Ticks and Tick-Borne Disease Surveillance in British Columbia

June 2023

Provincial Health Services Authority

BC Centre for Disease Control
Provincial Health Services Authority

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Key Findings

- The reported number of cases of Lyme disease in British Columbia (BC) has fluctuated between 4 and 39 cases per year since 2006; however, more than half of these cases (53%) were acquired through travel outside of the province (Figure 1).
- The reported incidence of locally-acquired Lyme disease cases in BC has remained very low since 2006, ranging from 0.02 to 0.33 cases per 100,000 population annually (Figure 2).
- Human-related tick submissions to the Public Health Laboratory (PHL) at the BC Centre for Disease Control (BCCDC) have increased since 2013, while animal-related tick submissions have decreased in the same period corresponding with the introduction of fees for animal submissions (Figure 6).
- Ticks submitted to the PHL at the BCCDC and eTick show a similar pattern in terms of geographic distribution throughout the province. *Dermacentor* spp., known to carry the causative agents of Rocky Mountain spotted fever and tularemia, constituted the majority of human-related tick submissions from Interior Health and Northern Health. In contrast, Western blacklegged ticks (*Ixodes pacificus*) and *Ixodes angustus* constituted the majority of tick submissions from humans in Vancouver Coastal Health, Island Health, and Fraser Health (Figure 9); these ticks can carry causative agents for Lyme disease, anaplasmosis, and babesiosis.
- Ticks in BC are known to carry *Borrelia burgdorferi* (a causative agent of Lyme disease). More recently, ticks have also tested positive for *Anaplasma phagocytophilum* (the causative agent of anaplasmosis), *Babesia odocoilei*, and *Babesia microti* (two causative agents of babesiosis). *Babesia microti* was first documented in BC in 2019, and *Anaplasma phagocytophilum* and *Babesia odocoilei* were first detected in BC ticks in 2022. There have been no reported human cases of babesiosis or anaplasmosis in BC; however, there have been locally-acquired cases in Washington State. Climate change is a likely contributor to the emergence of new tick-borne diseases in BC.

List of Acronyms

BC	British Columbia
BCCDC	British Columbia Centre for Disease Control
CaLSeN	Canadian Lyme Sentinel Network
CLyDRN	Canadian Lyme Disease Research Network
FH	Fraser Health
IH	Interior Health
NH	Northern Health
NML	National Microbiology Laboratory
PHL	Public Health Laboratory
RHA	Regional Health Authority
RMSF	Rocky Mountain spotted fever
TBRF	Tick-borne relapsing fever
VCH	Vancouver Coastal Health
VIHA	Island Health

Lyme disease in British Columbia, 2006-2022

Lyme disease has been provincially reportable in British Columbia (BC) since 1994 and nationally reportable in Canada since 2009. The first cases of Lyme disease in BC were reported in 2006 and, since then, the total number of cases has fluctuated between 4 and 39 cases per year (Figure 1). Since 2006, there have been 214 total confirmed cases of Lyme disease reported to the British Columbia Centre for Disease Control (BCCDC). Of these, 99 (46%) were acquired within BC, and 113 (53%) were the result of travel-related exposures to a tick-endemic area outside of BC. Travel information for two cases was unavailable.

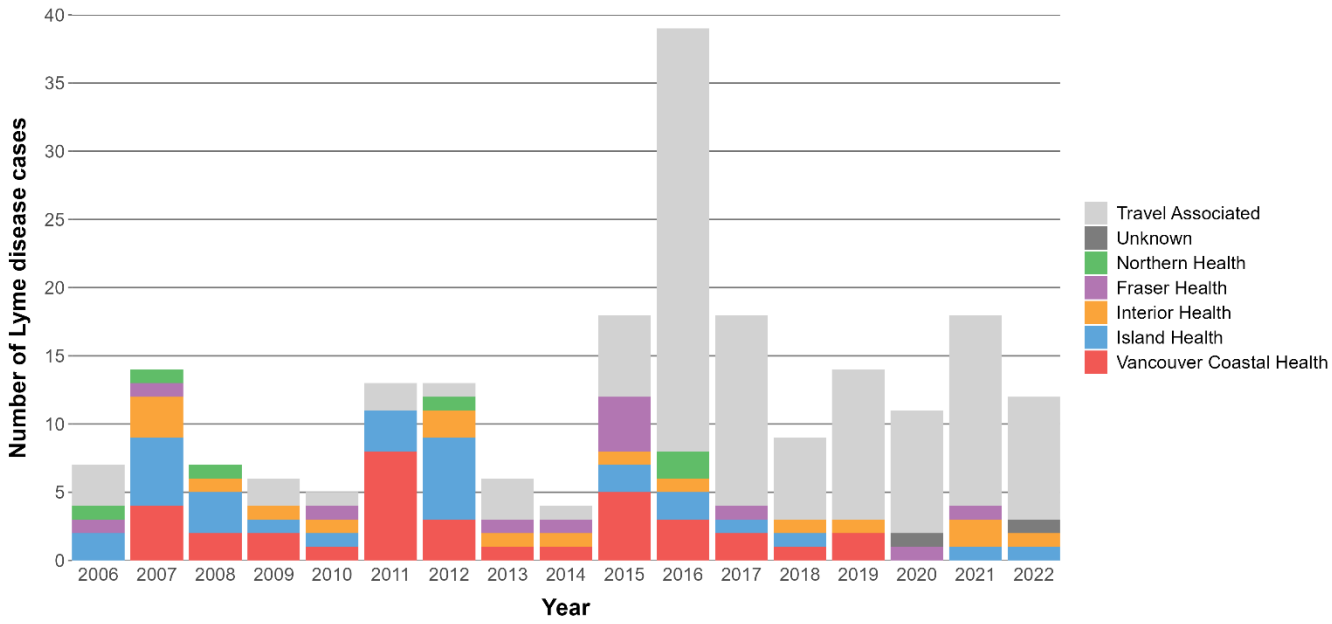
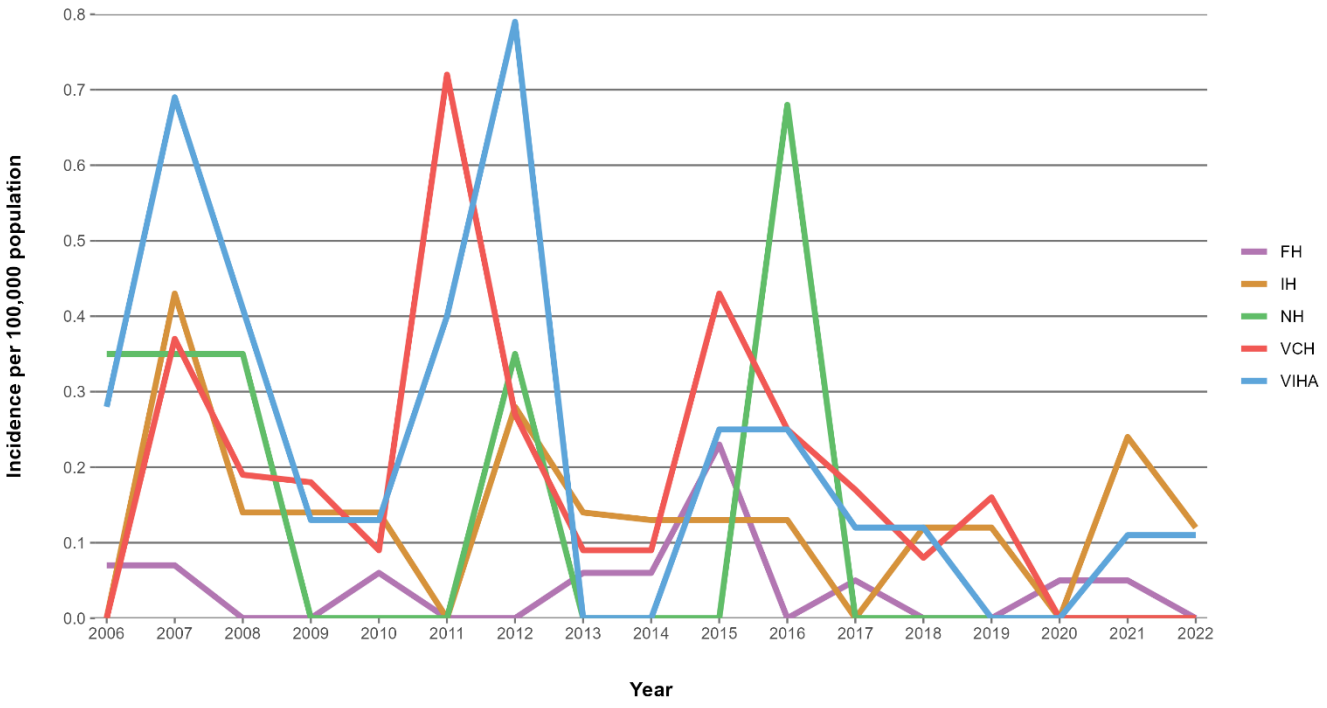


Figure 1. Number of Confirmed Lyme disease Cases by Reporting Regional Health Authority, 2006-2022 (n = 214).

Of the 99 confirmed, locally-acquired cases of Lyme disease reported since 2006, 35 were reported by Vancouver Coastal Health (VCH), 29 were reported by Island Health (VIHA), 17 were reported by Interior Health (IH), 12 were reported by Fraser Health (FH), and 6 were reported by Northern Health (NH).

The reported incidence of locally-acquired Lyme disease cases in BC has remained very low since 2006, ranging from 0.02 to 0.33 cases per 100,000 population annually. In 2022, the incidence of confirmed, locally-acquired cases of Lyme disease in BC was 0.04 cases per 100,000 population.



HA	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
FH	0.07	0.07	0.00	0.00	0.06	0.00	0.00	0.06	0.06	0.23	0.00	0.05	0.00	0.00	0.05	0.05	0.00
IH	0.00	0.43	0.14	0.14	0.14	0.00	0.28	0.14	0.13	0.13	0.13	0.00	0.12	0.12	0.00	0.24	0.12
NH	0.35	0.35	0.35	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	0.00	0.00
VCH	0.00	0.37	0.19	0.18	0.09	0.72	0.27	0.09	0.09	0.43	0.25	0.17	0.08	0.16	0.00	0.00	0.00
VIHA	0.28	0.69	0.41	0.13	0.13	0.40	0.79	0.00	0.00	0.25	0.25	0.12	0.12	0.00	0.00	0.11	0.11

Figure 2. Incidence Rates of Confirmed Locally-Acquired Lyme disease Cases by Regional Health Authority, 2006-2022.

