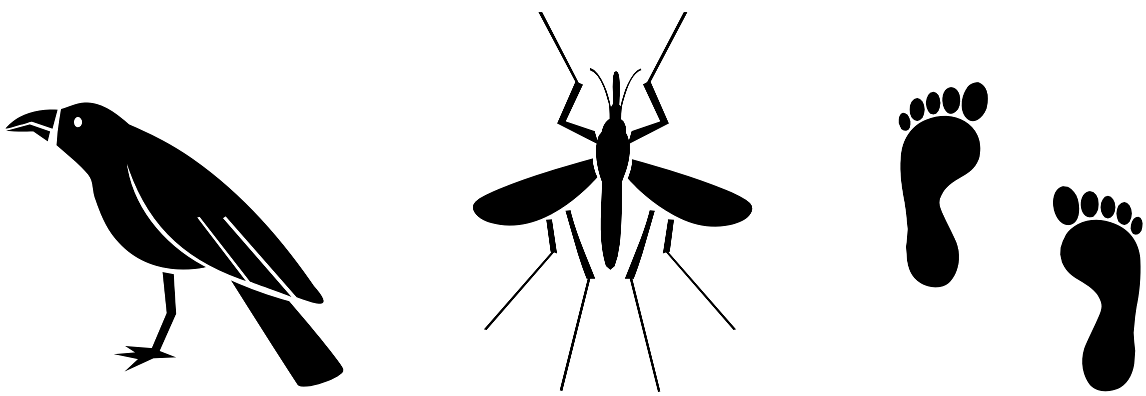
West Nile Virus Activity in British Columbia: 2011 Surveillance Program Results



Communicable Disease Prevention and Control Services
British Columbia Centre for Disease Control
www.bccdc.ca/westnile

Executive Summary

One equine case of West Nile Virus (WNV) infection was reported in 2011; the horse was located in the Central Okanagan. No other positive indicators (human, mosquito or corvid) were detected in 2011. This indicates establishment of WNV in both the south and central Okanagan Valley. In contrast with the low number of human infections seen in the past couple years, in 2011 WNV activity was high in Ontario and Quebec with a combined 101 human cases (Table 1).

WNV activity in the United States in 2011 was lower than 2010 and greater than 2009 (Table 1). Washington State had much lower activity in 2011 compared to both 2009 and 2010 (Figure 1).

Table 1: Human WNV Infections in North America, 2004-2011

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Canada	20	239	127	2,353	36	8	5	101
United States	2,344	2,949	4,052	3,404	1,301	515	972	627

Sources: (PHAC, as of November 20, 2011; http://www.phac-aspc.gc.ca/wnv-vwn/pdf_nsr-rns_2011/wnvnr_summary-resume2011-eng.pdf*)*

Corvid and mosquito surveillance in 2011 was focused on the higher risk areas of the province including Richmond, Fraser Health Authority (FHA), particularly the Fraser Valley and Interior Health Authority (IHA), particularly the South and Central Okanagan.

Forty corvids were collected for testing in 2011, a decrease over 2010. Decreased submissions were the result of programmatic changes in all regions and a reduced focus on corvid collections. The number of dead birds reported online (267) was down slightly from the number reported in 2010 (355).

Overall the number of mosquitoes trapped was up from last year despite having fewer permanent trap locations, likely reflecting the large *Aedes* population as well as selective trapping in the best mosquito locations. The average number of *Culex pipiens* trapped (27.6/trap-night) was higher than 2010 (23.7/trap-night), and the average number of Cx*. tarsalis* was also higher in 2011 (9.3/trap-night) than in 2010 (4.9/trap-night).

In addition to surveillance activities, in 2011 the BC Centre for Disease Control (BCCDC) provided WNV prevention brochures to stakeholders such as parks and tourist centres, responded to media inquiries, posted updates to our website and issued two news releases. The BCCDC also provided a media release in July in response to large numbers of nuisance mosquitoes to inform the public on personal protective measures and reducing mosquito breeding sites around the home.

