cases by gender and age group in Manitoba for 2017.

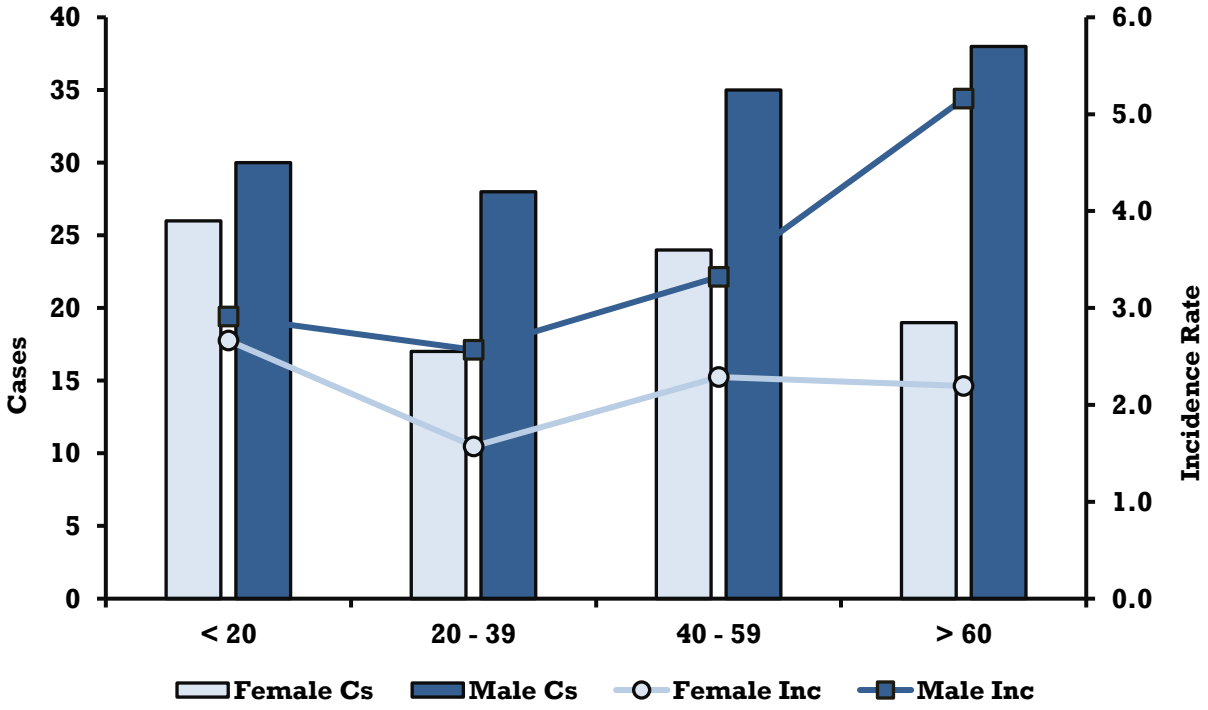

Figure 13: Number and incidence rate (per 100,000) of confirmed and probable Lyme disease cases by gender and aged group in Manitoba, 2012 – 2017.

In 2017 all but one of the confirmed and probable Lyme disease cases (n = 42), or 98%, had a likely exposure history within Manitoba (Figure 14). This represents a considerable increase from the five year average where approximately 81.5% of cases (range 65.0% - 87.5%) had likely local exposure history. The local history of exposure aligns with the ongoing trend at the National level, however at a greater magnitude. For example between 2009 and 2015 the proportion of cases acquired locally in Canada increased from 54.7% to 72.7%[11]. In 2017, the case with out of province exposure was linked with travel to northwestern Ontario.

