

# The Effects of Climate Change on Vector-Borne Diseases in Canada

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## WHAT IS CLIMATE CHANGE?

Climate change refers to long-term shifts in weather patterns and temperatures created by human activity.

These shifts can have detrimental effects on the global community<sup>[1,2]</sup>.



Increase in extreme heat events



Increase in wildfire events

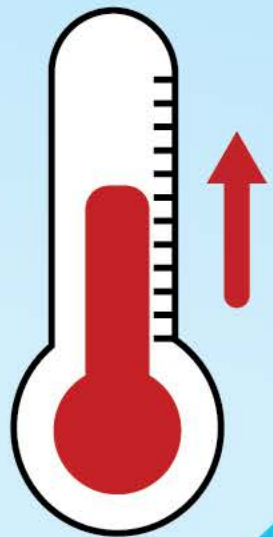


Increase in habitat changes



Increase in precipitation variability

Annual temperatures are projected to increase in Canada between 1.8°C and 6.3°C by the end of the century <sup>[3]</sup>. The largest increases in temperature are projected to affect Northern and Southern Canada during the winter and summer, respectively <sup>[4]</sup>. Researchers are concerned that warmer temperatures will allow vectors to expand their geographical range and to establish habitats in new regions across Canada.



Vectors are living organisms that can transmit pathogens to humans and cause illnesses known as vector-borne diseases <sup>[5]</sup>. In Canada, the two most common disease vectors are ticks and mosquitoes. These vectors can spread harmful infections by biting humans.

*Ixodes scapularis*



*Ixodes pacificus*



*Culex pipens*



*Culex restuans*



*Culex tarsalis*



**Dominant Tick Vectors in Canada** <sup>[6]</sup>:  
*Ixodes* species (i.e. *scapularis*, *pacificus*)

**Tick-Borne Diseases** <sup>[7]</sup>:

Lyme Disease | Anaplasmosis | Babesiosis  
Borrelia miyamotoi disease | Powassan virus disease

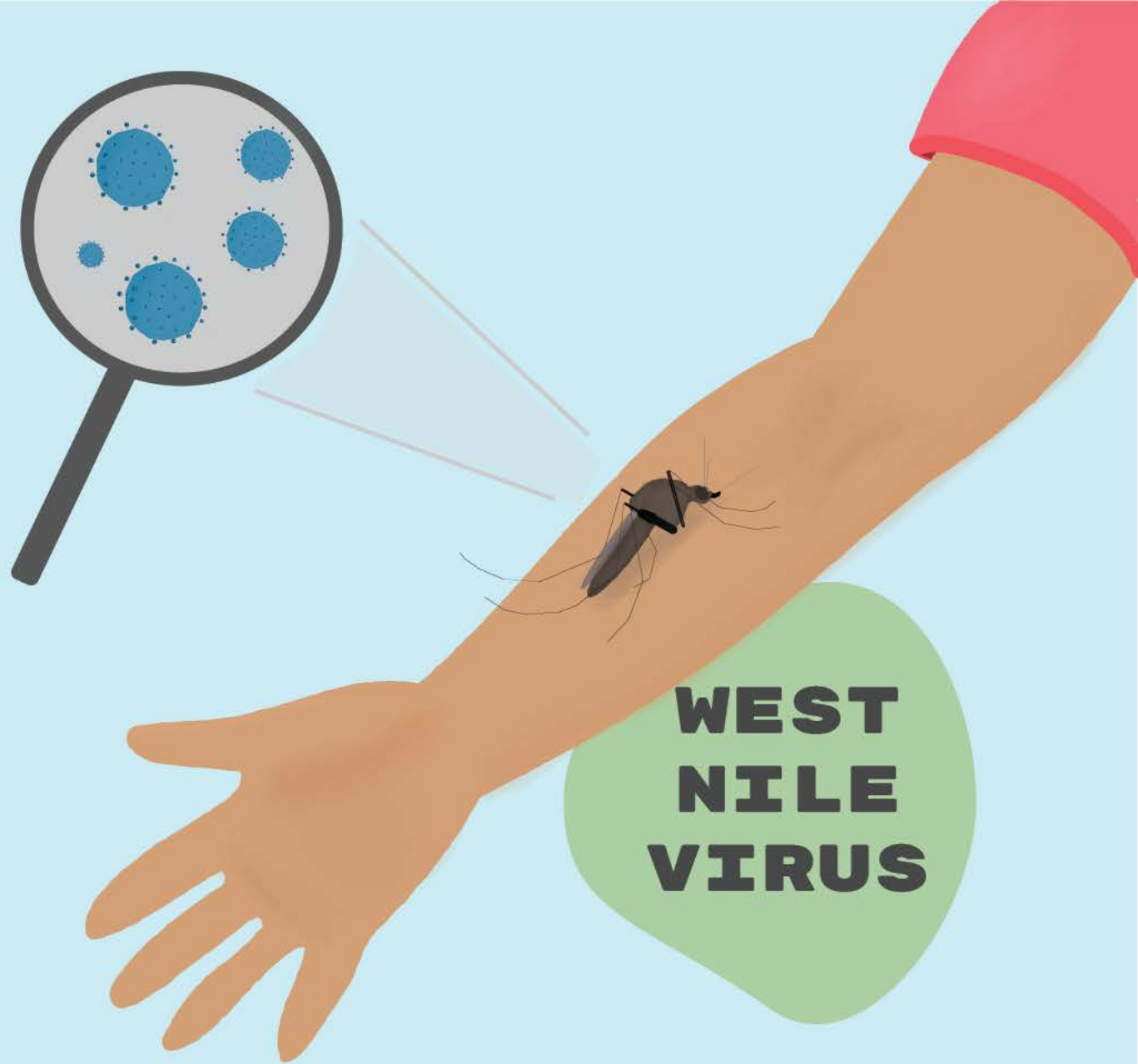
**Dominant Mosquito Vectors in Canada** <sup>[8,9]</sup>:  
*Culex* species (i.e., *pipiens*, *restuans*, *tarsalis*)

