

# Tick Surveillance

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## 2021 Summary

June 2022

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## Summary

Tick surveillance can be passive (examining ticks that are voluntarily submitted by the public) or active (targeted collection of ticks in their natural habitat). Both methods are useful for monitoring changes to the risk from Lyme disease and other tick-borne diseases.

Both active and passive tick surveillance are carried out in Saskatchewan and provide useful information on tick activity in the province. Surveillance began in 1995 and active surveillance for *Ixodes scapularis* (the blacklegged tick) has been ongoing in Saskatchewan since 2009. The blacklegged tick is the primary carrier for the agents that cause Lyme disease and a number of other tick-borne diseases in Canada and the U.S. The active surveillance program has the objectives of assessing the risk of Lyme disease in the province by checking for blacklegged ticks and determining if they have become established in any areas of the province, and determining what fraction of them carry the bacteria responsible for Lyme disease or other tick-borne diseases such as anaplasmosis and babesiosis. Confirmed human cases of Lyme disease or other tick-borne diseases are also recorded. The risk of acquiring Lyme disease from infected ticks increases substantially in areas where the blacklegged tick has become established.

Blacklegged ticks submitted or collected through the surveillance program are tested for *Borrelia burgdorferi* (the agent that causes Lyme disease), *Anaplasma phagocytophilum* (the agent that causes anaplasmosis) and as of 2013, *Babesia microti* (the agent that causes babesiosis), *Borrelia miyamotoi* (the agent that causes relapsing fever) and *Borrelia mayonii*, a newly described organism that can cause Lyme disease.

The sampling locations for active tick surveillance are determined by a number of factors including: computer modelling to map habitats likely to sustain tick populations, information from the passive sampling program (such as where blacklegged ticks have been collected), and any known human or animal Lyme disease cases that can be tracked to a definitive location. Other factors that are considered in sample site selection include sampling in suitable habitat areas such as parks and recreational areas where there is a high level of interaction among people, pets, wildlife, and proximity to known risk areas in neighbouring jurisdictions.

A small number of blacklegged ticks have been found over past years of passive sampling, but no reproducing populations of ticks have been detected in any areas of the province despite several years of active sampling. This means that, at present, there are no known Lyme disease risk areas in the province. However, the possibility of blacklegged ticks being dropped by migrating birds exists across the province, and approximately 14 percent of these ticks are infected with the bacteria that causes Lyme disease. Thus, there is still a risk to humans of contracting Lyme disease from an infected tick in Saskatchewan, even in the absence of known risk areas. Furthermore, since adult blacklegged ticks are active in the spring and fall months, and nymphs are found in the late spring and summer, the risk of being bitten by an infected tick can exist for the entire spring, summer, and fall period.

## 2021 Tick Surveillance Summary

- In Saskatchewan, both passive surveillance (via voluntary submissions) and active surveillance are conducted to monitor tick activity in the province.
- The majority of ticks (about 96%) obtained through the surveillance programs are the American dog tick (*Dermacentor variabilis*), winter tick (*Dermacentor albipictus*) or the Rocky Mountain wood tick (*Dermacentor andersoni*). These species are not known to be competent vectors of Lyme disease.
- In 2021, 969 ticks were identified through voluntary submissions and 15 were blacklegged ticks. Nine out of 15 blacklegged ticks were submitted for pathogen testing; zero tested positive for the bacteria that causes Lyme disease.
- Since 2008, 34,939 ticks have been identified through voluntary submissions and 105 (0.3%) were blacklegged ticks. Of the 105 blacklegged ticks, 94 were mailed in for testing, and 13 (~14%) tested positive for the bacteria that causes Lyme disease. Eight of the tested ticks (~9%) were positive for the bacteria that causes anaplasmosis. Three ticks (~3%) were co-infected with both agents.
- Active tick surveys have increased in recent years. Since 2014, over 323 active surveys have been completed in the province; 63 surveys at 52 sites were completed in 2021.
- Through active surveys in 2021, 556 ticks were collected - all were American dog ticks.

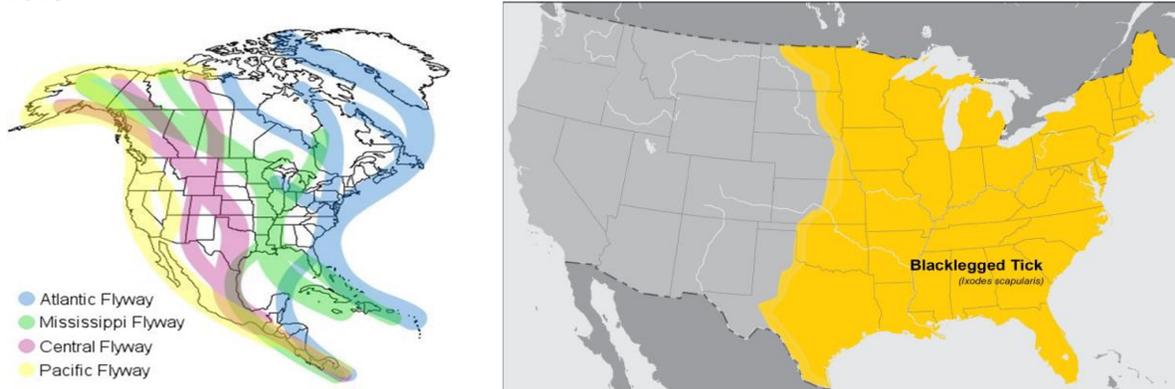
## Introduction

Lyme disease is caused by a bacterial infection transmitted to humans through the bite of certain types of ticks, most notably some species within the genus *Ixodes*. The range of the primary vector of Lyme disease in Canada, *Ixodes scapularis*, the blacklegged tick, has been rapidly expanding in Canada in recent years. This tick is now considered to be endemic to some localized areas of southern Ontario, Quebec, New Brunswick, Nova Scotia, and Manitoba. The risk of acquiring Lyme disease increases in areas where populations of infected blacklegged ticks are established. Another vector of Lyme disease, *Ixodes pacificus* or Western blacklegged tick, is established in areas of southern British Columbia<sup>1</sup>. Populations of blacklegged ticks are not known to be established in Saskatchewan at this time; however, small numbers of infected blacklegged ticks are transported into the province by birds migrating north. Several major flyways converge over Saskatchewan and can have birds that have picked up infected ticks from the midwestern and central states of the U.S. (Figure 1).