Amongst the five regional health authorities (RHAs), similar trends in the incidence rate of confirmed, locally-acquired cases of Lyme disease were observed. When stratified by RHA, the annual incidence fluctuated between 0 and 0.8 cases per 100,000 population (Figure 2). In each RHA, the following trends were observed:

Fraser Health

The first confirmed, locally-acquired case of Lyme disease was reported by FH in 2006. Since then, the number of confirmed, locally-acquired cases of Lyme disease reported has ranged from 0 to 4 cases per year. The incidence of Lyme disease has remained low since 2006, generally below 0.10 cases per 100,000 population, with the exception of a slight increase to 0.23 cases per 100,000 population in 2015.

Interior Health

The first confirmed, locally-acquired cases of Lyme disease were reported by IH in 2007. Since then, 0 to 3 confirmed locally-acquired cases have been reported annually. The incidence of Lyme disease in IH has fluctuated over time, between 0 and 0.43 cases per 100,000 population annually between 2007 and 2022. From 2013 to 2016, the incidence remained relatively stable at around 0.13 cases per 100,000 population annually.

Northern Health

The first confirmed, locally-acquired case of Lyme disease in NH was reported in 2006. Reports of confirmed, locally-acquired cases of Lyme disease in NH have ranged from 0-2 cases per year. The incidence of Lyme disease in NH has fluctuated between 0 and 0.68 cases per 100,000 population per year between 2006 and 2022. NH has not reported any confirmed, locally-acquired cases of Lyme disease since 2017.

Vancouver Coastal Health

The first confirmed, locally-acquired cases of Lyme disease in VCH were reported in 2008. Since then, reports of confirmed, locally-acquired cases of Lyme disease in VCH have ranged from 0 to 8 cases per year. The incidence of Lyme disease in VCH has shown relatively large fluctuations from year to year, ranging from 0 to 0.72 cases per 100,000 population annually between 2007 and 2022. From 2020 to 2022, no confirmed, locally-acquired cases of Lyme disease were reported by VCH for the first time since 2007.

Island Health

The first confirmed, locally-acquired cases of Lyme disease in VIHA were reported in 2006. Since then, reports of confirmed, locally-acquired cases of Lyme disease in VIHA have ranged from 0 to 6 cases per year. The incidence of Lyme disease in VIHA has fluctuated between 0 to 0.79 cases per 100,000 population per year from 2006 to 2022. Notable peaks occurred in 2007 (0.69 cases per 100,000 population) and 2012 (0.79 cases per 100,000 population). However, since 2013, the incidence has remained relatively stable, ranging from 0 to 0.25 cases per 100,000 population annually.

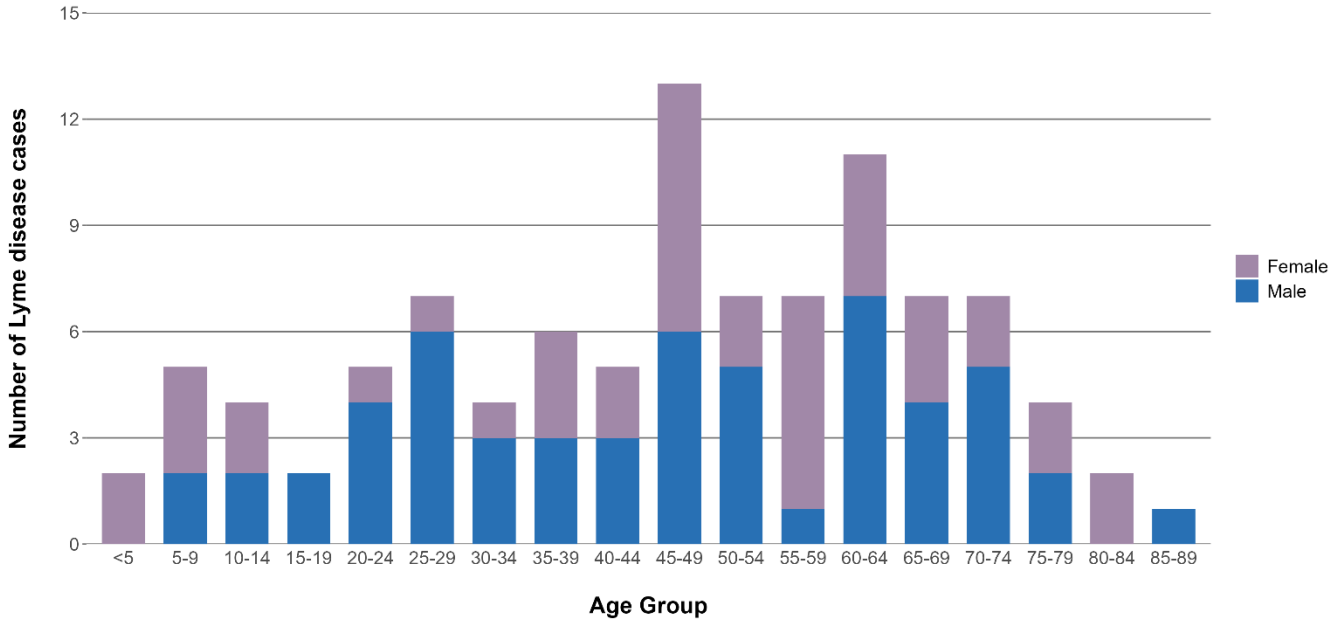


Figure 3. Confirmed Locally-Acquired Lyme disease Cases by Age Group and Sex, 2006-2022.

Of the 99 confirmed, locally-acquired cases of Lyme disease, 57% were male (56 cases) and 43% were female (43 cases). Cases of Lyme disease generally occur amongst older individuals, with the highest number of confirmed, locally-acquired Lyme disease cases occurring in the 45 to 49-year-old age group, followed by the 60 to 64-year-old age group (Figure 3).

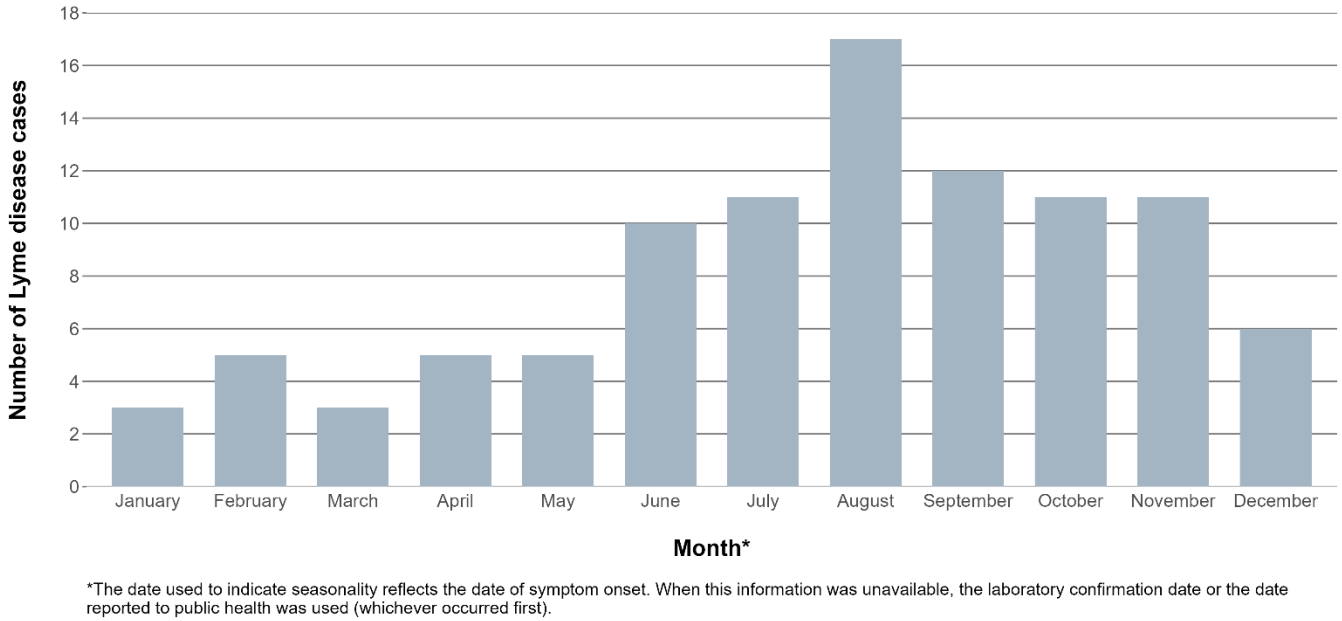


Figure 4. Confirmed, Locally-Acquired Lyme disease Cases by Month, 2006-2022.

The majority of cases occurred between June and November, although cases occur throughout the year (Figure 4). This distribution reflects human and pet activity in warmer months, the greatest host-seeking and blood-feeding behaviours of *Ixodes* spp. ticks during spring and summer, as well as the incubation period of Lyme disease. Nymphs are most active during the warmer months from late spring and summer, and adults are most active in early spring and fall when temperatures are slightly cooler. Therefore, it is unsurprising that the majority of Lyme disease cases occur during the warmer months.

Tick Surveillance in British Columbia

Tick surveillance in BC consists of three main activities: submissions of ticks from the public to the eTick platform, submissions of ticks from veterinary and healthcare professionals to the BCCDC Public Health Laboratory (PHL), and drag sampling by the Canadian Lyme Disease Research Network (CLyDRN). In addition to characterization, a subset of ticks undergo pathogen testing at BCCDC PHL or the National Microbiology Laboratory (NML) (Figure 5).