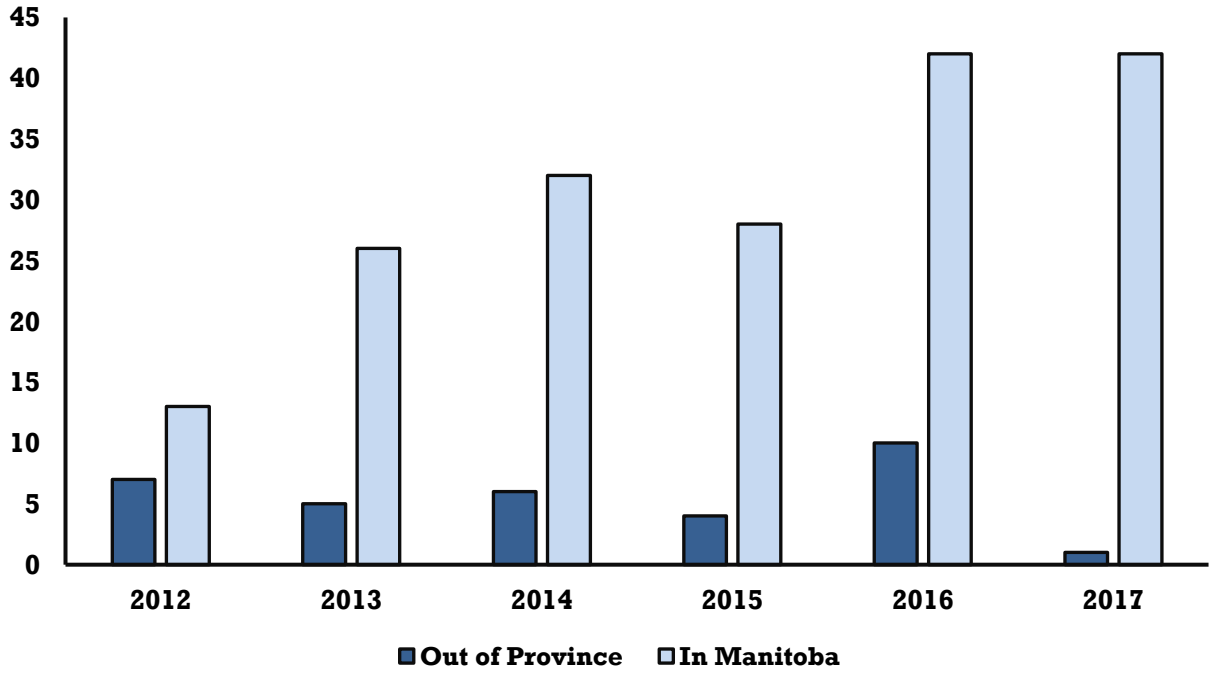

Figure 14: Confirmed and probable Lyme disease cases reported between 2012 and 2017 based on likely exposure, within or outside of the province (n = 216).

Seasonally the highest risk period for exposure to both the agents of Anaplasmosis and Lyme disease, based on likely month of exposure, falls between May and July (Figure 15). In 2017 approximately 82.9% of the confirmed and probable Lyme disease cases reported exposure between May and July. Further, since 2012 approximately 79.7% (n = 161) of confirmed and probable Lyme disease cases reported likely exposure in the same time period. For Anaplasmosis cases (reported since 2015) approximately 82.1% also reported likely exposure between May and July. This late spring/ early summer time frame

[11] Gasmi, S., Ogden, N. H., Lindsay, L. R. et al. **2017**. Surveillance for Lyme disease in Canada, 2009 to 2015. *Canadian Communicable Disease Report*, 43 (https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2017-43/ccdr-volume-43-10-october-5-2017/surveillance-surveillance-lyme-disease-canada-2009-2015.html).

corresponds to the peak activity period for BLT nymphs. When compared to adults, nymphs are smaller and even harder to see and hence remove.

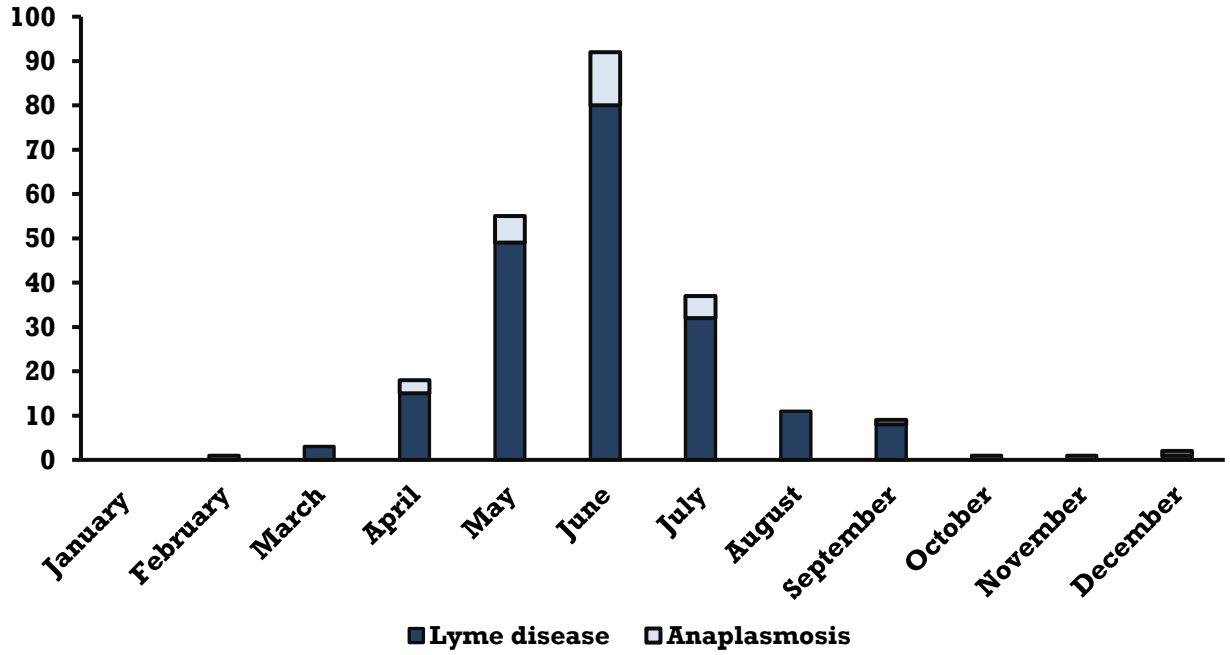

Figure 15: Likely exposure month for confirmed and probable Anaplasmosis cases 2015 – 2017; n = 28) and Lyme disease cases (2012 – 2017; n = 202)[12]