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<sup>1</sup> Henry B, Morshed M. Lyme disease in British Columbia: Are we really missing an epidemic? BC Med J. 2011; 53(5): 224-229

**Figure 1: North American Bird Flyways and Estimated Distribution of *Ixodes scapularis* – United States, 2018**



(Source: <https://www.michiganaudubon.org/bfc/safe-passage-great-lakes/> and [https://www.cdc.gov/ticks/geographic\\_distribution.html](https://www.cdc.gov/ticks/geographic_distribution.html))

The majority of ticks found in Saskatchewan are the American dog tick (*Dermacentor variabilis*). Other common species include the Rocky Mountain wood tick (*Dermacentor andersoni*) and the winter tick (*Dermacentor albipictus*). These species are not competent vectors of Lyme disease. A few ticks (~0.3%) are the blacklegged ticks; these are occasionally found in the southern and central part of the province. Since 2008, 105 blacklegged ticks have been detected in the province, and of the 94 ticks mailed in for testing, 13 (~14%) tested positive for *B. burgdorferi*, the bacteria that causes Lyme disease (Table 1). Blacklegged ticks may carry other organisms that cause human disease, including anaplasmosis and babesiosis. These diseases have not been documented in humans in Saskatchewan although, eight blacklegged ticks have tested positive for the bacteria that causes anaplasmosis.

### Determining Lyme Disease Risk

Monitoring for blacklegged ticks and the prevalence of infection with *Borrelia* spp. or other bacteria allows public health officials to assess the risk of human exposure to infected ticks in a given area. A Lyme disease risk area is defined as a location in which there is:

- evidence of established (reproducing) populations of blacklegged ticks. This is indicated by the presence of all three life-cycle stages (larva, nymph, adult) in an area, found over more than one year; and
- likely transmission of *B. burgdorferi*. This is demonstrated by laboratory testing (molecular detection or culture) of *B. burgdorferi* in ticks and/or rodent samples.

The following methods are used to determine risk areas in Saskatchewan:

1. drag sampling for ticks<sup>2</sup>; and
2. field-validated signals from passive tick surveillance<sup>3</sup>.

The risk can increase substantially in areas where infected tick populations become established. Tick abundance and infection rates for the bacteria that cause Lyme disease can be much higher and more localized in established areas than in non-established areas<sup>4</sup>.

<sup>2</sup> Ogden NH, Koffi JK, Pelcat Y, Lindsay LR. Environmental risk from Lyme disease in central and eastern Canada: a summary of recent surveillance information. *Can Comm Dis Rep* 2014; 40: 74-82

<sup>3</sup> Koffi JK, Leighton PA, Pelcat Y et al. Passive surveillance for *Ixodes scapularis* ticks: enhanced analysis for early detection of emerging Lyme disease risk. *J Med Entomol* 2012; 49: 400-409

<sup>4</sup> Lindsay LR (National Microbiology Laboratory)(Personal communication)

Lyme disease risk areas identified in Canada are summarized at: <https://www.canada.ca/en/public-health/services/diseases/lyme-disease/surveillance-lyme-disease.html>. Relevant provincial and territorial websites can be found at the following link: <https://www.canada.ca/en/public-health/services/diseases/lyme-disease.html#a5>

In order to maximize the probability of finding any risk areas (i.e. sites with established blacklegged tick populations) in Saskatchewan, the active surveillance program prioritizes the locations with the highest likelihood of supporting an established tick population. If such populations were found, this would be the first Lyme disease risk area known in Saskatchewan.

Several sources of information are used in determining these priority locations for active tick surveillance. These information sources include computer models, information from the passive surveillance program, any known human or animal cases of Lyme disease, and information from other nearby jurisdictions with known tick populations.

### **Tick Surveillance in Saskatchewan**

The Ministry of Health (Population Health Branch) has collaborated since 1995 with the Roy Romanow Provincial Laboratory (RRPL), the Public Health Agency of Canada - National Microbiology Laboratory (NML), and, since 2009, the University of Saskatchewan (U of S) to monitor ticks in the province. From 2016 to 2021, the Saskatchewan Health Authority (SHA), Regina office, assisted with the spring and fall surveys of ticks in southeastern Saskatchewan.

The goal of the Tick Surveillance Program is to assess the risk of acquiring Lyme disease and other tick-borne disease by determining whether the vector is present and/or established in Saskatchewan. Tick surveillance can determine the distribution and level of establishment of tick populations, specifically blacklegged tick populations within an area, monitor the infection prevalence, and assess the possible risk of infection to humans. The status of blacklegged tick populations in an area are classified as one of:

- established – field surveillance confirms that reproducing populations occur;
- adventitious – ticks are found only sporadically, both in time and space, and usually only a single stage of tick (i.e. adult females) is present; or,
- not Present – ticks have not been found in an area after surveys have been conducted to assess the level of establishment.

Tick surveillance can be passive (examining ticks or photographs of ticks voluntarily submitted by the public) or active (targeted collection of ticks in their natural habitat). Both methods are useful for monitoring changes to the risk from Lyme disease or other tick-borne diseases.

### **Passive Surveillance**

The objectives of passive tick surveillance are to assess potential risk of Lyme disease across the province and to provide input to the active surveillance program regarding when and where to sample for ticks.

## Methods

From 2009-2019, ticks were voluntarily submitted by veterinarians, health care workers, the general public, and other interested parties to the RRPL and the U of S for sorting and identification. In 2020, eTick was implemented, and has since become the primary platform for passive tick surveillance in the province. Through eTick, individuals submitted photographs of ticks they encounter. Researchers at the U of S identified ticks and requested all blacklegged ticks by mail for testing. All mailed-in blacklegged ticks were tested for *B. burgdorferi* at the U of S. Blacklegged ticks were also tested for *Borrelia mayonii*, *Anaplasma phagocytophilum*, *Babesia microti* and *Borrelia miyamotoi* at the NML or U of S.

More information on eTick can be found at the Government of Saskatchewan website or [www.eTick.ca](http://www.eTick.ca). Passive surveillance is recommended for jurisdictions, such as Saskatchewan, where established populations do not exist. It is found to be less useful in areas where there are known established tick populations<sup>5</sup>.