**Mosquito-Borne Diseases** <sup>[9,10]</sup>:

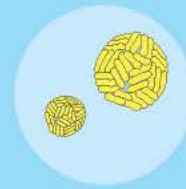
West Nile virus infection  
Eastern equine encephalitis virus



Among the diseases carried by Culex species, West Nile virus (WNV) is the most concerning health public issue due to the clinical consequences of WNV infections, such as paralysis and muscle weakness, and the abundance of Culex species <sup>[11,12]</sup>.



To date, the most common tick-borne disease in Canada is Lyme disease. With the emergence of climate change, researchers predict that Canada will also face an increase in cases of non-Lyme tick-borne diseases [6].



*Powassan virus* <sup>[13]</sup>  
Severe Symptoms: Encephalitis |  
Meningitis | Seizures



*Babesia microti* <sup>[14]</sup>  
Severe Symptoms: Hemolytic Anemia  
Thrombocytopenia | Jaundice



*Borrelia burgdorferi* <sup>[15]</sup>  
Severe Symptoms: Nerve Pain |  
Facial Palsy | Shooting Pains



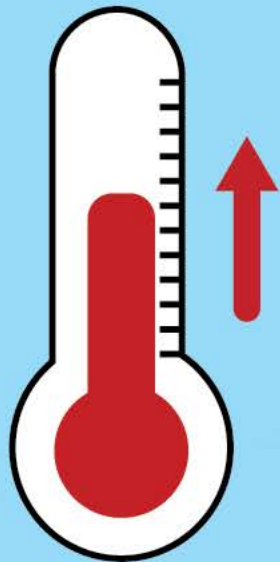
*Anaplasma phagocytophilum* <sup>[16]</sup>  
Severe Symptoms: Organ Failure |  
Respiratory Failure | Bleeding



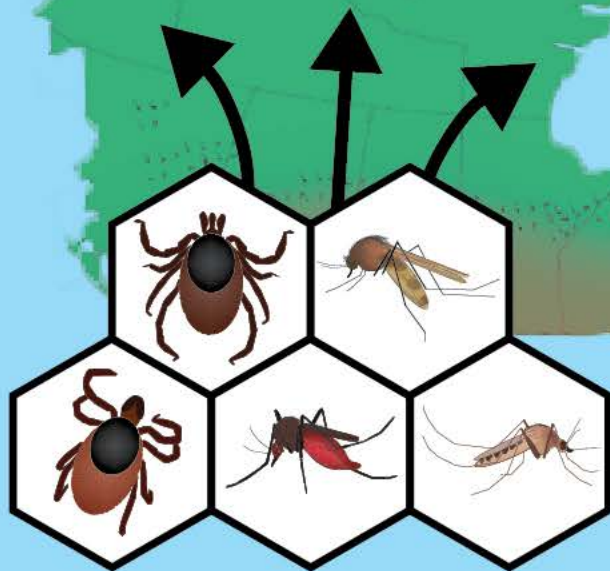
*Borrelia miyamotoi* <sup>[17]</sup>  
Severe Symptoms: Severe headache  
Vertigo | Abdominal Pain







Areas with pre-existing *I. scapularis* populations are predicted to grow as much as 4-fold by the 2080s<sup>[18]</sup>. Concurrently, *I. scapularis* populations are expected to expand 46 km North in Canada per year for the next decade<sup>[19]</sup>.