Among the 213 confirmed and probable Lyme disease cases recorded since 2012 with available information, only 74 (~ 34.7%) indicated a history of a tick-bite. Moreover, when combining the Anaplasmosis and Lyme disease cases since 2015 the proportion with a history of tick bite rose to approximately 42.1% (Table 15). However, individuals in the Winnipeg Health Region only recalled a tick bite in 36.8% of the cases, compared to cases reported in the other three southern Health Regions that had proportion of tick bites exceeding 44.6%. Cases were more likely to indicate a history of contact with suitable tick habitat (~ 88.3%) than a history of tick bite (Table 16). Similarly a history of outdoor recreation was more commonly recalled as a potential risk factor (~ 58.4%) as opposed to a history of tick bite (Table 17).

[12] Data presented in Figure 15 includes data from cases with exposure histories within and outside of the province. Likely exposure information was unavailable for one Anaplasmosis and fourteen Lyme disease cases in the specified time period.

Table 15: Proportion of confirmed and probable Anaplasmosis (n = 29) and Lyme disease (n = 130) cases with a history of tick bite prior to symptom onset, 2015 – 2017.

Heatlh Region	Proportion	Total # Cases	History of tick bite
WRHA	36.8%	57	21
SH-SS	44.6%	65	29
IEHR	46.2%	26	12
PMH	45.5%	11	5
TOTAL	**42.1%**	**159**	**67**

Table 16: Proportion of confirmed and probable Anaplasmosis (n = 28) and Lyme disease (n = 109) cases with a history of contact with suitable tick habitat, 2015 – 2017.

Heatlh Region	Proportion	Total # Cases	Contact with Suitable Habitat
WRHA	88.5%	52	46
SH-SS	84.6%	52	44
IEHR	91.3%	23	21
PMH	100.0%	10	10
TOTAL	**88.3%**	**137**	**121**

Table 17: Proportion of confirmed and probable Anaplasmosis (n = 28) and Lyme disease (n = 109) cases with a history of outdoor recreation, 2015 – 2017.

Heatlh Region	Proportion	Total # Cases	Outdoor Recreation
WRHA	57.7%	52	30
SH-SS	53.8%	52	28
IEHR	73.9%	23	17
PMH	50.0%	10	5
TOTAL	**58.4%**	**137**	**80**

The burden of Lyme disease cases increased in three of the Interlake-Eastern, Southern Health – Santé Sud and Prairie Mountain Health Regions in 2017 compared to the previous 5 year average (Figure 16). Based on region of residence, the 2017 case numbers were highest in the Southern Health – Santé Sud Health Region (n = 21), more than double those observed in the Interlake-Eastern and WRHA (n = 9) (Figure 16; Table 18). The 2017 and five year average incidence rates were highest in Southern Health – Santé Sud (10.45 and 9.02 per 100,000 respectively) and the Interlake-Eastern Health Region (6.97 and 2.53 per 100,000 respectively). The higher incidence rates in these two regions, reflects both the distribution and longer history of numerous BLT risk areas within.