## Active Surveillance

The objective of active surveillance is to detect the location of any established blacklegged tick populations and to identify Lyme disease risk areas (if any) in the province. Active surveillance uses targeted surveys to look for blacklegged ticks in locations where other information (passive surveillance, human cases, and suitable habitat) suggest the possibility of tick populations occurring. In order to establish baseline information on tick populations, an important goal of active surveillance is to repeatedly sample many of the same sites every year and conduct seasonal sampling (i.e. spring or fall) at other sites.

## Methods

Adult blacklegged ticks are active in the spring and fall months, while nymphs are found in the spring and summer months. To detect these ticks during the season, active tick surveillance by drag sampling was done by staff from the SHA. Training in tick surveillance techniques and tick identification has been provided by the U of S and Phil Curry, project coordinator contracted with the SHA.

Drag sampling consists of dragging a white flannel cloth over and around vegetation where ticks may be present. The cloth is 1 m<sup>2</sup> and is attached to a 1.2 m wooden dowel, with a cord or rope used to pull the drag cloth (Fig. 2).

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<sup>5</sup> Koffi JK, Leighton PA, Pelcat Y et al. Passive surveillance for *Ixodes scapularis* ticks: enhanced analysis for early detection of emerging Lyme disease risk. J Med Entomol 2012; 49: 400-409

**Figure 2: Tick Surveillance Using a Drag**



*(Photo courtesy of Phil Curry)*

To be consistent with sampling methods in other provinces, a standard 2 km survey per site has been adopted in Saskatchewan<sup>6</sup>. The survey consists of collecting and recording ticks every 10 m, for a total of 200 times (total distance of 2000 m or 2 km). Because the drag cloth is 1 m<sup>2</sup>, the total area sampled per site will be 2000 m<sup>2</sup> or 0.2 hectare. For the spring and fall surveys, the distance travelled was often more than 2 km. A minimum of two hours of sample effort by the surveyors was completed at each site which allowed for a greater distance to be travelled.

Canadian Lyme Disease Research Network (CLyDRN) sampling is conducted by drag sampling along two 1000 m transects (total 2000 m<sup>2</sup> or 2 km) in suitable tick habitat. Tick samples are collected every 25 m and an in-depth analysis is conducted of the ecological factors that support the establishment of a tick population. Measurements include: weather during collection, latitude/longitude coordinates at each sample point, temperature, forest and understory vegetation types, litter depth, soil humidity and percent canopy cover. There are usually four people involved in a CLyDRN survey, two surveyors and two observers recording the data.

During the surveys, “flagging” was done at a few of the individual survey points where the bush was too thick to allow for dragging. Dragging was done by dragging the white cloth over relatively open ground, whereas “flagging” (i.e., moving the cloth in a waving motion over and through vegetation) was usually done in densely brushy ground. With flagging, the end of the drag cloth can be gripped at one end so that the cloth hangs vertically downwards, and the device used to flag vegetation. Ticks that are questing for passing hosts cling to the cloth and can be removed for identification and counting.

Ticks were removed from the drag cloth (and from the clothing of the sampler) with fine forceps and numbers and species taken from the drag cloth were recorded. All male or female adult ticks and nymphs of any species from CLyDRN sites were placed into collection vials for identification. For all other sites, only adult blacklegged ticks and nymphs were collected and placed in vials for identification and testing.

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<sup>6</sup> Rochon K (University of Manitoba) (Personal Communication)

Drag or flag sampling is usually done in the late morning or early afternoon and is not effective when it is raining, when the vegetation is wet (from rain or dew), or when temperatures are less than 4°C.

## Site Selection

Sites for active sampling included provincial parks, provincial recreation/historic sites and ecological reserves, national historic sites, regional parks, urban parkways, sites where blacklegged ticks have been collected by passive surveillance, as well as sites of ‘most likely exposure’ for human or domestic animal Lyme disease cases. Sites also included those tested annually or several times per year as “sentinel” sites along the Upper Assiniboine, Qu’Appelle and Souris River watersheds, which are tributaries to the larger Assiniboine River watershed in southern Manitoba where established populations of blacklegged ticks have been found.

Potential risk areas for the establishment of blacklegged ticks have been identified through development of a risk model for the Prairie Provinces (Appendix A – Figure 5). This model integrates temperature, habitat as a combined geo-layer of forest cover and agricultural land use, and rainfall to produce a risk map for Saskatchewan, Manitoba and Alberta. The map identifies low to high potential (risk index 0-5) for *I. scapularis*, and has helped to further guide active tick surveillance in Saskatchewan (Appendix A – Figure 5). Of the 64.6 million hectares of habitat classified in Saskatchewan, 1,463,322 ha have been classified as having some risk for establishment of the blacklegged tick, with 181,984 ha classified as having a high risk potential (risk category 4-5) for establishment of blacklegged ticks<sup>7</sup>. All active tick surveys are conducted in high risk areas.

Included in the active surveys for 2021 were eight Canadian Lyme Disease Research Network (CLyDRN) sites in Saskatchewan. A more detailed summary of the site selection criteria is included in Appendix A.

## Surveillance Results

### Passive Surveillance

In 2021, 969 ticks were identified through the passive surveillance program and 15 (1.5%) were adult blacklegged ticks (Table 1). Of the 15 blacklegged ticks, nine were mailed in for pathogen testing and of these, zero tested positive for the Lyme disease agent, *B. burgdorferi*. Two blacklegged ticks were collected from humans and 13 from dogs.

There was no significant change in blacklegged ticks collected or positive test results from 2008-2016 (Av. 1 positive tick/yr.; range 0-2). In 2017, however, the numbers collected and numbers that tested positive increased to 15 and four, respectively (Table 1). In 2018 and 2019, fewer blacklegged ticks were collected; however, in 2018 two of six tested positive while in 2019 zero ticks tested positive. Compared to 2018 and 2019, blacklegged tick submissions increased in 2020 and 2021. It is unclear whether this represents an actual increase in tick numbers or is a result of increased awareness by the public to submit blacklegged ticks. A higher number (3 of 7 blacklegged ticks) tested positive for *B. burgdorferi* in 2020 while in 2021, none of the tested ticks were positive.

Over the last 14 years (2008-2021), 34,939 ticks were collected and of these 105 (~0.3%) were blacklegged ticks. Of the 94 blacklegged ticks mailed in for pathogen testing, 13 (~14%) were infected with *B. burgdorferi* and eight (~9%) were infected with *A. phagocytophilum*. Three ticks (~3%) were co-infected with both agents (Table 1).