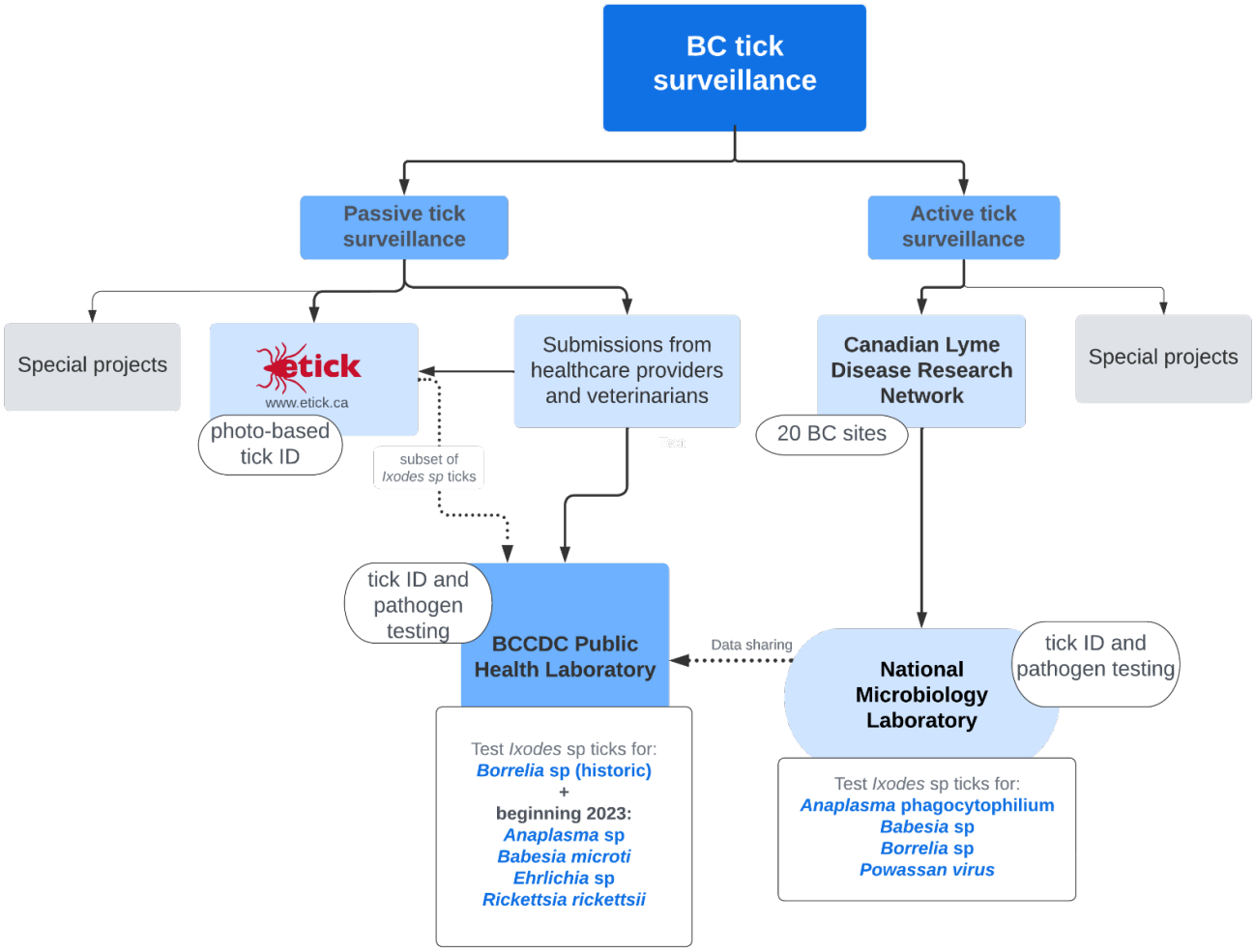


Figure 5: Overview of BC's Tick Surveillance Program.

Trends in Tick Submissions to British Columbia Centre for Disease Control Public Health Laboratory, 2002-2021

The PHL at the BCCDC characterizes, when possible, ticks found on animals or humans from veterinarians and healthcare providers, respectively. The surveillance data presented are based on the passive submissions of ticks, and the attributed location of the ticks is variable and may reflect any one of the following: where the tick was acquired, where it was submitted, or the residence of the patient.[1] This service was free for veterinarians until 2014, which may explain the decrease in animal tick

[1] To submit a tick sample, fill out the parasitology requisition form and submit to the BC Centre for Disease Control Public Health Laboratory.

submissions from 2014 onward (Figure 6). Tick submissions from humans, however, have steadily increased since 2012.

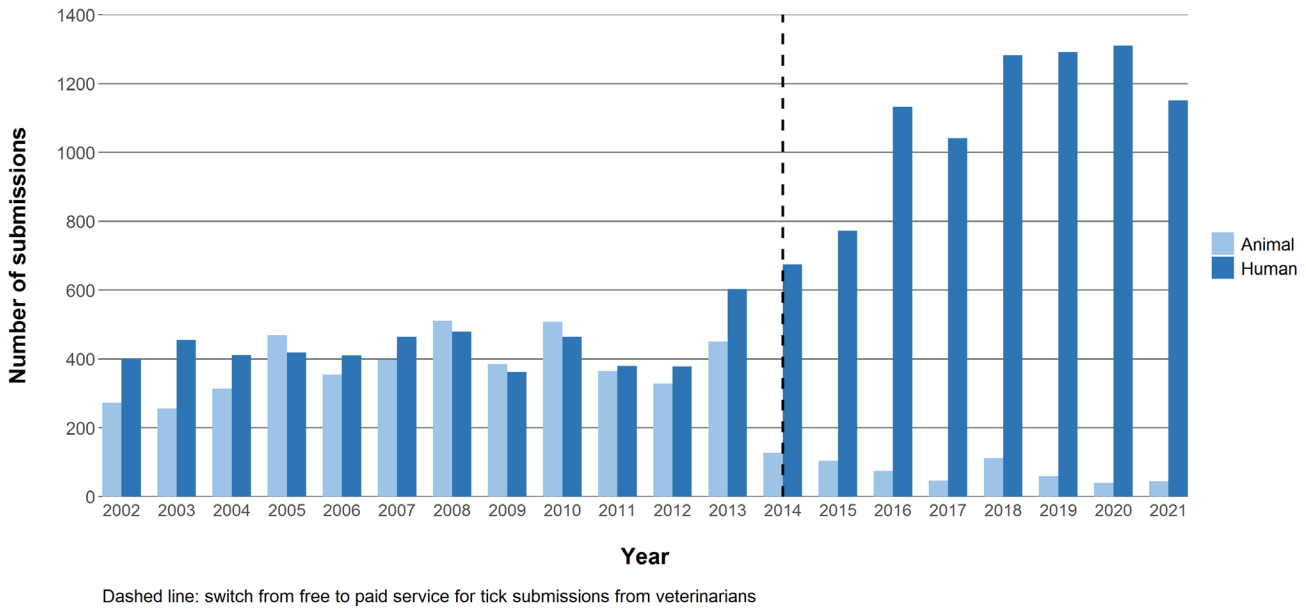


Figure 6. Number of Ticks from Humans and Animals Submitted to the BCCDC Public Health Laboratory, 2002-2021.

From 2002 to 2021, 13,881 ticks found on humans were submitted to the BCCDC PHL from locations throughout the province. Submissions of ticks from humans to BCCDC PHL were highest between March and June, with a second smaller peak occurring in the months of October and November (Figure 7).

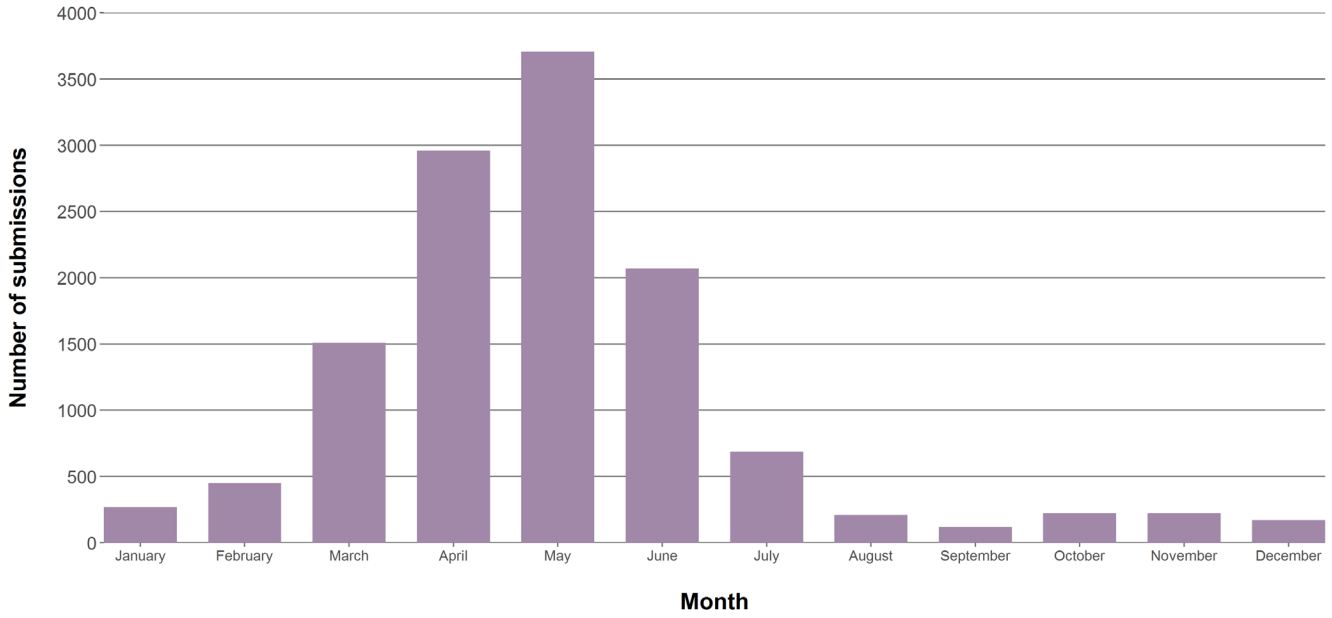


Figure 7. Seasonality of Tick Submissions from Humans to the BCCDC Public Health Laboratory, 2002-2021.