Figure 1: WNV Activity in the Pacific Northwest, 2011

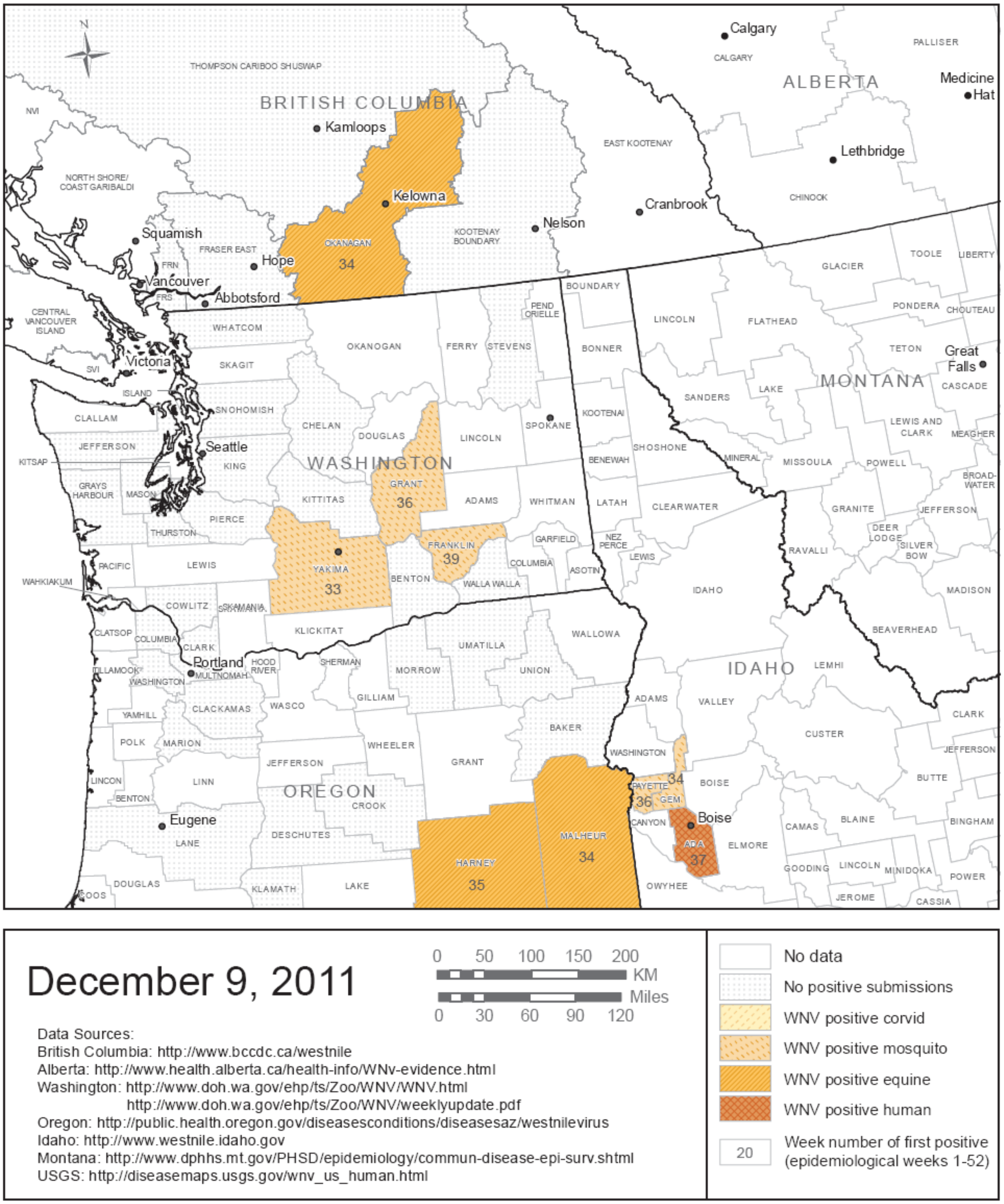


Table of Contents

Tables:

Figures:

Summary of Surveillance Activities

Surveillance Planning Sessions

In May 2011, BCCDC hosted their annual BC Vector-Borne Disease Committee Meeting (formerly the Provincial WNV Meeting), which included attendees from the Health Authorities (HA), municipalities, colleagues in animal health, and other stakeholders. Past surveillance results were evaluated and plans for the upcoming 2011 season were reviewed.