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<sup>7</sup> Saskatchewan Ministry of Health, unpublished data

**Table 1: Number of Ticks Collected, Blacklegged Ticks and Ticks Positive for *Borrelia burgdorferi* and *Anaplasma phagocytophilum* (2008-2021)**

Year	Ticks					
	Ticks (all species)	Blacklegged ticks	Blacklegged ticks positive for <i>Borrelia burgdorferi</i> <sup>1</sup>	Blacklegged ticks positive for <i>Anaplasma phagocytophilum</i> <sup>2</sup>	Blacklegged ticks co-infected with both <i>Borrelia</i> and <i>Anaplasma</i>	Total Blacklegged ticks positive
2008	N/A	5	0	1	0	1
2009	1,478	5	1	1	1	1
2010	1,139	3	0	0	0	0
2011	736	3	1	0	0	1
2012	2,896	1	0	0	0	0
2013	1,726	10	1	2	1	2
2014	3,176	5	0	0	0	0
2015	5,103	9	1	1	1	1
2016	5,300	9	0	0	0	0
2017	5,112	15	4	0	0	4
2018	2,233	6	2	0	0	2
2019	2,393	7 <sup>3</sup>	0	0	0	0
2020	2,678	12 <sup>4</sup>	3	1	0	4
2021	969	15 <sup>5</sup>	0	2	0	2
<b>Total</b>	<b>34,939</b>	<b>105</b>	<b>13</b>	<b>8</b>	<b>3</b>	<b>18</b>

Notes:

<sup>1</sup>*Borrelia burgdorferi* is the bacteria that causes Lyme disease.

<sup>2</sup>*Anaplasma phagocytophilum* is the bacteria that causes anaplasmosis, an illness with symptoms that can range from fever, muscle pain, head ache to severe symptoms such as difficulty breathing, hemorrhage, renal failure or neurological problems that can be fatal.

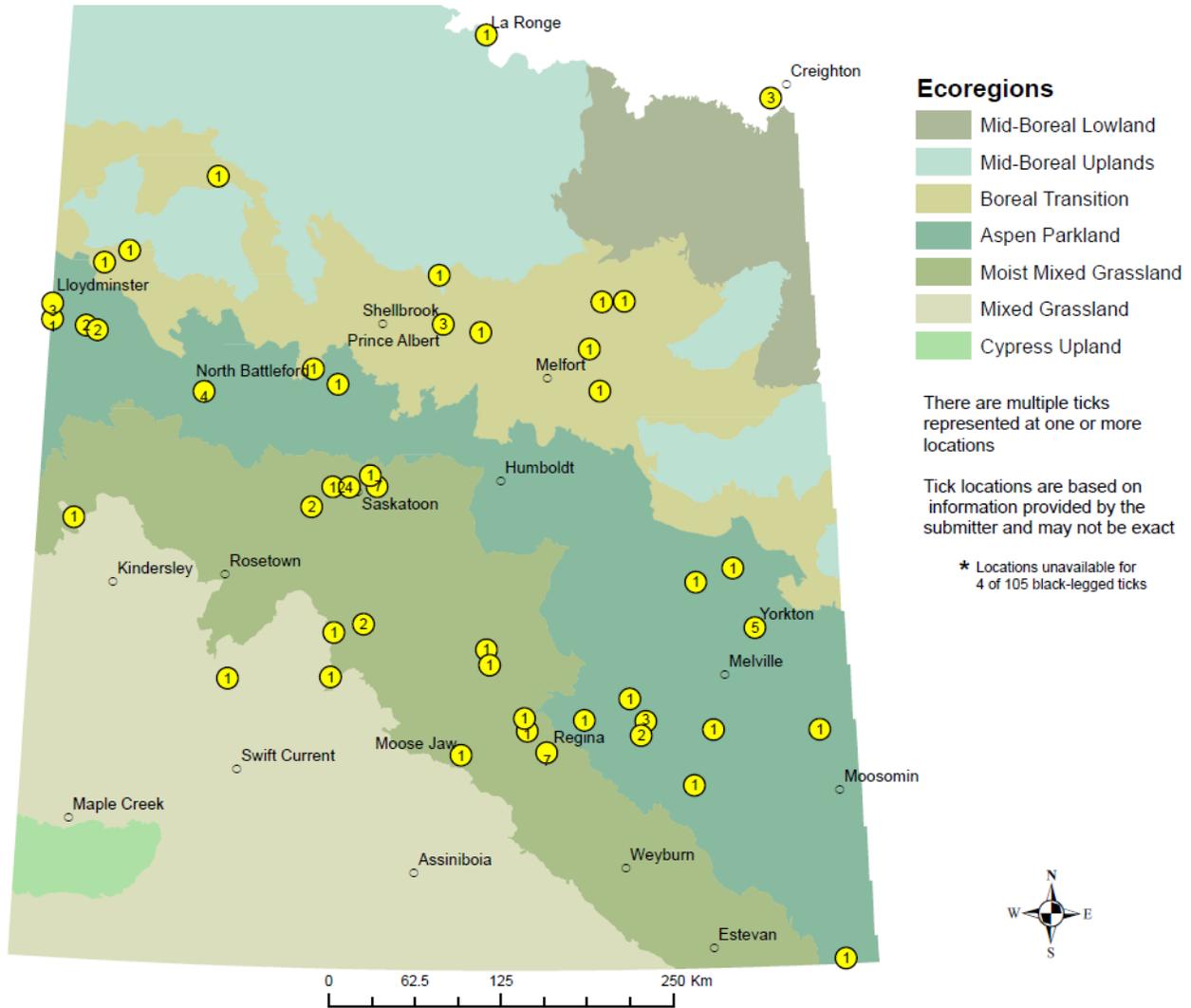
<sup>3</sup>One blacklegged tick tested positive for *Borrelia miyamotoi*.

<sup>4</sup>Of the 12, only seven blacklegged ticks were mailed in for pathogen testing. All seven ticks tested negative for *Borrelia miyamotoi*, *Borrelia mayonii*, and *Babesia microti*.