The majority of ticks identified by the BCCDC PHL were, in descending order: *Ixodes pacificus* (52%), *Dermacentor andersoni* (36%), and *Ixodes angustus* (4%). *Dermacentor andersoni* constitutes the majority of human tick submissions from IH and NH. In IH, the incidence rate of *Dermacentor andersoni* submissions had increased substantially between 2009 and 2019 (Figure 8). In NH, the incidence rate of *Dermacentor andersoni* submissions had been similarly increasing between 2011 and 2019 (Figure 8). In BC, the incidence of *Ixodes pacificus* and *Ixodes angustus* submissions peaked in 2018 and the incidence of *Dermacentor andersoni* submissions peaked in 2019 (Figure 8). In FH, VCH, and VIHA, *Ixodes pacificus* is the most commonly submitted tick species from humans. The incidence rate of *Ixodes pacificus* submissions from FH has fluctuated over time, ranging from 2 to 5 ticks per 100,000 population per year (Figure 8). In VCH and VIHA, the incidence rate of *Ixodes pacificus* has been increasing since 2012 (Figure 8).

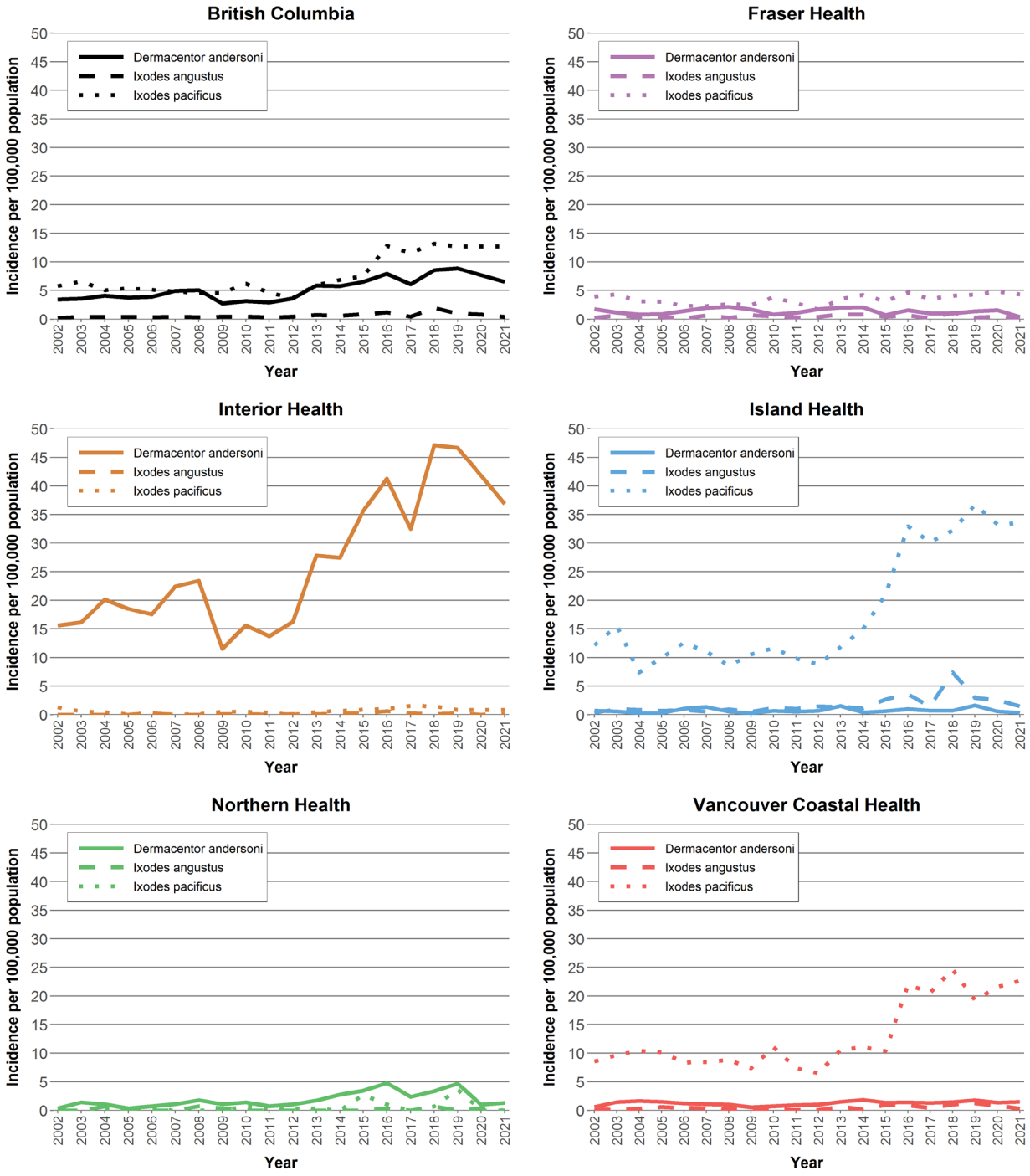


Figure 8. Incidence Rates of *Dermacentor andersoni*, *Ixodes pacificus*, and *Ixodes angustus* Tick Submissions from Humans to the BCCDC Control Public Health Laboratory by Regional Health Authority, 2002-2021.

***Ixodes* spp. Tick Submissions**

Of the 13,881 tick submissions from humans, 8,368 (60%) were *Ixodes* spp., 7,843 of which were able to be further characterized (94%). The most common *Ixodes* spp. ticks submitted were *Ixodes pacificus* (7,204 ticks, 92%), followed by *Ixodes angustus* (574 ticks, 7%), *Ixodes ricinus* (13 ticks, 0.2%), and *Ixodes scapularis* (12 ticks, 0.2%). Species of ticks and the diseases they carry vary by region. Table 1 below shows common tick-borne diseases known to be transmitted by *Ixodes* spp. ticks and evidence for local transmission in BC.

Table 1. Tick-Borne Diseases Associated with *Ixodes* spp. Ticks in British Columbia.

Pathogen	Human Disease	Detected in BC *Ixodes* spp. Ticks	Identified at or reported to BCCDC in Humans with BC-Only Exposure
Anaplasma phagocytophilum	Anaplasmosis	Yes	No
Babesia spp.	Babesiosis	Yes	No
Borrelia burgdorferi	Lyme disease	Yes	Yes
Powassan virus	Powassan virus	No	No

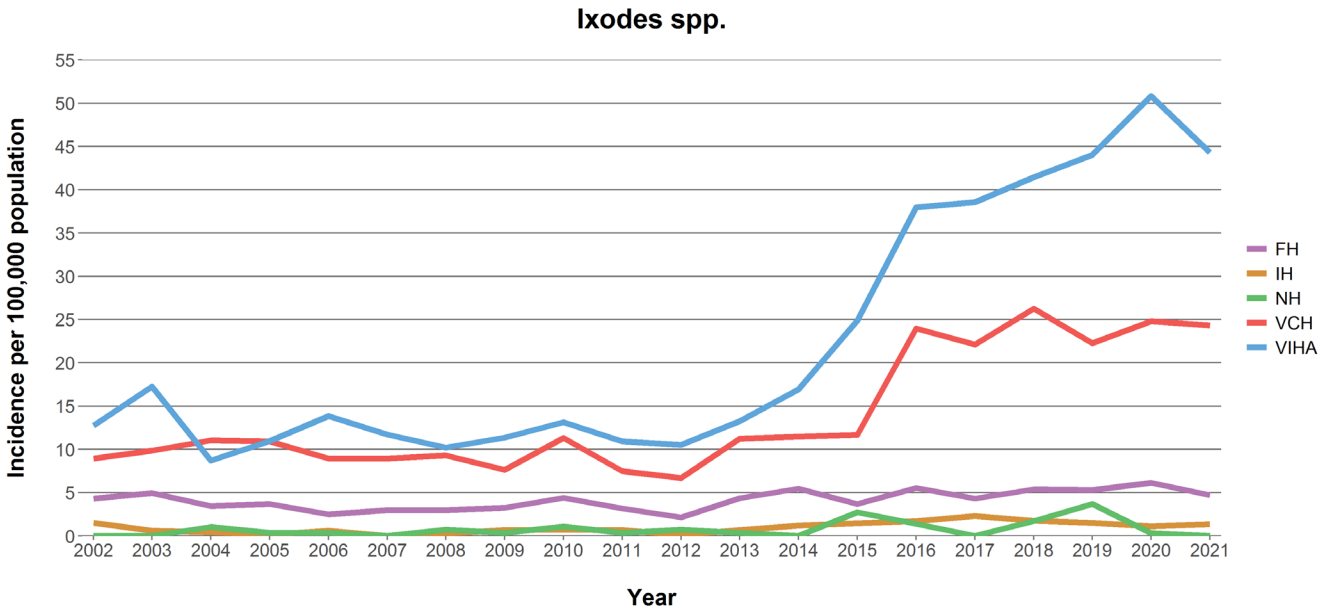


Figure 9. Incidence Rates of *Ixodes* spp. Tick Submissions from Humans by Regional Health Authority, 2002-2021.

Rates of *Ixodes* spp. tick submissions from human hosts have been increasing in VIHA and VCH beginning in 2012 and have remained stable in FH, NH, and IH since 2002 (Figure 9). However, there has not been a concomitant increase in reported Lyme disease cases during this time. The highest rates of *Ixodes* spp. tick submissions were found in VIHA, followed by VCH, FH, IH, and NH, which aligns with known blacklegged tick distribution patterns in BC.