The infection rate of West Nile virus in *Cx. Tarsalis* populations is predicted to grow as much as 27-fold by the 2080s. In addition by 2050, *Cx. tarsalis* populations are projected to expand their geographical range by 1-2.5x across the Canadian prairies<sup>[20]</sup>.

Continued warming of the climate across Canada will result in negative effects on tick-borne diseases.

Shorter lifecycle durations of the *I. capularis* and *I. pacificus* lifecycle have been strongly linked to increased temperatures <sup>[21,22]</sup>. Thus, as different regions in Canada become warmer, researchers speculate that ticks will also reproduce faster.



An illustration of a tick with a dark brown, oval body and a black, circular head. It has eight red legs. The tick is positioned on a green leaf, with its front legs extended upwards and outwards, as if it is questing. The background is a light blue sky with several green blades of grass.

Did you know? Questing is a host-seeking behaviour of ticks where they climb onto vegetation, extend their front legs, and wait to attach themselves onto a passing host <sup>[23]</sup>.

Researchers found the questing behavior of *I. scapularis* to be prolonged with increased temperatures, up to a threshold of 25°C <sup>[24]</sup>.

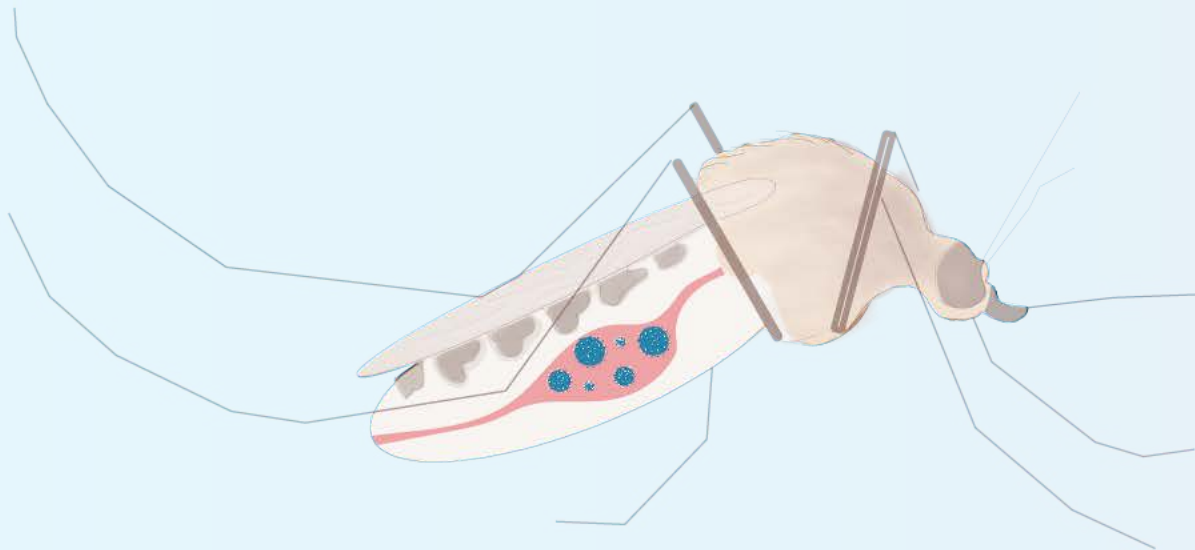


**Did you know:** In a past study, researchers estimated that migratory birds travelling through Canada can disperse as much as 175 million *I. scapularis* ticks per year <sup>[25]</sup>.

Warmer temperatures will both extend and advance the duration of tick activity within the year, thus enabling them to seek and infect different hosts at higher turnover rates <sup>[26]</sup>.