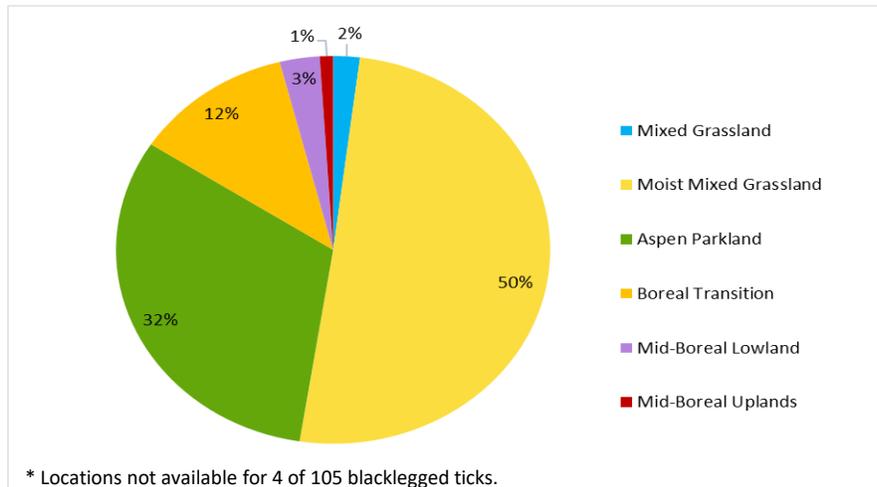
<sup>5</sup>Nine out of 15 blacklegged ticks were mailed in for pathogen testing. Blacklegged ticks were not tested for *Borrelia miyamotoi*, *Borrelia mayonii*, and *Babesia microti* in 2021.

Blacklegged ticks have been collected throughout the province but predominantly in the moister and more wooded moist mixed-grass prairie, aspen parkland and boreal transition areas (Figure 3). Only six percent have been found in the drier and less wooded mixed grassland and mid-boreal ecoregions (Figure 4).

**Figure 3: Blacklegged Tick Locations in Saskatchewan 2008-2021 (N=101)\***



**Figure 4: Percent Blacklegged Ticks by Ecoregion in Saskatchewan 2008-2021 (N=101)\***



## Active Surveillance

### Results

**Spring surveys** – During the spring and early summer period, 30 surveys were completed in suitable tick habitat (Table 2). Eight CLyDRN sites were surveyed in the spring in cooperation with staff and students from the U of S. Conditions were dry and mainly sunny at all but two sites (Fort Esperance and Fort Livingstone) and these were re-sampled one week later. Scattered rain from thunderstorms did occur during the first week of June.

Sampling was done during the late morning-early afternoon period when conditions were generally favourable for tick activity (i.e. dry, sunny or partly overcast, low winds). Temperatures during the spring sampling period were generally warm and ranged from 9 – 34°C (mean 19°C).

In the spring surveys, 556 ticks were collected (277 females, 248 males, 31 nymphs) and all were the American dog tick (*Dermacentor variabilis*). Numbers were down substantially from 2020 when 1,746 American dog ticks were collected.

**Fall surveys** – In the fall of 2021, 33 surveys were completed in southeastern and east central Saskatchewan (Table 2). The fall survey program began on September 22, 2021 and the last survey was completed on November 9, 2021.

Sampling was done during the early afternoon period when temperatures warmed up enough to stimulate tick activity. Temperatures, particularly in September and October, were warm and dry throughout the fall period (av. 14.7° C; range 6 - 24° C). Colder temperatures and scattered rain/snow showers briefly delayed the surveys for one week from October 21 to October 28. Surveys continued into early November and ceased when cool, wet weather occurred throughout the province. The last survey for the season was completed on November 9, 2021.

There were no black-legged ticks collected in any of the spring or fall surveys.

**Table 2: Active surveys completed in Saskatchewan (2021) – “S-F” indicates spring or fall sampling at the same site, CLyDRN sites are indicated.**