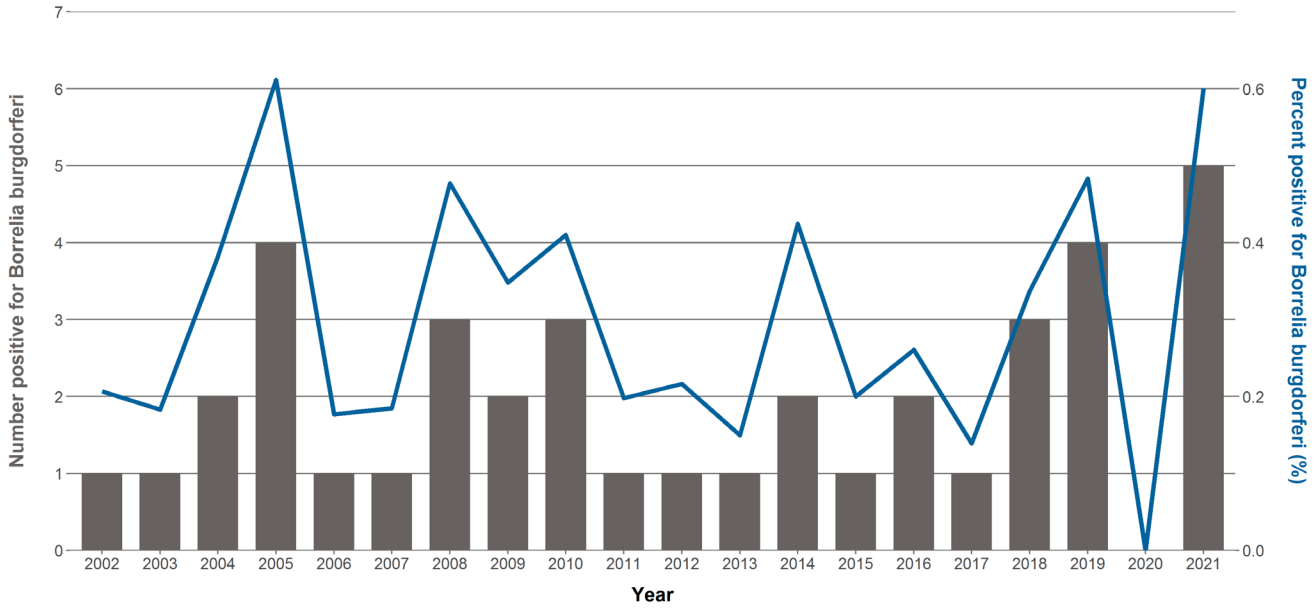


Figure 10. Annual Number and Percent Positivity of *Ixodes* spp. Ticks Testing Positive for *Borrelia burgdorferi*, 2002-2021.

The number and percent of *Ixodes* spp. ticks from humans and animals that test positive for *Borrelia burgdorferi* is highly variable, ranging from 0 to 5 ticks per year (0 to 0.6% of ticks testing positive), with peaks occurring every 2-3 years mirroring the life cycle of ticks (Figure 10). However, it is important to note that some *Ixodes* spp. ticks that tested positive for *Borrelia burgdorferi* may have been collected outside of BC. In 2020, no ticks tested positive for *Borrelia burgdorferi* (a percent positivity of 0), followed by 5 ticks testing positive for *Borrelia burgdorferi* in 2021 (a percent positivity of 0.60%) (Figure 10).

Dermacentor spp. Tick Submissions

Of 13,881 ticks found on humans that were submitted to BCCDC PHL between 2002 and 2021, 5,173 were *Dermacentor* spp. (37%). Of these, 5,141 *Dermacentor* spp. ticks had an identifiable species (99%), with the most common species being *Dermacentor andersoni* (4,937 ticks, 96%), followed by *Dermacentor variabilis* (120 ticks, 2%), *Dermacentor albipictus* (82 ticks, 2%), and *Dermacentor occidentalis* (2 ticks, 0.04%).Table 2 shows common tick-borne diseases known to be transmitted by *Dermacentor* spp. ticks and evidence for local transmissions in BC.

Table 2. Tick-borne Diseases Associated with *Dermacentor* spp. Ticks in British Columbia.

Pathogen	Human Disease	Identified in Humans with BC-Only Exposure
Francisella tularensis	Tularemia	Yes*
Rickettsia rickettsii	Rocky Mountain Spotted Fever	Yes
N/A (toxin mediated)	Tick Paralysis	Yes

*Tularemia has multiple additional sources of exposure in addition to tick bites, including direct skin exposure with infected sick or dead animals, eating or drinking contaminated food or water, and inhaling *F. tularensis* bacteria (Centers for Disease Control and Prevention, 2018).

While there have been cases of tick-acquired tularemia and RMSF reported in BC, these occurrences are very rare, ranging from 0-2 cases per year of tick-borne tularemia and 0-3 cases of RMSF per year in BC.

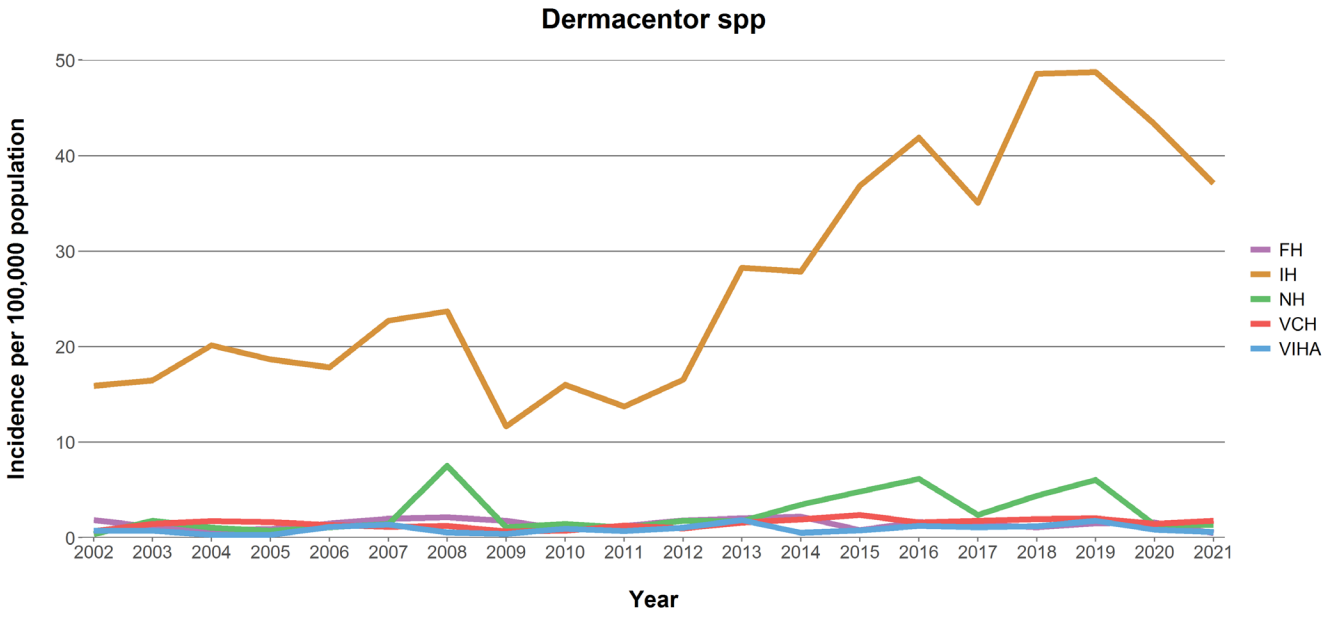


Figure 11. Incidence Rates of *Dermacentor* spp. Tick Submissions from Humans by Regional Health Authority, 2002-2021.

Rates of *Dermacentor* spp. tick submissions from human hosts are consistently highest in IH and increased between 2009 and 2019 (Figure 11). In all other RHAs, rates of *Dermacentor* spp. tick submissions from human hosts have remained relatively low and stable since 2002 (Figure 11). Slight peaks in the rate of *Dermacentor* spp. submissions from humans were seen in NH in 2008, 2016, and 2019 (Figure 11).

Other Tick Submissions

The remainder of ticks submitted to the BCCDC PHL, collectively less than 2% of all submissions (340 ticks), were identified as one of *Amblyomma* spp., *Haemaphysalis* spp., *Hyalomma* spp., *Ornithodoros* spp., and *Rhipicephalus* spp. (Figure 12).

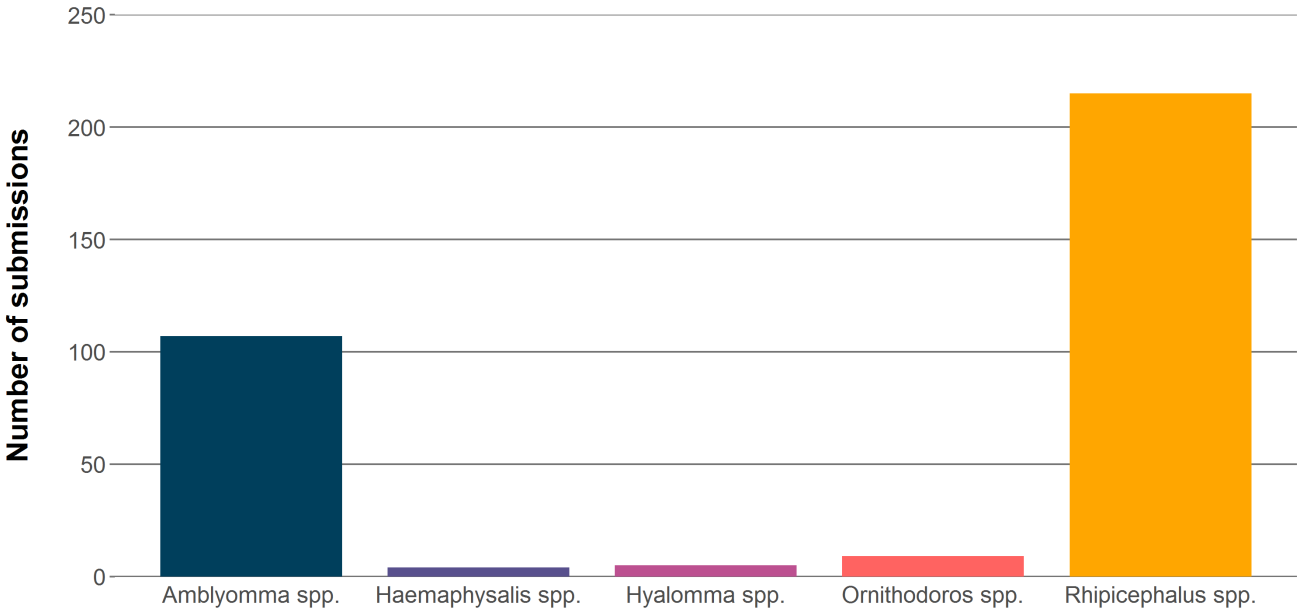


Figure 12. Number of *Amblyomma* spp., *Haemaphysalis* spp., *Hyalomma* spp., *Ornithodoros* spp., and *Rhipicephalus* spp. Tick Submissions from Humans 2002-2021.

Amblyomma spp.