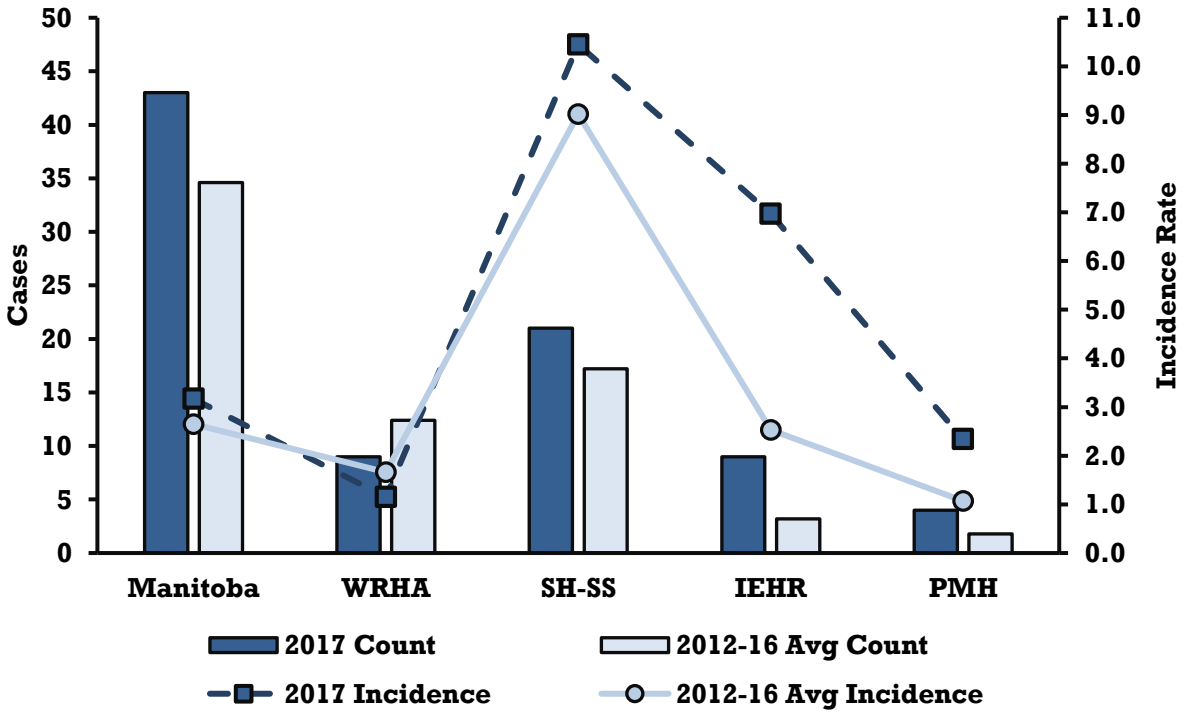

Figure 16: Lyme disease incidence (per 100,000) rates and cases numbers for confirmed and probable cases reported by Health Region of residence between 2012 and 2017.

Table 18: Lyme disease incidence rates (per 100,000) for confirmed and probable cases, reported by Health Region of residence between 2012 and 2017.

	Manitoba	WRHA	SH-SS	IEHR	PMH
2017 Count	43	9	21	9	4
2012-2016 Avg Count	34.6	12.4	17.2	3.2	1.8
2017 Incidence	3.17	1.15	10.45	6.97	2.34
2012-16 Avg Incidence	2.65	1.66	9.02	2.53	1.07

When the average incidence rates (per 100,000) are examined based on likely exposure location at the health district[13] level two distinct observations are apparent (Figure 17). 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) typically correspond to regions with a longer history of BLT establishment.

[13] 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.