Tick Sampling Locations and Sites 2021	Date	Latitude	Longitude	Females	Males	Nymphs	Total
<b>Provincial Parks</b>							
Buffalo Pound	2021-05-31	50.583300	-105.415800	24	20	5	49
Crooked Lake S	2021-06-08	50.596030	-102.658183	23	21	1	45
Crooked Lake F	2021-09-28	50.596030	-102.658183	0	0	0	0
Duck Mountain	2021-06-23	51.637862	-101.637882	14	10	0	24
Echo Valley S	2021-06-08	50.793290	-103.894600	39	40	2	81
Echo Valley F	2021-09-21	50.793290	-103.894600	0	0	0	0
Good Spirit – CLyDRN	2021-06-17	51.527303	-102.697369	10	5	0	15
Moose Mountain S	2021-05-19	49.824480	-102.345650	8	16	4	28
Moose Mountain F	2021-09-22	49.824480	-102.345650	0	0	0	0
Greenwater Lake	2021-09-24	52.497258	-103.495230	0	0	0	0
Fort Carlton	2021-06-30	52.869790	-106.527321	3	1	0	4
Pike Lake (East) S - CLyDRN	2021-05-31	51.910214	-106.827419	33	19	0	52
Pike Lake (West) F	2021-09-29	51.888543	-106.812701	0	0	0	0
<b>Recreation/Historic Sites and Ecological Reserves</b>							
Bird's Point (Round Lake) S	2021-06-25	50.536900	-102.334999	2	2	0	4
Bird's Point (Round Lake) F	2021-10-05	50.536900	-102.334999	0	0	0	0
Wascana Trails – CLyDRN	2021-06-22	50.560507	-104.842561	1	0	0	1
Cannington Manor	2021-09-22	49.733299	-102.016701	0	0	0	0
Wood Mountain Prov. Historic Site	2021-06-23	49.288201	-106.393973	8	9	0	17
White Butte Trails - CLyDRN	2021-06-29	50.462611	-104.380674	1	0	0	1
Saskatchewan River Forks	2021-10-16	53.233258	-105.086155	0	0	0	0
Buffalo Pound – Upper Qu'Appelle Natural Area	2021-11-09	50.719675	-105.593905	0	0	0	0
Fairy Hill	2021-06-22	50.777305	-104.615159	9	5	0	14
<b>Regional Parks</b>							
Carlton Trail S	2021-06-23	50.675180	-101.694870	4	3	0	7
Carlton Trail F	2021-09-30	50.675180	-101.694870	0	0	0	0
Melville	2021-10-07	50.937075	-102.795862	0	0	0	0
Esterhazy S	2021-06-24	50.659440	-102.066380	3	3	0	6
Esterhazy F	2021-10-01	50.659440	-102.066380	0	0	0	0
Lady Lake	2021-10-19	51.976280	-102.635360	0	0	0	0
Moosomin	2021-10-06	50.076320	-101.707520	0	0	0	0
Saltcoats	2021-09-23	51.032220	-102.152770	0	0	0	0
Welwyn (Rocanville)	2021-06-15	50.339490	-101.522740	12	8	4	24
Whitesand	2021-09-23	51.491600	-102.894070	0	0	0	0
Outlook and District	2021-06-09	51.485192	-107.066567	1	1	2	4
Woodlawn (Estevan)	2021-06-10	49.114750	-102.985560	3	0	0	3
Table Mountain (west of Battleford)	2021-10-05	52.815262	-108.603781	0	0	0	0
<b>Urban Parks</b>							
Beaver Creek Cons. Area (Saskatoon - MVA) – CLyDRN	2021-06-02	51.980126	-106.706103	24	21	0	45
Chief Whitecap Park (Saskatoon- MVA) – CLyDRN	2021-06-01	52.069434	-106.725321	0	1	0	1
Gabriel Dumont Park (Saskatoon - MVA)	2021-06-24	52.112571	-106.677457	1	0	0	1
Cosmopolitan Park (Saskatoon - MVA)	2021-06-24	52.128976	-106.647435	0	0	0	0
Kershaw/Varley Parks (Saskatoon)	2021-10-17	52.141665	-106.550146	0	0	0	0
Lakewood Park (Saskatoon)	2021-11-04	52.106000	-106.585138	0	0	0	0
SW Dog Park (Saskatoon)	2021-11-04	52.100656	-106.741990	0	0	0	0
Kingsway Ecol. Zone (Moose Jaw - WVA)	2021-05-18	50.371726	-105.551379	2	4	0	6
Wellesley Park (Moose Jaw - WVA)	2021-09-23	50.377850	-105.534697	0	0	0	0
Connor Park (Moose Jaw - WVA)	2021-11-05	50.368574	-105.554740	0	0	0	0
Little Red River Park (Prince Albert)	2021-10-16	53.219796	-105.711464	0	0	0	0
Logan Green (Yorkton) – CLyDRN	2021-06-18	51.196040	-102.461090	4	1	0	5
Ravine Ecological Reserve (Yorkton)	2021-10-18	51.207790	-102.494369	0	0	0	0
Finlayson Island (Battleford)	2021-10-05	52.742025	-108.285271	0	0	0	0
Wellington Park (Manitou Beach)	2021-07-02	51.717970	-105.434360	1	0	0	1
<b>National Historic Sites</b>							
Fort Esperance S	2021-06-09; 2021-06-16	50.492222	-101.577500	14	18	10	42
Fort Esperance F	2021-09-29	50.492222	-101.577500	0	0	0	0
Fort Livingstone S	2021-06-10; 2021-06-16	51.902629	-101.957103	5	7	3	15
Fort Livingstone F	2021-10-20	51.902629	-101.957103	0	0	0	0
Batoche	2021-10-28	52.708950	-106.099486	0	0	0	0
<b>Community Pastures</b>							
Spy Hill-Elllice-Archie North (2) S-F	2021-10-29	50.579972	-101.596174	0	0	0	0
<b>Other:</b>							
Strawberry Hills – CLyDRN	2021-06-04	52.194506	-106.379856	28	33	0	61
Strawberry Hills North	2021-10-06	52.194506	-106.379856	0	0	0	0
Stushnoff West	2021-10-21	50.623935	-103.832355	0	0	0	0
Taylor Beach – Katepwa Lake	2021-10-29	50.695958	-103.655700	0	0	0	0
Prince Albert – 21 <sup>st</sup> Street	2021-10-16	53.194429	-102.078314	0	0	0	0
				277	248	31	556

**Weather during the spring and fall sampling period** – Weather conditions at the start of the 2021 season were cooler and drier than normal during April and May. Soil moisture levels were already dropping during the previous summer and fall, and the winter snow-pack was not enough to replenish spring moisture levels. The cool, dry conditions in the spring were followed by extremely hot, dry weather in June and July. Soil moisture levels continued to drop resulting in low relative humidity levels on the ground and in the surrounding vegetation. These conditions, in turn, affect tick activity at all active stages (larvae, nymph and adult) and their ability to seek hosts for a blood meal. In addition, the dry conditions can lead to excessive egg desiccation and mortality, which can set back the next couple of generations. Showers and slightly cooler temperatures occurred in south central and south eastern areas in August, before warmer and drier conditions returned in September and October. Temperatures in north eastern and east central areas were quite warm, 2 to 4° C above normal (Table 3). A summary of the mean monthly temperatures for southern and central Saskatchewan during the tick season is provided in Table 3.

Tick species such as *Ixodes scapularis* and *Dermacentor variabilis* require relatively moist and humid conditions to grow. Four successive years of dry spring conditions (2017-2021) may deter the establishment and maintenance of these tick species. While data from spring surveys at three provincial parks indicated a decline in *Dermacentor variabilis* numbers between 2014 and 2019 at two of the parks (Echo Valley and Buffalo Pound), in 2020, higher tick numbers were detected in both parks. In 2021, numbers increased slightly at Echo Valley Park, but decreased at Buffalo Pound (Table 4). Numbers increased during the four year period 2017-2020 at Moose Mountain Provincial Park, however, in 2021, of the three parks, the lowest number of ticks were detected at this park. The number of ticks collected at each of the three parks fluctuate year to year and there is insufficient data at this stage to conclusively determine a trend. Additional long-term surveys at multiple sites are required to see if this trend to lower numbers during dry conditions is actually occurring.