The BCCDC PHL received 107 *Amblyomma* spp. tick submissions from humans between 2002 and 2021 (Figure 12). Of these, 51 (48%) had an identifiable species. The most common species were as follows: *Amblyomma americanum* (31 ticks, 61%), *Amblyomma maculatum* (11 ticks, 22%), *Amblyomma cajennense* (8 ticks, 16%), and *Amblyomma imitator* (1 tick, 2%). *A. americanum*, also known as the "lone star tick", is widely distributed in the United States, but have been reported throughout Canada, typically in southern Ontario (Childs & Paddock, 2003; Lindquist et al., 2016). *A. americanum* is known to spread ehrlichiosis, Heartland virus disease, southern tick-associated rash illness, Bourbon virus disease, and tularemia (Centers for Disease Control and Prevention, 2022b). *A. maculatum* have been

reported on birds in Canada, and is known to transmit *Rickettsia parkeri* rickettsiosis (Centers for Disease Control and Prevention, 2022b; J. D. Scott et al., 2001). *A. cajennense* and *A. imitator* have not been reported in Canada (Estrada-Peña et al., 2004; Oliveira et al., 2010).

Haemaphysalis spp.

The BCCDC PHL received 4 *Haemaphysalis* spp. tick submissions from humans between 2002 and 2021 (Figure 12). Of these, half (2 ticks) were able to be identified as *Haemaphysalis leporispalustris*, while the other two could not be identified further. *H. leporispalustris* are known to be present in Canada, and have been associated with tularemia and RMSF in rabbit and rodent populations (Gabriele-Rivet et al., 2015; Parker et al., 1951; Philip & Parker, 1938).

Hyalomma spp.

The BCCDC PHL received 5 *Hyalomma* spp. tick submissions from humans between 2002 and 2021 (Figure 12). Of these, 3 ticks (60%) were able to be identified as *Hyalomma marginatum*. The other two did not have an identifiable species. *Hyalomma* spp. ticks are not established in North America (European Centre for Disease Prevention and Control & European Food Safety Authority, 2022).

Ornithodoros spp.

Between 2002 and 2021, the BCCDC PHL received 9 *Ornithodoros* spp. tick submissions from humans (Figure 12). All 9 were identified as *Ornithodores hermsi*, a tick species typically found in coniferous forests at elevations around 1500-8000 feet. *O. hermsi* is a known vector of *Borrelia hermsii*, the causative agent of tick-borne relapsing fever (TBRF), the most commonly-reported autochthonous tick-borne disease in Washington State, with between 1 and 12 cases reported annually (Washington State Department of Health, 2021). Most cases in Washington State are associated with overnight stays in cabins, but some cases are reported to have been exposed in their primary residence (Washington State Department of Health, 2017). BCCDC PHL provides testing services for the diagnosis of *B. hermsii* TBRF, although submissions remain low, between 5 to 25 samples submitted annually (Morshed et al., 2017). The number of cases of TBRF detected by BCCDC PHL ranges from 0 to 7 per year (Morshed et al., 2017).

Rhipicephalus spp.

The BCCDC PHL received 215 *Rhipicephalus* spp. tick submissions from humans between 2002 and 2021 (Figure 12). Of these, 144 ticks (67%) were identified as *Rhipicephalus sanguineus*, while 71 ticks (33%) could not be further identified. *Rhipicephalus sanguineus*, commonly known as the brown dog tick, is the primary vector of RMSF in the southwestern United States and Mexico; however, it is not known to be established in Canada (Bestul et al., 2022). There have been documented findings of R. *sanguineus* on imported dogs in BC (Western College of Veterinary Medicine, 2021).

Trends in Tick Submissions to eTick, 2021-2022

eTick utilizes public participation to identify and monitor ticks in Canada. Members of the public are able to submit photos of ticks they encounter through the free eTick application, where the ticks are classified by tick specialists. The identification results, along with other data, such as collection date and location, are mapped to visualize the diversity of ticks across Canada and how the distribution of tick species changes in response to factors such as climate change. The eTick platform has identified 1,173 ticks collected in BC from 2021 to 2022 in all five RHAs.

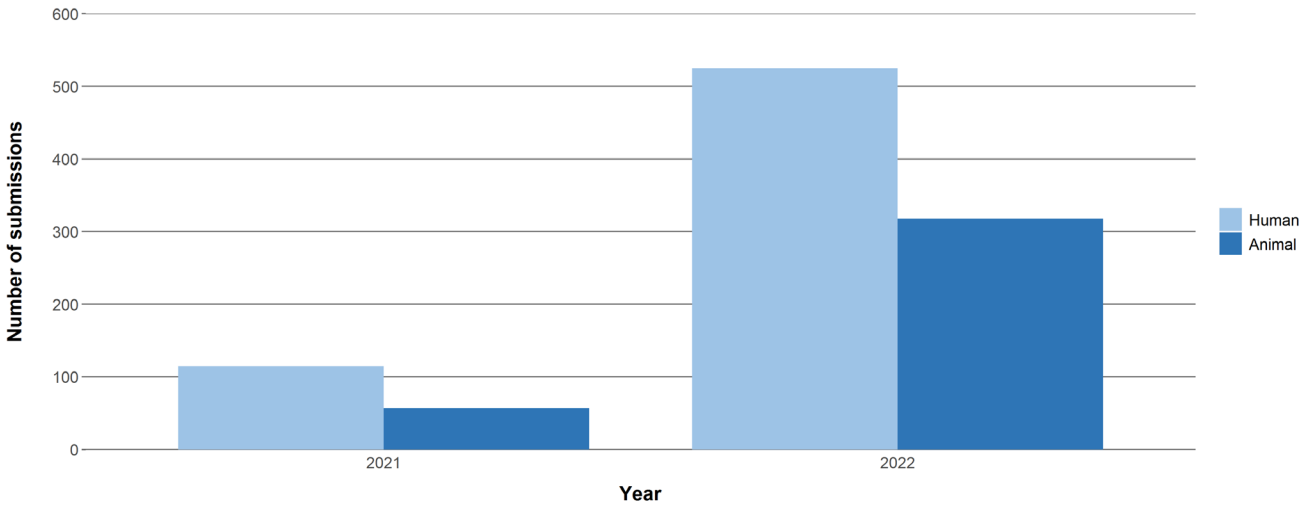


Figure 13. Tick Submissions from Humans and Animals in British Columbia to eTick, 2021-2022.

In 2021, eTick identified 115 ticks from humans and 57 ticks from animals in BC (Figure 13). In 2022, this number increased to 525 samples from humans and 318 samples from animals (Figure 13).

Of the 640 ticks collected from humans throughout 2021 and 2022, 628 (98%) were able to be identified. Of these, 475 were *Dermacentor* spp., 147 were *Ixodes pacificus*, 4 were *Ixodes angustus*, 1 was *Ixodes scapularis*, and 1 was *Rhipicephalus sanguineus*. *Dermacentor* spp., *Ixodes pacificus*, and *Ixodes angustus* are known to be established in BC, while *Ixodes scapularis* is mainly found in Central and Eastern Canada (Wilson et al., 2022). *Rhipicephalus sanguineus* is not known to be established in Canada.

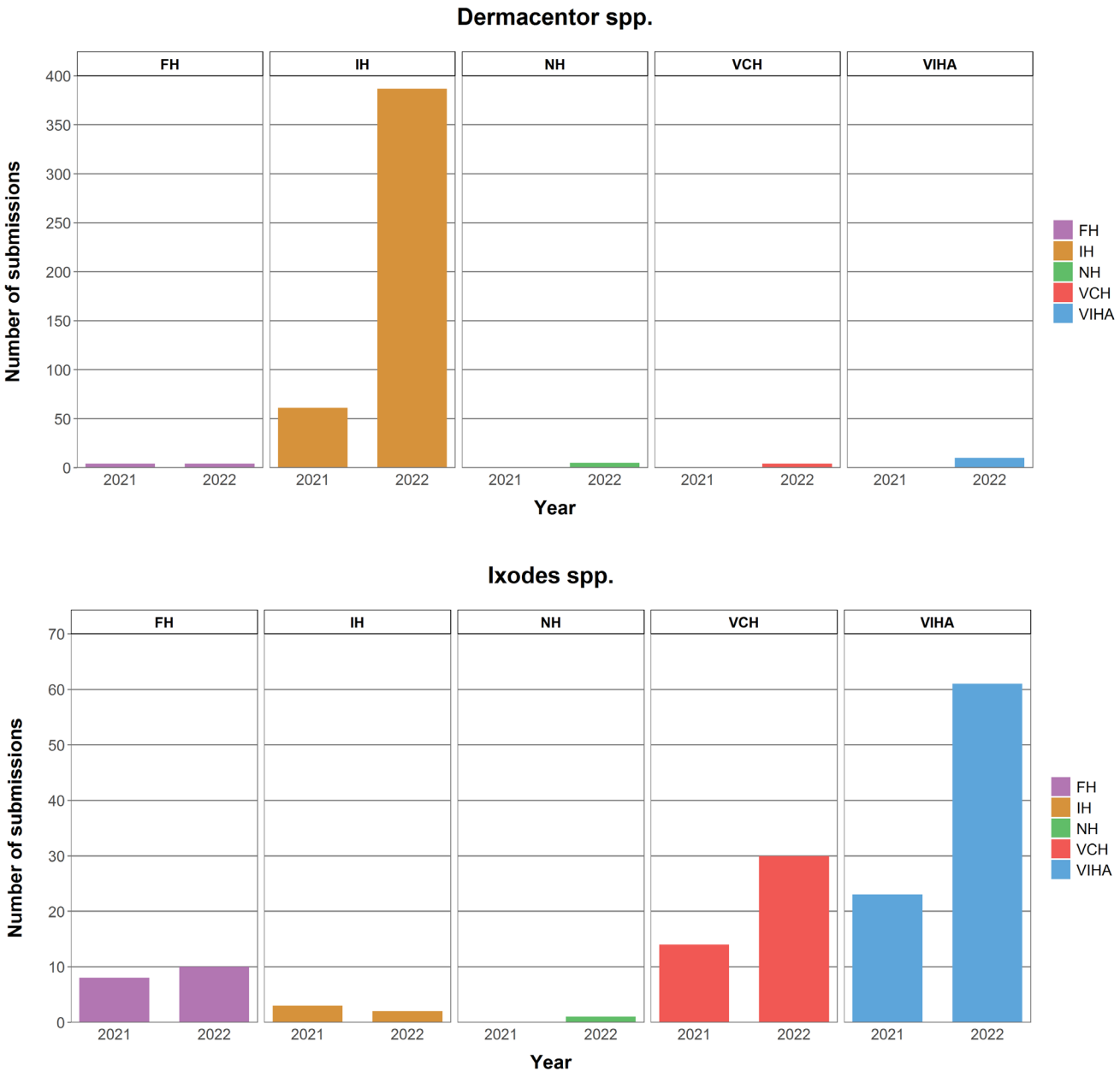


Figure 14. Human Tick Submissions to eTick by Genus and Regional Health Authority, 2021-2022.