Surveillance Activities

Active WNV surveillance is carried out on both corvids and mosquitoes. Passive surveillance is focused on humans, horses and potentially other species that could be infected and reported. The objectives of WNV surveillance are two-fold:

1. To monitor WNV activity in various species in BC to:
    a. Predict increased risk to human health
    b. Inform public health decisions
    c. Guide communication strategies
    d. Monitor the effectiveness of control measures

2. To optimize mosquito control decision-making by identifying:
    a. The geographic and temporal distribution of potential vector species in BC
    b. Mosquito development sites

Human surveillance involves the BCCDC Communicable Diseases Prevention and Control Services (CDPACS; formerly Epidemiology Services), Provincial Health Services Authority (PHSA) Public Health Microbiology and Reference Laboratories (PHMRL), Canadian Blood Services (CBS), BC Transplant Society and the physicians of BC. Physician requests for WNV testing received by BCCDC labs are tracked. Data sharing protocols with CBS are in place to ensure prompt deferral of blood collected from suspected WNV-infected persons and to allow BCCDC to monitor asymptomatic infections identified through screening of the blood supply. From May to November, all solid organs and tissues intended for transplant are screened prior to transplant. In the low risk period (December through April) only organs from donors with a travel risk are screened.

In accordance with established practice, information on any probable human cases was communicated to the requesting physician as well as to the appropriate HA to enable administration of a case questionnaire to collect information on symptoms, travel history and likely mode of transmission. Cases are classified as either West Nile Non-Neurological Syndrome (WN-Non-NS) or West Nile Neurological Syndrome (WNNS) according to both self-reported symptoms and clinical information collected from the patient's physician. Cases are further categorized as probable or confirmed depending on the laboratory test performed. Case definitions can be found at http://www.phac-aspc.gc.ca/wnv-vwn.

The human testing algorithm entails screening acute serum samples for Flavivirus EIA – IgM and IgG. Convalescent sera are requested and tested in parallel with the acute sample for both IgM and IgG. Hemagglutinin Inhibition testing is performed on positive IgM and/or IgG samples, as required. WNV IgG avidity is also done as required. Probable positive cases are referred to the National Microbiology Laboratory (Winnipeg) for confirmatory plaque-reduction neutralization testing (PRNT).

BCCDC works with the Animal Health Centre (AHC), Animal Health Branch, BC Ministry of Agriculture (MoA) in the reporting of animal cases of WNV. Work is ongoing to improve monitoring and reporting of animal infections between animal health and public health. Additionally, a recommendation has gone forward to make WNV in animals reportable to public health under the new Public Health Act Communicable Disease Regulation being drafted.

As per established protocols, corvid surveillance was achieved in 2011 through two mechanisms:

- Dead corvids were submitted by the Regional Health Authorities to the AHC in Abbotsford during the surveillance season for WNV testing using PCR only. Tissue samples from positive specimens would be sent to the PHSA PHMRL for confirmation. The change to PCR testing was implemented in 2011 due to issues identified with the commercial rapid immunochromatographic antigen detection assay (VecTest®).
- In addition to birds tested, an online form was available on the BCCDC website (www.bccdc.ca/westnile) for the public to report sightings of dead corvids. The intent is that dead corvids sighted by the public and reported through the online form are separate from those picked up for testing. The locations of birds tested and reported online were used to create corvid density maps for regions of the province with sufficient data (maps.bccdc.org).

Surveillance for WNV in horses is passive. That is, there is no active program to look for infection or test the sero-prevalence of WNV antibodies in horses. Instead, serologic specimens from horses suspected of being infected with the virus are collected by the attending veterinarians and submitted to a veterinary diagnostic lab for WNV testing. Specimens are tested using the IgM enzyme-linked immunosorbent assay (ELISA, also called enzyme immunoassay, or EIA), and rarely, serum neutralization tests. WNV is often fatal in horses. Specimens from horses that die or are euthanized after exhibiting neurological symptoms, and are submitted for diagnostic necropsy to the AHC, may be tested for WNV by immunohistochemistry and/or PCR.