**Table 3: Mean Monthly Temperatures - Difference from Normal – Southern Saskatchewan 2021**

Month	Difference from normal
May	0 to -2°C
June	+2 to +3°C
July	+2 to +3°C
August	0 to -2°C
September	0 to +2°C; +2 to +4°C <sup>1</sup>
October	0 to +2°C; +2 to +4°C <sup>1</sup>
November	0 to +2°C; +2 to +3°C <sup>2</sup>

<sup>1</sup> East central and north east Saskatchewan

<sup>2</sup> Southern Saskatchewan

(Source: Canadian Drought Monitor. Agriculture Canada)

**Table 4: Total *Dermacentor variabilis* numbers from spring surveys at three provincial parks 2014-15 and 2017-21**

Location	2014	2015	2017	2018	2019	2020	2021
Echo Valley Prov. Park	214	509	42	67	35	79	81
Moose Mountain Prov. Park	121	57	38	53	137	110	28
Buffalo Pound Prov. Park	106	242	57	-	14	107	49

**Habitat quality** – Most survey sites were located in areas with high potential risk for blacklegged tick establishment – classes 4-5 (**Appendix A – Figure 5**). Habitat quality was rated as excellent at most sites and ranged from brushy sites with high grass along walking or game trails, picnic sites in wooded areas to wooded understory vegetation in undisturbed poplar, Manitoba maple, ash and oak bluffs. Special attention for sampling was focused along hiking and biking trails in or near urban areas (**Figures 6 – 9**). Other areas of focus included game trails, deer bedding areas, and woodpiles which provide good habitat for small rodents. Habitat quality was more limited at two smaller sites, one site in an urban backyard and vacant lot in Prince Albert where a blacklegged tick had been found, and at Cannington Manor, a small provincial historic site in south east Saskatchewan.

Habitat quality and suitability also varied depending on location in the watershed and the amount of precipitation received. Sites further south and west along the upper Qu’Appelle River and its tributaries, Wascana Creek and the Moose Jaw River, were drier and dominated by mixed grass and shrub vegetation. Although these areas contained suitable habitat, shrub and treed areas were characteristically shorter and confined to narrower strips along the river and creek areas (**Figure 10**). Conversely, sites along the eastern sections of Qu’Appelle River valley and in the aspen parkland and boreal transition areas were moister with larger tracts of aspen, Manitoba maple, ash, and bur oak predominating and with deeper litter layers.

### Next Steps

In 2022, passive surveillance will continue with submissions primarily received through eTick, the digital image-based tick identification platform. The goals for active surveillance include intensive sampling in aspen parkland habitat in southeast and east central Saskatchewan, close to the Manitoba border, where established blacklegged tick populations have been detected in Manitoba (**Appendix A – Figure 5**). These sites are in the Upper Assiniboine and Qu’Appelle River watersheds near the communities of Esterhazy, Rocanville, Kamsack, Sturgis and Yorkton. The nine “sentinel” sites along the Qu’Appelle and Upper Assiniboine Rivers that were sampled in previous years will be re-sampled in the spring and fall of 2022. These sites include: Echo Valley, Moose Mountain, Crooked Lake and Pike Lake Provincial Parks, Bird’s Point Ecological Reserve, Fort Esperance and Fort Livingstone National Historic Sites, Esterhazy and Carlton Trail Regional Parks, and Spy Hill-Ellice-Archie Community Pasture<sup>8</sup>. An increased number of surveys will be completed in urban parks, ecological reserves and recreation areas in and near large urban areas. Spring surveys at CLYDRN sites will continue at sites near Saskatoon, Regina and Yorkton with surveys starting in late April or early May to coincide with the earlier emergence of the blacklegged tick from winter dormancy<sup>9</sup>.

<sup>8</sup> The Spy Hill-Ellice-Archie Community Pasture is a large pasture (1,510 km<sup>2</sup>) that straddles the Saskatchewan/Manitoba border and is bounded by the Assiniboine River to the east and the Qu’Appelle River to the south. It contains a large amount of habitat of high risk for blacklegged tick establishment.

<sup>9</sup> Black-legged ticks survive the winter by becoming dormant and hiding in leaf litter or by attaching to a host. They emerge approximately two weeks earlier than the American dog tick and can become active in warm, sunny locations when the temperatures exceed 4°C.

## **Conclusion**

The Saskatchewan Tick Surveillance Program has grown in recent years. Communication enhancements and the implementation of eTick have resulted in an increase in voluntary submissions from veterinarians, health care workers and the general public. Through active surveillance, over 323 active surveys have been completed in the province since 2014. In spite of this increased effort, no known blacklegged tick populations have been detected in Saskatchewan. However, 105 blacklegged ticks have been collected through the passive surveillance system since 2008 and a number of these have been infected with the agents that cause Lyme disease and human granulocytic anaplasmosis. These ticks have most likely been brought into the province through human travels and from migratory birds.

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## Appendix A

### Site Selection for Active Surveillance

In Saskatchewan, active tick surveillance efforts are prioritized based on a number of criteria including:

- sites where blacklegged ticks have been detected through the passive surveillance program;
- sites of most likely exposure for human or domestic animal cases;
- sites in suitable habitat areas where climate models have predicted the establishment of the blacklegged ticks<sup>10 11 12</sup> (Figure 5). These models suggest that areas in southern Saskatchewan, and in particular southeastern Saskatchewan, are suitable for the potential establishment of this tick. Areas include wooded riparian and lake edges in river valleys, aspen poplar bluffs, and fragmented forested uplands (i.e. Moose Mountain Provincial Park, Duck Mountain Provincial Park) because of their potentially more hospitable habitat and abundance of host species (i.e. small rodents, rabbits, birds, deer). In addition, this region of the province is in close proximity to areas of southern Manitoba where established populations of the blacklegged tick have been detected<sup>13</sup>; and,
- suitable habitat sites where there is a high degree of interaction among people, domestic animals, and wildlife. These include provincial parks, ecological reserves, recreation and historic sites, national historic sites, urban parks, regional parks, private campgrounds and resort developments.

Included in the active surveys for 2021 were eight CLyDRN sites in Saskatchewan. A project pillar of Canada's National Lyme Disease Strategy, CLyDRN's goal is to establish a national network of sentinel regions allowing a standardized approach to observe the changing Lyme disease risk across Canada. This, in turn will serve as a platform to integrate environmental and epidemiological risk data for each region and across Canada. Located near the cities of Saskatoon, Regina and Yorkton, CLyDRN tick surveillance sites will provide detailed and standardized collection of data on tick distribution and abundance in Saskatchewan and will provide baseline information on current and future Lyme disease risk as the vector and disease becomes established in the province.

Key outcomes of the Lyme Sentinel Network include:

- 1) the first standardized, national, real-time portrait of Lyme disease risk across Canada,
- 2) new capacity to detect/monitor Lyme disease risk factors, and
- 3) a novel integrated structure to assess how risk and risk factors are changing along the continuum of disease emergence across the country.