Dermacentor spp. ticks were primarily found in IH, whereas *Ixodes* spp. ticks were more widely distributed across the province, with the greatest number of *Ixodes* spp. ticks found in VIHA and VCH (Figure 14).

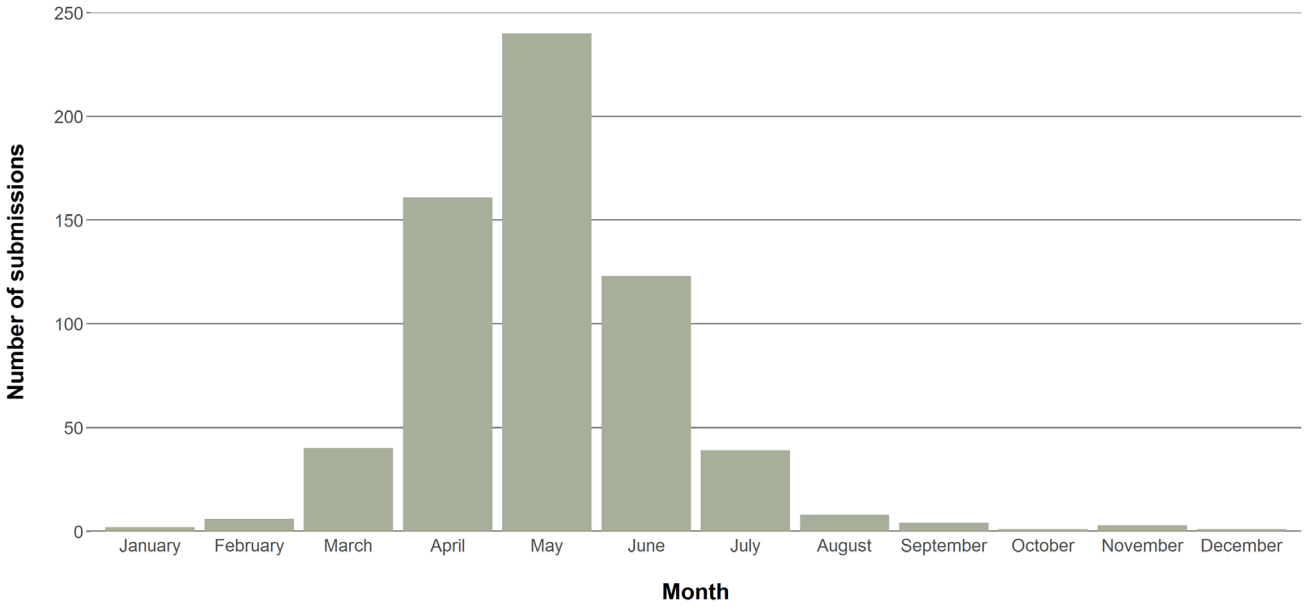


Figure 15. Seasonality of Tick Submissions from Humans to eTick by Month, 2002-2021.

The greatest number of tick submissions from humans to eTick occurred in May, with a slight secondary peak seen in November (Figure 15). These observations are consistent with the seasonality of tick submissions to BCCDC PHL.

The seasonality of *Ixodes* spp. tick submissions to eTick mirrors that of *Ixodes* spp. tick submissions to BCCDC PHL and precedes peak reporting of confirmed, locally-acquired human Lyme disease cases by approximately three months (Figure 16). Both eTick and BCCDC PHL saw *Ixodes* spp. submissions peak in May, whereas the reporting of confirmed, locally-acquired human Lyme disease cases tended to peak in August (Figure 16). The interval between peak exposures and peak disease incidence likely reflects the incubation period, the interval between clinical assessment and lab testing, and/or the interval between lab confirmation and reporting to public health. While the incubation period of Lyme disease typically ranges from 3 to 30 days after a tick bite, approximately 20% of people infected do not develop erythema migrans, a manifestation of early localized Lyme disease (Mead & McCormick, 2024). Clinical manifestations of early disseminated and late disseminated Lyme disease may occur weeks to months after the exposure. Additionally, antibodies against Lyme disease bacteria usually take a few weeks to develop, and thus tests are not likely to be positive until 4 to 6 weeks after exposure (Centers for Disease Control and Prevention, 2022a).

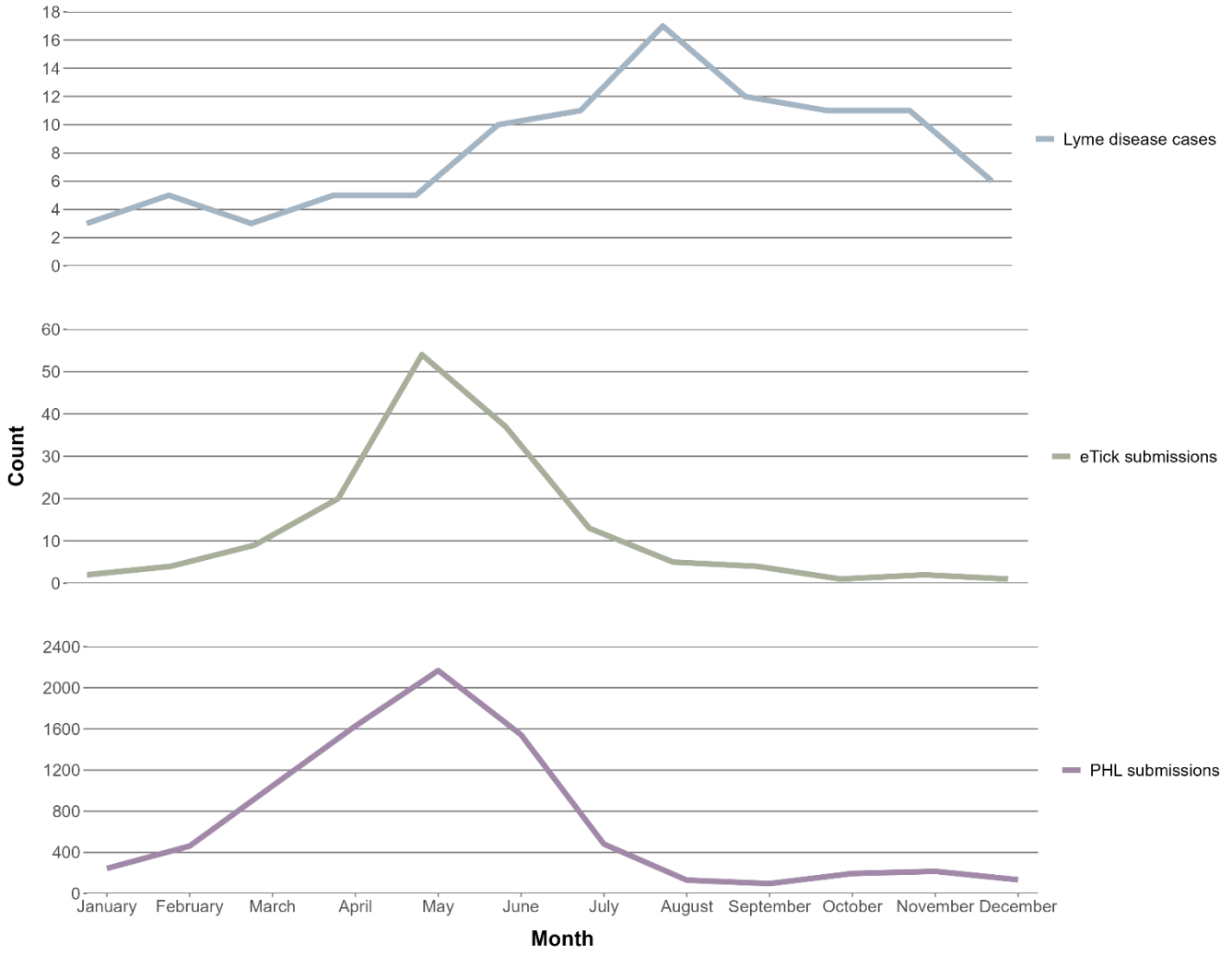


Figure 16. Seasonality of Submissions of Confirmed Human Cases of Lyme disease in BC (2006-2022) and *Ixodes* spp. Tick Submissions from Humans to eTick (2021-2022) and BCCDC Public Health Laboratory (2002-2021).

Trends in Tick Sampling by Canadian Lyme Disease Research Network, 2019 & 2021-2022

In 2019, 2021-2022, the CLyDRN operated their pan-Canadian sentinel surveillance initiative, the Canadian Lyme Sentinel Network (CaLSeN). The network operates active surveillance of ticks by drag sampling and submits collected *Ixodes* spp. ticks for testing at the NML for *Borrelia burgdorferi, Borrelia miyamotoi*, *Anaplasma phagocytophilum*, *Babesia* spp., *Babesia odocoilei*, *Babesia microti*, and Powassan virus. In 2019, the Metro Vancouver region was selected for drag sampling. Sampling was not conducted in 2020 due to the COVID-19 pandemic. In 2021, two regions in the south coast of BC were selected for drag sampling: Metro Vancouver and South Vancouver Island. Each region was comprised of five sampling sites. In 2022, four regions were selected: Metro Vancouver, South

Vancouver Island, Central Vancouver Island, and Okanagan. The Central Vancouver Island and Okanagan regions each consisted of four sampling sites, Metro Vancouver consisted of five sampling sites, and South Vancouver Island consisted of seven sampling sites.