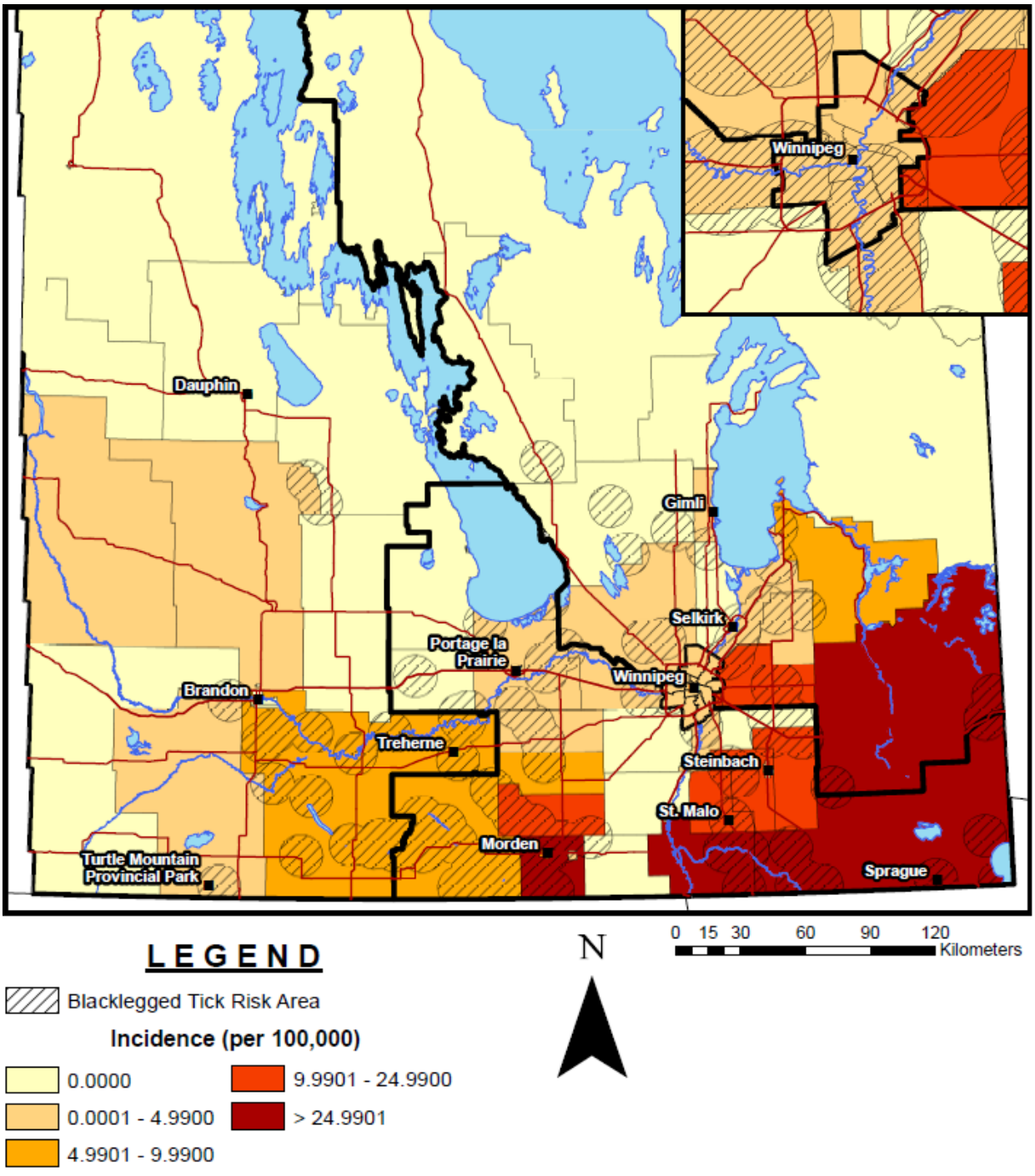

Figure 17: Average incidence, per 100,000, of all confirmed and probable Lyme disease cases reported in Manitoba between 2009 and 2017 based on Health District of likely exposure (n = 194).

Common clinical symptoms observed in more than 50% of the confirmed and probable Lyme disease cases reported since 2015 were those associated with early Lyme disease (Table 19). Physician observed Erythema migrans (EM) was recorded in approximately 60.5% of the

cases, far less than the approximate 74% reported in confirmed and probable cases elsewhere in Canada[14]. Other commonly observed symptoms were non-specific and associated with early Lyme disease and included fatigue (67.0%), headache (57.1%), Fever (55.5%), malaise (53.0%) and myalgia (52.5%). Less common symptoms included a mixture of non-specific manifestations of early Lyme disease, such as arthralgia (41.7%), and late disseminated Lyme disease, such as recurrent brief joint swelling (34.7%). With the exception of fatigue and generalized weakness, symptoms associated with early disseminated Lyme disease were relatively uncommon, with Bell's Palsy and cardiac symptoms observed in only 11.9% and 9.1% of cases respectively.

Table 19: Clinical symptoms associated with confirmed and probable Lyme disease cases reported to Manitoba Health, Seniors and Active Living since 2015[15]

	Symptom	Frequency observed	Cases with symptoms	Total Cases
Common	Fatigue	67.0%	73	109
	Erythema migrans	60.5%	75	124
	Headache	57.1%	64	112
	Fever	55.5%	61	110
	Malaise	53.0%	53	100
	Myalgia	52.5%	53	101
Less Common	Sweats/ Chills	46.7%	49	105
	Generalized Weakness	45.9%	45	98
	Arthralgia	41.7%	45	108
	Stiff Neck	40.2%	41	102
	Recurrent Brief Joint Swelling	34.7%	34	98
	Anorexia	31.3%	31	99
	Nausea	20.2%	20	99
Uncommon	Cough	15.2%	15	99
	Bell's Palsy	11.9%	12	101
	Cardiac Symptoms	9.1%	9	99
	Lymphadenopathy	9.0%	9	100
	Anemia	3.1%	3	98
	LFT Elevation	3.1%	3	98
	Thrombocytopenia	2.0%	2	98

[14] Gasmi, S., Ogden, N. H., Lindsay, L. R. et al. **2017**. Surveillance for Lyme disease in Canada, 2009 to 2015. *Canadian Communicable Disease Report*, 43 (https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2017-43/ccdr-volume-43-10-october-5-2017/surveillance-surveillance-lyme-disease-canada-2009-2015.html).

[15] The clinical case report form changed in 2016 to query specific symptoms, and again in 2017 to include additional symptoms (i.e. anemia, thrombocytopenia and LFT elevation). Where queries were absent on the forms, the interpretation was treated as 'unknown' and not included in the denominator.

Discussion

Following their initial discovery by researchers from the University of Manitoba in 1989, extensive surveillance was undertaken to determine the extent of the BLT distribution in the province[16] [17]. Despite these early efforts that continued through the 1990s and early 2000s, no evidence of BLT establishment was detected. However, following an investigation into a cluster of human cases with a common exposure history, the first BLT risk area was identified in the extreme southeast corner of the province in 2006. Since then, and likely aided by changing climate[18], the number and distribution of BLT risk areas have continued to increase throughout Manitoba. These risk areas now extend north of Dauphin and as far west as the Saskatchewan border.