Active surveillance for the blacklegged tick has been conducted in the province since 2008 and the number of surveys was increased in 2014. Surveillance has continued at several sites that were systematically surveyed as part of a province-wide surveillance project over a 5-year period (2013-2017)<sup>14</sup> and at additional sites identified through a pilot project for surveys in the southeast and east central regions conducted yearly from 2016 – 2021.

It is important to note that reproducing or established blacklegged tick populations have not been detected in Saskatchewan. In order to establish baseline information on tick populations, an important goal of active surveillance is to do repeated sampling at many of the same sites every year, and seasonal sampling (i.e. spring or fall) at other sites.

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<sup>10</sup> Ogden NH, Maarouf A, Barker IK et al. Projections for range expansion of the Lyme disease vector *Ixodes scapularis*, in response to climate change. Int J Parasitol. 2006. 36: 63-70

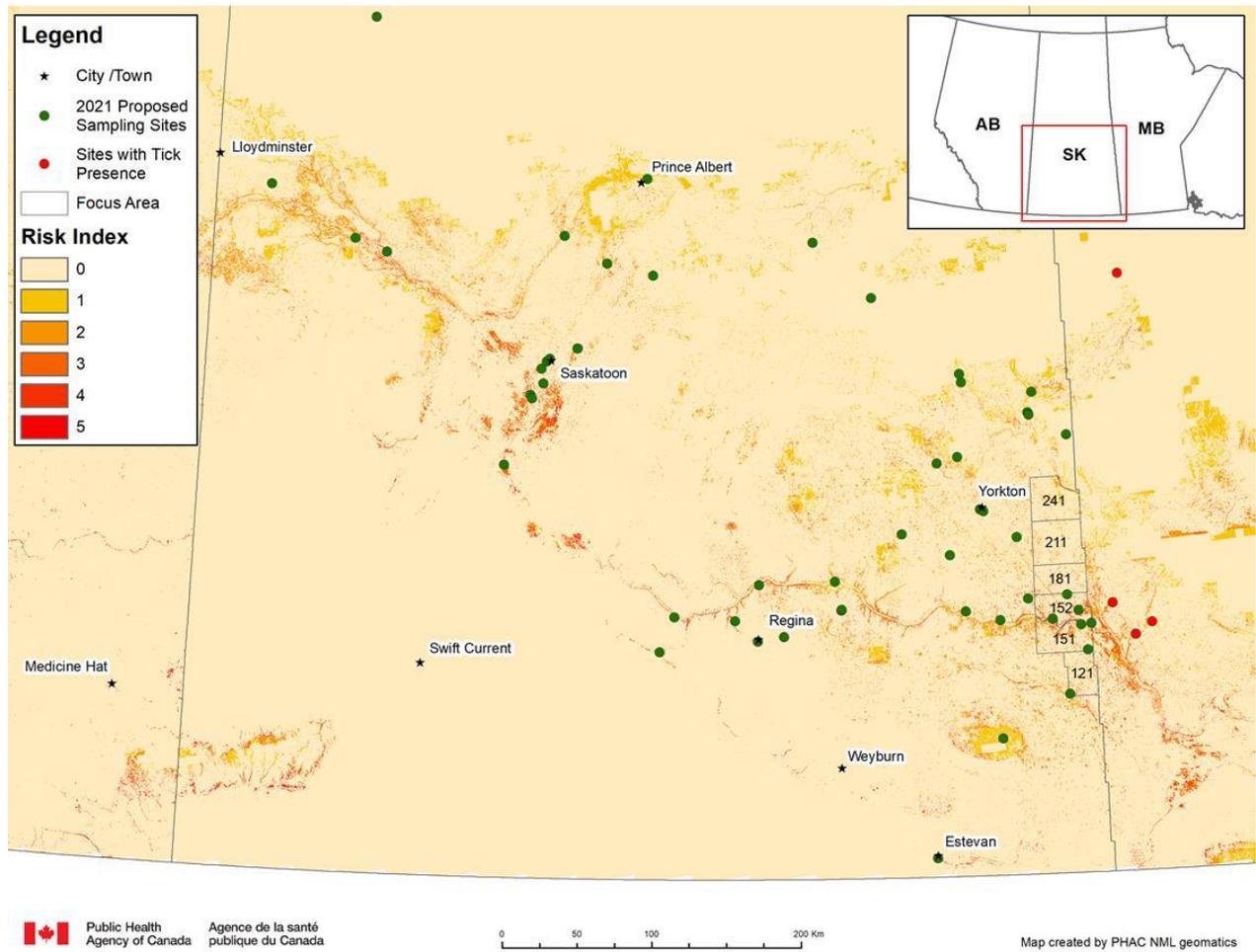
<sup>11</sup> Gabriele-Rivet V, Koffi J, Pelcat Y et al. A risk model for the Lyme disease vector *Ixodes scapularis* (Acari: Ixodidae) in the Prairie Provinces of Canada. 2017. J. of Med. Ent. (in press)

<sup>12</sup> Wittrock V and Wheaton E. Climate connections with vector-borne diseases: a case study of the *Ixodes scapularis* tick and Lyme disease in the Canadian prairies. 2010. SRC Publication No. 12829-15E10

<sup>13</sup> Graham-Derham S (Manitoba Health, Seniors and Active Living)(personal communication)

<sup>14</sup> Chilton NB, Curry PS, Lindsay LR, Rochon K, Lysyk TJ, Dergousoff. Passive and active surveillance for *Ixodes scapularis* (Acari: Ixodidae) in Saskatchewan, Canada. J Med Entomol. 2020. 57(1): 156-163

**Figure 5: Habitat Suitability for Blacklegged Tick Establishment in Saskatchewan - Low to High Potential Risk (Risk Index 0 – 5), 2021 Sampling Sites (green dots) – Manitoba Sites with Tick Presence (red dots) and Focus Area.**



**Appendix B – Habitat Quality**

**Figures 6-7: Hiking trails – Cosmopolitan Park (Saskatoon) and Wellington Park (Manitou Beach)**



*(Photos courtesy of Phil Curry)*

**Figure 8: Lakewood Park (Saskatoon)**



*(Photo courtesy of Phil Curry)*

**Figure 9: Lakewood Park with adjacent homes (Saskatoon)**



*(Photo courtesy of Phil Curry)*

**Figure 10: Riparian habitat with dry hillsides along Buffalo Pound Lake (upper Qu'Appelle River)**



*(Photo courtesy of Phil Curry)*