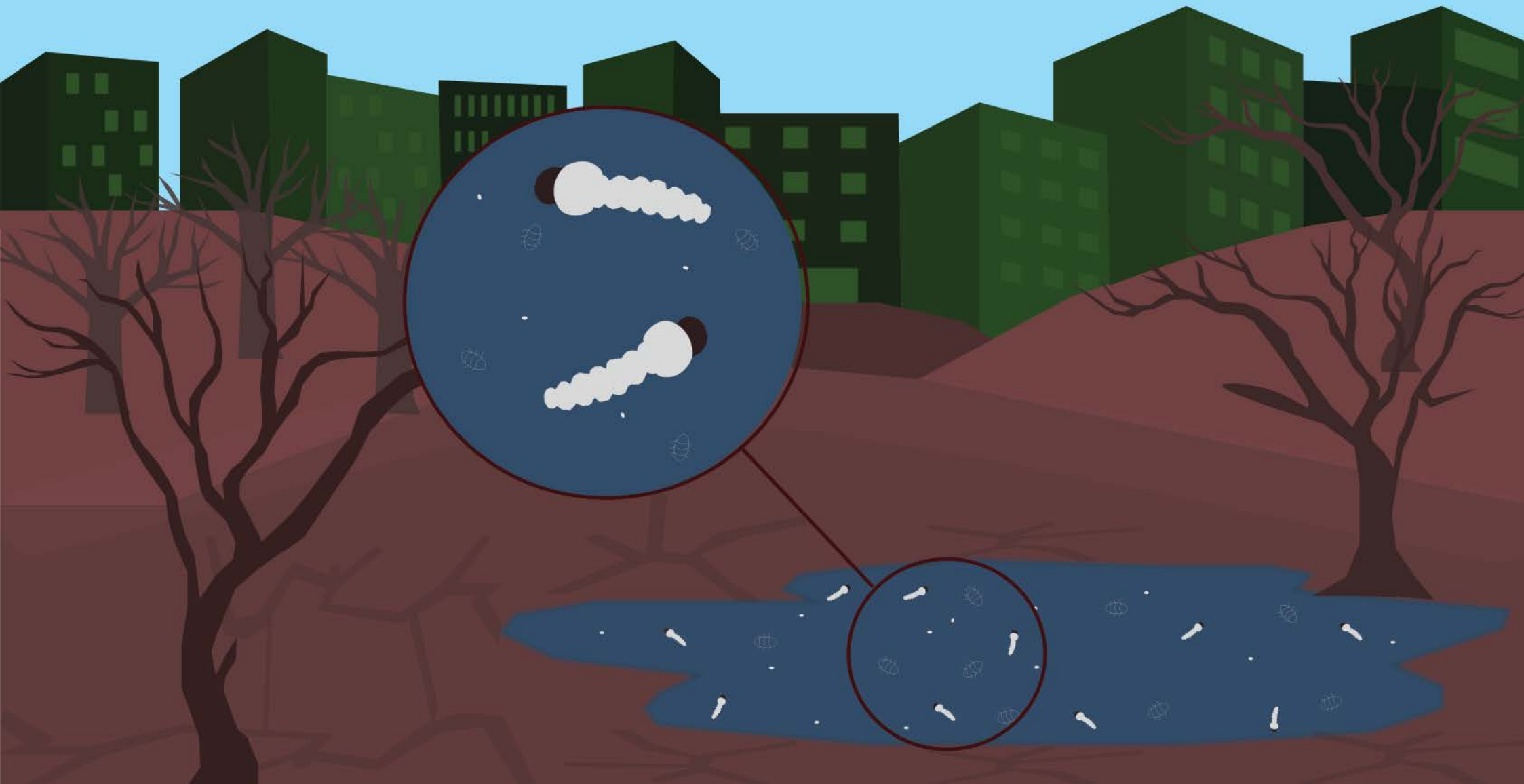


The span of development for Immature *Cx. tarsalis* mosquitos was also found to be shorter with increased temperatures <sup>[27]</sup>. In addition, warmer temperatures can increase the viral replication of WNV in *Culex* species, thus resulting in higher viral loads and infectivity <sup>[28,29]</sup>.



Continued warming of the climate across Canada will result in negative effects on mosquito-borne diseases.

With warmer climates, incidents of drought are predicted to occur more often in Canada. Droughts reduce the water flow in local rivers and lakes, which in turn, creates stable habitats for rearing mosquitoes <sup>[30,31]</sup>.





Along with other mechanisms, increase in air temperature can also augment the rate of mineralization and release of nutrients from soil into bodies of water, thereby creating habitats that better support the development and rearing of mosquito populations <sup>[32,33]</sup>.



The diagram shows a landscape with a yellow sky, a large sun, and orange clouds. In the foreground, there is a green field with several brown houses and two green trees. A blue pond is located in the lower right. A large, dark grey, cone-shaped arrow points from a circular inset on the left towards the pond. The circular inset shows a cross-section of the soil with white, worm-like shapes representing microorganisms. A red arrow originates from a red dot in the soil inset and points towards the pond. A light green speech bubble with the text 'LEACHING MINERALS' is positioned near the red arrow. The pond contains small white and grey shapes, likely representing mosquito larvae and pupae.

**LEACHING  
MINERALS**