In 2017 approximately 98% of all *Ix. scapularis* specimens received via the passive surveillance program were collected from localities in Manitoba. Moreover, nearly 8 in 10 submissions were associated with previously known BLT risk areas. As in 2016, humans accounted for approximately 30% of the hosts associated with a submitted BLT, whereas dogs, historically the most common host, accounted for roughly 36%. In comparison, the proportion of BLTs received from dogs and human hosts in the 2010 passive surveillance program was approximately 59% and 14% respectively.

BLTs continue to be collected via the passive program, including the newly launched Tick-checker (see Appendix A for more information) in relatively steady numbers. Submissions of BLTs were received in two peaks, a larger one in October, and a smaller one in May/ June. The seasonality of BLT submissions or activity, aligns with trends seen elsewhere in Canada[19] [20] . In addition, approximately 75% of the nymphs collected via the passive program were collected between May and July. Although low in overall number the peak in

[16] Galloway, T. D. **1989**. Lyme disease vector, *Ixodes dammini*, identified in Manitoba. *Canada Diseases Weekly Report*, 15 (37): 185.
[17] Galloway, T. D., Christie, J. E., Sekla, L. and Stackiw, W. **1991**. Current status of the Lyme borreliosis vector, *Ixodes dammini*, in Manitoba. *Canada Diseases Weekly Report*, 17 (47): 259-260.
[18] Ogden, N. H., St- Onge, L., Barker, I. K., Brazeau, S., Bigras-Poulin, M., Charron, D. F., Francis, C. M., Heagy, A., Lindsay, L. R., Maarouf, A., Michel, P., Milord, F., O'Callaghan, C. J., Trudel, L., and Thompson, R. A.. **2008**. Risk Maps for Range Expansion of the Lyme disease Vector, *Ixodes scapularis*, in Canada Now and With Climate Change. *International Journal of Health Geographics*, 7 (24), https://doi.org/10.1186/1476-072X-7-24
[19] Nelder, M. P., Russell, C., Lindsay, L. R., Dhar, B., Patel, S. N., Johnson, S., Moore, S., Kristjanson, E., Li, Y. and Ralevski, F. **2014**. Population-Based Passive Tick Surveillance and Detection of Expanding Foci of Blacklegged Ticks *Ixodes scapularis* and the Lyme disease Agent *Borrelia burgdorferi* in Ontario, Canada. *PLoS One*, 9 (8): 1 – 12.
[20] Clow, K. M., Ogden, N. H., Lindsay, L. R., Russell, C. B., Michel, P., Pearl, D. L. and Jardine, C. M. **2018**. A field-based indicator for determining the likelihood of *Ixodes scapularis* establishment at sites in Ontario, Canada. *PLoS One*, 13 (2), 10.1371/journal.pone.0193524

nymph activity corresponds to the period of likely exposure of more than 8 in 10 tick-borne disease cases a trend observed again both locally and elsewhere[21].

As in previous seasons the MIR among BLT specimens received via the passive surveillance program for common pathogens of human health importance fluctuated. For example, the MIR for *B. burgdorferi* increased from 15.0% in 2016 to 16.7% in 2017, whereas the MIR for *A. phagocytophilum* and *B. microti* decreased from 5.0% to 4.0% and 4.1% to 1.5% respectively. The MIR was slightly less than the 19.1% and 18.1% observed in Ontario and Quebec respectively[22] [23], though the rates overall have hovered between 11.4% and 25.0% since 2008. Despite the lower MIR the distribution of infected ticks was again quite broad, with larger numbers found in the Interlake-Eastern and Southern Health – Santé Sud Health Regions. Further, the distribution of infected BLTs was typically associated with known BLT risk areas. A small number of BLT specimens were co-infected with more than one pathogen, with the most common combination being *B. burgdorferi* and *A. phagocytophilum*.

Extensive active surveillance efforts were undertaken in 2017, and 11 new BLT risk areas were identified. All but one of the newly identified risk areas was situated in western Manitoba, marking a further westward range expansion of BLTs. More than half of the new risk areas were not associated with previously identified region, though they all possessed suitable habitat for BLT establishment and survival.

In 2017 the *B. burgdorferi* MIR for BLTs collected via active surveillance in Manitoba was 41.3% (active). The elevated MIR, a considerable increase from 2016, was largely a function of the high numbers of BLTs processed from the Turtle Mountain Provincial Park area where more than half of the specimens were positive for *B. burgdorferi*. The provincial MIR associated with active surveillance is on par with those observed in 'hyper-endemic' regions of the US, such as New Jersey, Pennsylvania and Wisconsin where the rates often exceed 30

[21] Eisen, R. J., Kugeler K. J., Eisen, L., Beard, C. B. and Paddock, C. D. **2017**.Tick-Borne Zoonoses in the United States: Persistent and Emerging Threats to Human Health, *ILAR Journal*, https://doi.org/10.1093/ilar/ilx005

[22] Gasmi, S., Ogden, N. H., Leighton, P. A., Lindsay, L. R. and Thivierge, K. **2016**. Analysis of the human population bitten by *Ixodes scapularis* ticks in Quebec, Canada: Increasing risk of Lyme disease. *Ticks and Tick-borne Diseases*, 7: 1075-1081.

