Locally Transmitted Mosquito-Borne Viruses and Their Competent Mosquito Vectors in British Columbia

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Introduction

Background

British Columbia (BC) is home to over 50 mosquito species with varied distribution and habitats[1]. A subset of these species can carry and transmit pathogens that affect human and animal health[2]. Surveillance of local mosquito populations has detected three of these pathogens: West Nile virus (WNv)[3] and two California serogroup viruses (CSGv), Jamestown Canyon virus (JCv) and Snowshoe hare virus (SSHv)[4,5].

Transmission of mosquito-borne viruses is most common from late spring to early fall[2], although infections with these viruses have been rarely detected in BC. Infections are most often asymptomatic or present mild, flu-like symptoms, and in rare cases can progress to severe neuroinvasive disease[4,6]. Individuals most vulnerable to developing severe symptoms include young children, older adults, and those with underlying health conditions[2,5]. In most mosquito-borne illness transmission cycles, humans are incidental, dead-end hosts, meaning they can become infected but do not transmit the virus directly to others or back to mosquitoes[2].

As climate change alters ecosystems, conditions such as increased rainfall and warmer temperatures may expand mosquito ranges, extend mosquito activity seasons, increase population sizes, increase biting rates, and shorten viral incubation periods within mosquitoes[7,8]. These changes may also facilitate the arrival of invasive mosquitoes and the pathogens they carry into BC. Together, these factors may increase human exposure to mosquito-borne pathogens, making monitoring of mosquito populations increasingly important.

Purpose and Scope

This document applies a One Health approach, recognizing the interconnectedness of humans, animals, and the environment[9]. Its purpose is to raise public awareness, support informed decision-making among public health, medical, and veterinary professionals, and highlight emerging threats and surveillance priorities.

This document focuses on mosquito-borne viruses with confirmed local transmission in BC, along with the endemic and invasive mosquito species in the province that are known competent vectors for these viruses (Table 1). It is important to note that the specific mosquito species responsible for recorded cases of illness in BC are unknown. The species included have demonstrated vector competency in experimental settings and could potentially transmit these viruses, but their roles in confirmed local transmission of mosquito-borne viruses have not been established. Additionally, some mosquito species in BC have demonstrated vector competency for other mosquito-borne pathogens; however, local transmission has not yet been detected in the province and therefore are not addressed here. Given these uncertainties, reducing mosquito bites through general precautions remains an important risk mitigation strategy.

Mosquito Borne Viruses of Concern in British Columbia

California Serogroup Viruses (SSHv and JCv)

The CSG viruses are a serogroup consisting of many viruses, including SSHv and JCv[4]. The specific mosquito species responsible for human cases in BC have not yet been determined, though vector competency has been demonstrated in *Aedes*, *Anopheles*, *Culiseta*, *Culex*, and *Coquillettidia* species[10]. Primary reservoirs for SSHv are snowshoe hares and squirrels, and white-tailed deer and other ungulates (moose, elk, and bison) for JCv[11]. There have been sporadic reports illnesses caused by CSGv in BC for several years, including a cluster of encephalitis cases affecting three children and one adult in the Whistler region in 2024 linked to SSHV infection[4,5].

West Nile virus (WNv)

In BC, WNv poses risk of infection to horses, humans, and birds[6]. Competent vectors present in BC include *Aedes dorsalis, Aedes melanimon, Aedex vexans, Culex restuans, Culex tarsalis, Coquillettidia perturbans*, and the invasive species *Aedes japonicus* and *Culex pipiens*, though *Culex tarsalis* and *Culex pipiens* are considered the primary vectors[12]. Wild birds, including corvids such as crows, jays, and ravens, are the main reservoir hosts for WNv. Birds and horses are the species most likely to develop clinical illness. Humans, horses, and other mammals can become infected but are dead-end hosts, as they do not contribute to onward transmission. Locally-acquired cases have primarily occurred in BC's Okanagan and Kootenay regions, with the first human and horse cases reported in 2009[3]. The British Columbia Centre for Disease Control conducts ongoing surveillance for WNv in BC and provides updates on detections in people and animals through the WNv Dashboard.