The 2019 sampling season resulted in 17 ticks captured in Metro Vancouver (10 *Ixodes pacificus* and 7 *Ixodes angustus*), and these results were published previously (Guillot et al., 2020). During the 2021 and 2022 sampling years, *Ixodes angustus* nymphs were exclusively found at the Metro Vancouver sampling site and represented the majority of ticks collected at this site (Figure 17). In addition, exclusive to this site were *Ixodes sculptus* adult ticks, which have been documented in BC prior (Lindquist et al., 2016). *Dermacentor andersoni* were exclusively found at the Okanagan sampling site, and *Ixodes pacificus* were found in Metro Vancouver, South Vancouver Island, and Central Vancouver Island (Figure 17). The greatest number of ticks was captured in South Vancouver Island, where 68 *Ixodes pacificus* nymphs, 26 *Ixodes pacificus* larvae, 6 *Ixodes pacificus* adults, and 1 *Ixodes auritulus* nymphs were captured (Figure 17).

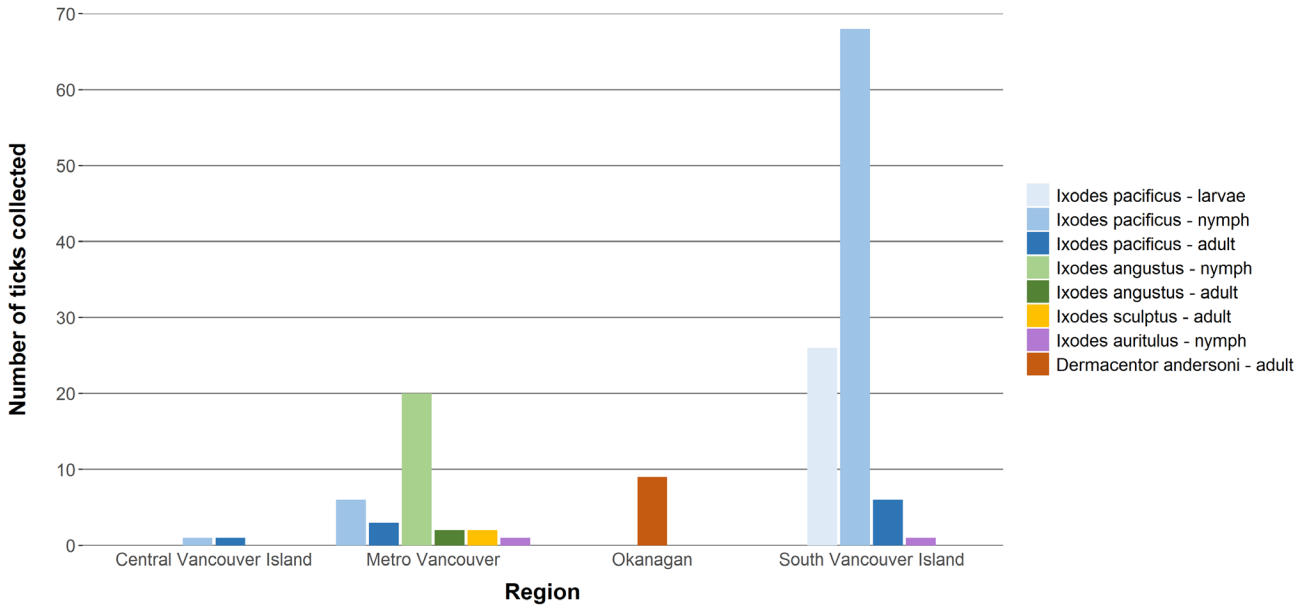


Figure 17. Number of Ticks Collected by Sampling Site, Species, and Life Stage, 2021-2022.

Of the ticks captured, 128 *Ixodes* spp. were submitted to NML for two-stage Polymerase Chain Reaction testing (17 in 2019, 27 in 2021, and 84 in 2022). None of the ticks submitted in 2021 tested positive for *Borrelia burgdorferi*, *Borrelia miyamotoi*, *Anaplasma phagocytophilum*, *Babesia* spp., *Babesia odocoilei*, *Babesia microti*, or Powassan virus. The test results of the *Ixodes* spp. ticks submitted for testing in 2019 and 2022 by sampling region are outlined on the following page:

Central Vancouver Island

- None of the *Ixodes* spp. ticks collected in Central Vancouver Island tested positive for *Borrelia burgdorferi, Borrelia miyamotoi*, *Anaplasma phagocytophilum*, *Babesia odocoilei*, *Babesia microti*, or Powassan virus.

Metro Vancouver

- Babesia microti was detected in three *Ixodes angustus* ticks in distinct sampling regions of Metro Vancouver (Figure 18).

Okanagan

- None of the ticks collected in the Okanagan were *Ixodes* spp. ticks and were therefore not tested for pathogens.

South Vancouver Island

- *Babesia odocoilei* was detected in four *Ixodes pacificus* ticks collected from the same sampling site (Figure 18).
- At a different sampling site, *Anaplasma phagocytophilum* was detected in two *Ixodes pacificus* ticks and *Borrelia burgdorferi* was detected in an *Ixodes pacificus* tick (Figure 18).

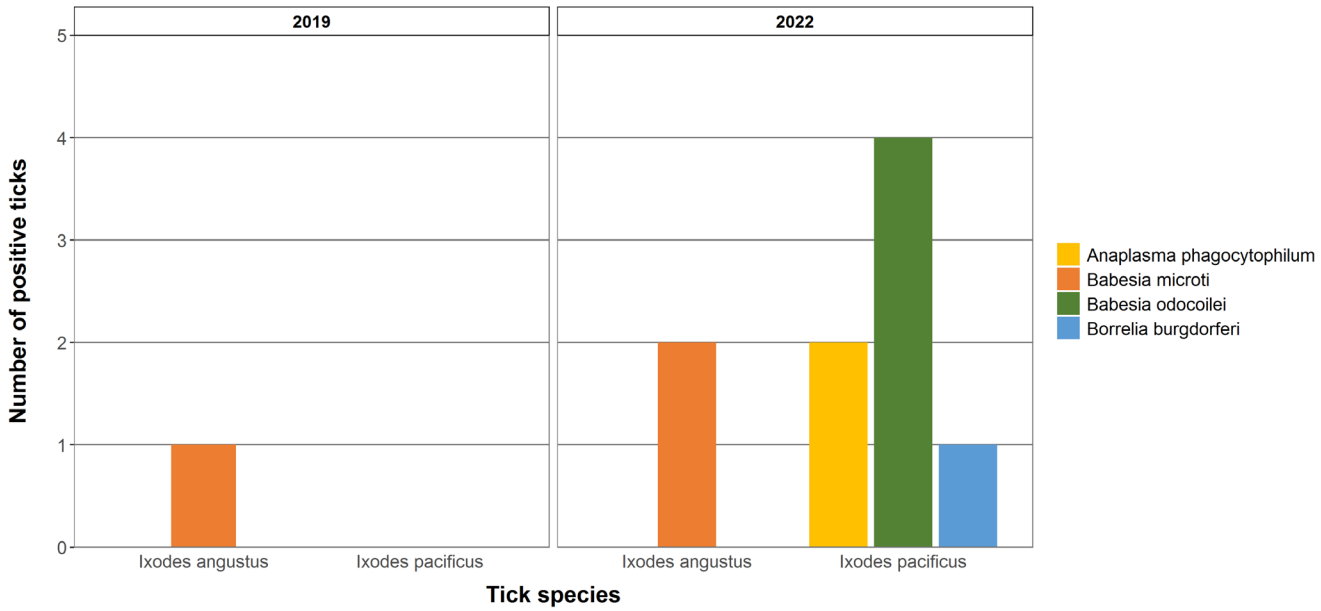


Figure 18. Number of Sampled *Ixodes* spp. Ticks Positive for *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, *Babesia odocoilei*, and *Babesia microti*, 2019 & 2022.

Borrelia burgdorferi was previously known to be circulating amongst local tick populations, and *Anaplasma phagocytophilum* has been detected in mammals in BC (Lester et al., 2005). However, *Babesia odocoilei* and *Babesia microti* are recently emerging pathogens to BC. Climate change can be expected to facilitate the presence of these tick-borne diseases.

Babesia odocoilei was previously not known to be circulating amongst BC ticks, with the prior range described to be as far north and west as Alberta (J. Scott et al., 2018). White-tailed deer, *Odocoileus virginianus*, were the first reported host of *B. odocoilei*, and infection has resulted in cervine babesiosis in white-tailed deer as well as other cervid hosts (Bartlett et al., 2009; Pattullo et al., 2013; Waldrup et al., 1989).

Babesia microti was first reported in BC in 2019, when it was detected in an *Ixodes angustus* nymph, but has previously been detected in *Ixodes scapularis* ticks in Manitoba, New Brunswick, Ontario, and Quebec (Dibernardo et al., 2014). *Babesia microti* is a parasite responsible for babesiosis and is known to be endemic to the upper mid-western and northeastern United States (Vannier et al., 2015).

There have been no known human cases of *B. microti* or *B. odocoilei* reported in BC. These pathogens and associated human diseases can be found below in Table 3.

Table 3. Pathogens Found in BC Ticks obtained by Canadian Lyme Disease Research Network and Associated Human Diseases.

Tick Species	Common Name	Pathogen Found	Human Disease
Ixodes angustus	None	*Babesia microti*	Babesiosis
Ixodes pacificus	Western Blacklegged Tick	*Anaplasma phagocytophilum*	Anaplasmosis
		Borrelia burgdorferi	Lyme disease

Resources

- For more information on Lyme disease, consult the BCCDC website.
- For more information on eTick and CLyDRN, please consult the following resources:

  eTick: https://www.etick.ca/

  CLyDRN: www.clydrn.ca/
- To submit a tick finding to eTick:
  1. Create an account
  2. Ensure that your tick is really a tick (consult "How can I recognize a tick?")
  3. Take a few pictures of the tick (consul the photographic guide or video photographic guide)
  4. Sign in and enter your tick information and upload your pictures at https://www.etick.ca/etickapp/submit/report-index
  5. Keep your tick for a period of at least 5 days following submission in case additional photos are needed to complete the identification

- To submit a tick to BCCDC Public Health Laboratory:
  1. Fill out the Parasitology Requisition form and follow the instructions on the form for preparing the sample.
  2. Follow the sample collection and transport guidelines and deliver the sample to BCCDC Public Health Laboratory or Central Processing & Receiving – Lane Level (CPR-LL), 655 West 12th Avenue, Vancouver.

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