[23] Nelder, M. P., Russell, C., Lindsay, L. R., Dhar, B., Patel, S. N., Johnson, S., Moore, S., Kristjanson, E., Li, Y. and Ralevski, F. **2014**. Population-Based Passive Tick Surveillance and Detection of Expanding Foci of Blacklegged Ticks *Ixodes scapularis* and the Lyme disease Agent *Borrelia burgdorferi* in Ontario, Canada. *PLoS One*, 9 (8): 1 – 12.

or 40% [24] [25] [26]. However, the provincial MIR rates are still far lower than those observed in areas of New York's Hudson Valley where rates ranged from 45.7 to 65.0%[27]. Though the MIR detected via active surveillance in 2017 was high it should be cautioned that it fluctuates year to year based on a number of factors, including the extent of surveillance efforts and the length of tick establishment in the surveyed region (Turtle Mountain had been previously identified as a risk area in 2012).

The MIR for *A. phagocytophilum* in Manitoba was considerably higher than those observed in other Canadian jurisdictions, such as Ontario, where passive surveillance conducted between 2008 and 2012 showed that they never exceeded 0.50%[28]. Moreover, the MIR rates, approximately 4.0% and 14.3% for BLT collected via passive and active surveillance respectively, were similar to those observed in neighboring jurisdictions and in 'hyper endemic' regions in the US. For instance, passive surveillance in North Dakota revealed that approximately 8.5% of BLTs were positive for *A. phagocytophilum*[29]. Further, the MIRs in Wisconsin ranged between 3 and 9%, while in New York's Hudson Valley active surveillance revealed rates of 12.3%.

The burden of tick-borne diseases such as Anaplasmosis and Lyme disease continues to increase in Manitoba. In terms of Anaplasmosis, nearly 9 in 10 cases reported likely exposure within the province. Moreover, approximately 72% of the cases were recorded among individuals 40 years of age and older, with a median age of 57.0. This data aligns with a recent retrospective sero-survey conducted in Manitoba that demonstrated that Anaplasmosis is more common among older individuals (i.e. > 48 years of age)[30]. As seen

[24] Adelson, M. E., Rao, R. V. S., Tilton, R. C., Cabets, K., Eskow, E., Fein, L., . Occi, J. L. and Mordechai, E. **2004**. Prevalence of *Borrelia burgdorferi*, *Bartonella* spp., *Babesia microti* and *Anaplasma phagocytophila* in *Ixodes scapularis* Ticks Collected in Northern New Jersey. *Journal of Clinical Microbiology*, 42 (6): 2799 – 2801.

[25] Hutchinson, M. L., Strohecker, M. D., Simmons, T. W., Kyle, A. D. and Helwig, M. W. **2015**. Prevalence Rates of *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Babesia microti* in Host-Seeking *Ixodes scapularis* from Pennsylvania. *Journal of Medical Entomology*, 52 (4): 693-698.

[26] Lee, X., Coyle, D. R., Hoang Johnson, D. K., Murphy, M. W., McGeehin, M. A., Murphy, R. J., Raffa, K. A. and Paskewitz, S. M. **2014**. Prevalence of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* in *Ixodes scapularis* Nymphs collected in Managed Red Pine Forests in Wisconsin. *Journal of Medical Entomology*, 51 (3): 694-701.

[27] Prusinski, M. A., Kokas, J. E., Hukey, K. T., Kogut, S. J., Lee J. and Backenson, P. B. **2014**. Prevalence of *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Babesia microti* in *Ixodes scapularis* Collected from Recreational Lands in the Hudson Valley Region, New York State. *Journal of Medical Entomology*, 51 (1): 226-236.

[28] Nelder, M. P., Russell, C., Lindsay, L. R., Dhar, B., Patel, S. N., Johnson, S., Moore, S., Kristjanson, E., Li, Y. and Ralevski, F. **2014**. Population-Based Passive Tick Surveillance and Detection of Expanding Foci of Blacklegged Ticks *Ixodes scapularis* and the Lyme disease Agent *Borrelia burgdorferi* in Ontario, Canada. *PLoS One*, 9 (8): 1 – 12.

[29] Russart, N. M., Dougherty, M. W. and Vaughan, J. A. **2014**. Survey of Ticks (Acari: Ixodidae) and tick-borne pathogens in North Dakota. *Journal of Medical Entomology*, 51 (5): 1087-1090.

[30] Kadkhoda K and Gretchen A. **2016**. Retrospective Study Investigating the Seroprevalence of *Anaplasma phagocytophilum* in Manitoba, Canada: 2011–2014. *Open Forum Infectious Diseases*, 3(4):ofw199. https://academic.oup.com/ofid/article/3/4/ofw199/2343997 .

elsewhere, males accounted for more than 60% of the total case numbers. The study also showed that Anaplasmosis may be more prevalent than actually reported.