Vector Competency

The vector competence of mosquito species for pathogens of concern is summarized in Table 1. Competency is determined experimentally by evaluating whether a mosquito species can acquire, replicate, and transmit the virus following exposure under controlled laboratory conditions.

Conclusion

BC is home to several mosquito species capable of transmitting pathogens that impact human and animal health. Recent cases of mosquito-borne disease, combined with the potential for climate change to expand mosquito ranges and extend transmission seasons, highlight the need for ongoing surveillance. While detected infections in BC remain rare, continued monitoring is essential to detect emerging threats, monitor mosquito species and associated pathogen distribution, and support timely public health action, including protective measures and appropriate clinical care.

Spending time outdoors is important for mental and physical health and simple precautions can significantly reduce the risk of mosquito bites. This can include wearing light-coloured, loose, long-sleeved clothing, applying insect repellent containing DEET or icaridin to exposed skin, using screens or mosquito netting where possible, and eliminating standing water around the home to reduce mosquito breeding sites[13].

Table 1. Mosquito species in BC with competency for SSHv, JCv, and WNv along with their current endemic (E) vs invasive (I) classifications[1] and distribution in the province[14].

Species[a,b]	Known Distribution	Evidence of Competency		
		SSHv	JCv	WNv
Aedes cinereus (E)	Widely distributed throughout BC	☑ [15]	☑ [16]	☐
Aedes communis (E)	Widely distributed throughout BC	☑ [15]	☑ [17]	☐
Aedes dorsalis (E)	Interior of BC & coastal salt marshes around Georgia Strait, Metro Vancouver	☐	☐	☑ [12]
Aedes excrucians (E)	Whistler Region	☑ [15]	☑ [16]	☐
Aedes fitchii (E)	Southern Interior of BC, Vancouver Island	☑ [15]	☐	☐
Aedes implicatus (E)	Okanagan, Similkameen Valley	☑ [18]	☐	☐
Aedes intrudens (E)	Okanagan, Similkameen Valley	☑ [15]	☐	☐
Aedes japonicus (I)	Georgia Strait, Washington Coast, Gulf Islands, Lower Mainland & Southern Vancouver Island	☐	☐	☑ [12]
Aedes melanimon (E)	Southern dry interior of BC	☐	☐	☑ [12]
Aedes provocans (E)	Northeastern BC	☑ [19]	☑ [10,20]	☐
Aedes punctor (E)	Okanagan	☑ [15,19]	☐	☐
Aedes vexans (E)	Metro Vancouver, Lower Mainland & Fraser Valley, Okanagan	☐	☐	☑ [12]
Anopheles punctipennis (E)	Vancouver Island and the southern mainland of BC	☐	☑ [21]	☐
Culex pipiens (I)	Widely distributed across Southern BC. Found on Vancouver Island, Valemount, & Prince George	☑ [22]	☐	☑ [12]
Culex restuans (E)	Vancouver Island	☐	☐	☑ [12]
Culex tarsalis (E)	Common from the West Coast to the Okanagan; east to Cranbrook; southern Vancouver Island	☐	☐	☑ [12]
Culiseta inornata (E)	Widely distributed throughout BC	☑ [22]	☑ [10]	☐
Coquillettidia perturbans (E)	Metro Vancouver, Vancouver Island, Georgia Strait, Fort Nelson, Prince George, Northern BC	☐	☑ [10]	☑ [12]

[a]Endemic species are mosquito species that are native to BC. Invasive species are mosquito species that have been introduced to BC from other parts of the world and can negatively impact the ecosystem.

[b]Invasive species may be recorded (detected on at least one occasion) or considered established (observed in the wild for two or more consecutive years), meaning they have reproduced and survived local winters.

Acknowledgements

The British Columbia Centre for Disease Control provides services to a diverse population including First Nations, Métis Peoples, and Inuit living in various settings and communities across British Columbia. As a provincial organization, we operate on the unceded traditional and ancestral lands of First Nations. The British Columbia Centre for Disease Control is located on the unceded, ancestral, and occupied, traditional lands of the xʷməθkʷəy̓əm (Musqueam), Sə̓lílwətaʔ (Tsleil-Waututh), and Skwxwú7mesh (Squamish) Nations.

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