In 2017 both confirmed and probable Lyme disease cases and incidence rates decreased slightly. However, the overall trend of increasing disease burden in the province continued with the 2017 rates exceeding the previous five year average. Since, Lyme disease became nationally reportable in 2009 the case numbers and incidence rate increased from 5 and 0.4/100,000 to 43 and 3.2/ 100,000 in 2017, respectively. The Manitoba data mirrors the national trend where between 2009 and 2016 incidence rates rose from 0.4/100,000 to 2.7/ 100,000 and confirmed and probable Lyme disease cases have increased nearly seven-fold from 144 in 2009 to 992. The 2017 Manitoba incidence rate of 3.2 is closest to the 2.7 observed in Ontario (2016)[31]. Although the incidence of Lyme continues to increase it is far less than the national high of 34.4/ 100,000 recorded in Nova Scotia (2016) or the 23.6/ 100,000 recorded in Minnesota (2016).

Nearly 98% of the Lyme disease cases reported in 2017 had an exposure history within Manitoba. As with Anaplasmosis, males accounted for the majority of cases and the incidence rates were highest among individuals 60 years of age and older. The trend was similar in Ontario where the highest incidence rates were recorded among individuals in the 50 – 74 years of age range, and Nova Scotia where most cases were recorded among individuals between 50 and 69 years of age[32] [33]. Similarly the majority of cases (~ 83%) had likely exposure between May and July which aligns with the peak in nymph activity.

The proportion of Anaplasmosis and Lyme disease cases recalling a tick bite, since 2015, was approximately 42.1% provincially, fluctuating slightly at the Health Region level. The recall rates however, were much higher than those previously recorded in Nova Scotia (~ 26.4%) or the US (~ 14 – 16%). Common risk factors among tick-borne disease cases in the province included a history of exposure to suitable tick habitats (~88.3%) and a history of outdoor recreation (~58.4%). Occupational exposure was noted in 6.7% of tick-borne disease cases reported since 2015.

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[31] Gasmi, S., Ogden, N. H., Lindsay, L. R. et al. **2017**. Surveillance for Lyme disease in Canada, 2009 to 2015. *Canadian Communicable Disease Report*, 43 (https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2017-43/ccdr-volume-43-10-october-5-2017/surveillance-surveillance-lyme-disease-canada-2009-2015.html).

[32] Johnson, K. O., Nelder, M. P., Russell, C., Li, Y., Badiani, T., Sander, B., Sider, D. and Patel, S. N. **2018**. Clinical manifestations of reported Lyme disease cases in Ontario, Canada: 2005-2014. *PLoS One*, June 1, 2018 (https://doi.org/10.1371/journal.pone.0198509)

[33] Hatchette, T. F., Johnston, B. L., Schleihauf, E., Mask, A., Haldane, D., Drebot, M., Baikie, M., Cole, T. J., Fleming, S., Gould, R. and Lindsay, L. **2015**. Epidemiology of Lyme Disease, Nova Scotia, Canada, 2002 – 2013. *Emerging Infectious Diseases*, 21 (10): 1751 – 1758.

For Anaplasmosis, Fever was the most common symptom followed by a list of other non-specific symptoms. More specific laboratory findings, such as thrombocytopenia and LFT elevation were only noted in 27% of cases (though it should be cautioned that the sample size was quite small). For Lyme disease one of the most common symptoms was a physician observed Erythema migrans, although this was only noted in 60.5% of cases, less than the nearly 70% observed in Ontario, but closer to the 53.2% seen in Nova Scotia. Common Lyme disease symptoms reported among Manitoba cases were non-specific (i.e. fatigue, headache, fever, malaise and myalgia) and associated with early Lyme disease. Symptoms associated with early disseminated Lyme disease such as those with neurological and/ or cardiac involvement were recorded less often than those associated with late disseminated Lyme disease (i.e. recurrent brief joint swelling). The proportion of cases with symptoms of late disseminated Lyme disease were consistent with observations in Nova Scotia, but slightly less than in Ontario. Given the proportion of Lyme disease cases exhibiting symptoms of either early or late disseminated disease, continued efforts to raise awareness among health care providers and the public are required.

In Manitoba, as in Canada, the impact posed by TBDs, most notably Anaplasmosis and Lyme disease continue to increase. MHSAL continues to monitor and assess the distribution and establishment of BLT risk areas throughout the province. In addition, MHSAL monitors the infection rates of BLT specimens collected via passive and active surveillance for known and newly emerging pathogens of public health importance (i.e. *Borrelia miyamotoi*, *Borrelia mayonii* and Deer Tick virus). Information regarding the prevalence of human infections with TBD is reviewed to pinpoint trends and target health care provider specific messaging to affect clinical practice. Overall, MHSAL analyses tick and human disease data to provide members of the public with relevant information to encourage the adoption of personal protection measures to minimize their potential exposure to BLT, the first and primary line of defence against TBDs.