Mosquito surveillance focuses annually on identification and distribution of adult vector mosquitoes and PCR testing of female *Culex* mosquitoes. Mosquito surveillance activities were started June 1st, 2011 with surveillance focused on the three higher risk RHAs in BC. IHA focused the number of trap locations in the Okanagan and Thompson

Cariboo Shuswap. FHA reduced the number of traps and targeted specific sentinel communities with duplicate trapping. In Richmond traps were not moved, and as in previous years, they were operated 2 times a week to increase mosquito counts. These decisions were based upon a risk assessment of the respective areas. Traps were run overnight and the catches sent in coolers to BCCDC for identification and WNV testing.

The PHSA PHMRL separated mosquito submissions into sex and taxonomic groupings: 1) *Aedes,* 2) *Anopheles,* 3) *Coquillettidia,* 4) *Culiseta* and 5) *Culex*. Mosquitoes were sorted on a chill table (to prevent denaturation of any viral RNA) and identified to genus, and in the case of *Culex*, to species. If a trap failed to capture any mosquitoes, the information (i.e. trap malfunctioned, no mosquitoes trapped or trap was not run) was faxed to the lab and recorded. Beginning in 2006, only female *Culex* mosquitoes were tested for the virus in groups of up to 50 mosquitoes per pool, by PCR. The remaining mosquitoes were identified but not tested. When traps contained more than 500 mosquitoes, the entire sample was sorted to selectively pick out all the female *Culex* mosquitoes for PCR testing. Five hundred mosquitoes from large volume traps were initially identified and reported; the remainder (i.e. non-*Culex* species) was saved for identification at the end of the season. A fraction of the remainder (½, ¼, ⅛, etc.) was identified and the total number for each genus in the trap extrapolated.

Ongoing, prospective, cumulative temperature degree-day maps were used to help forecast higher risk areas for WNV. Degree day assessments can assist in predicting the number of generations of mosquitoes expected in a given area and the speed of virus replication.

Mosquito, bird, geographic and temperature data were integrated using an interactive online mapping tool (maps.bccdc.org). This was developed to assist stakeholders with geo-spatial risk assessment to help target appropriate mosquito control activities. Larval data, collected by independent mosquito control contractors are included in this mapping tool for use by Medical Health Officers (MHO) when making mosquito control decisions.

Those involved in WNV surveillance activities include BCCDC CDPACS, PHSA PHMRL; CBS, MoA and HA staff; federal, provincial, municipal and regional government staff; mosquito control contractors; academic centres; wildlife biologists and communications personnel. All were invited to participate in regular teleconferences to discuss emerging surveillance issues. Surveillance results from BC, across Canada and the United States were summarized in a routine surveillance report distributed to BC stakeholders, including members of the surveillance group, infectious disease physicians, medical microbiologists and those involved in the provision of blood products and transfusion services.

Surveillance Results

Results at a Glance

Table 2: Summary of BC Surveillance Statistics, 2011

	Human samples[1]	Corvids Submitted[1]	Corvids Sighted[1]	Mosquito Pools[2]	Horse
# Tested	415	40	267	2,282	
# Positive	0	0		0	1

1. This table includes data from May 30-October 11, 2011
2. A pool may contain up to 50 mosquitoes that are tested at one time.

Surveillance of WNV in Humans

Epidemiology of Human Infections

In 2011, 415 human specimens were tested by PHSA PHMRL, with no positive results.

One hundred and one human infections were reported in Canada in 2011 (37 in Quebec, 64 in Ontario). Thirty eight (37%) were classified as neurological syndrome. Four deaths were reported. A total of 672 human WNV infections were reported in the US in 2011. No human infections were reported from Washington State.

Protecting the Blood Supply from WNV – Testing at CBS

CBS performs year-round WNV nucleic acid testing on every donation. Although routine screening is performed in mini-pools (MP) of six specimens, more sensitive, single unit (SU) testing is selectively done for blood donations collected from regions of higher WNV risk (Busch et al. 2005). CBS uses two criteria for implementing SU testing: either a positive donor test result or an incidence of public health-reported symptomatic WNV in a health region over a two week period exceeding either 1:1,000 in rural areas or 1:2,500 in urban settings. SU testing is then implemented for a minimum of one week for all donor clinics in proximity to an affected region. WNV testing reverts to routine MP screening if neither criterion is met over the ensuing one week period.

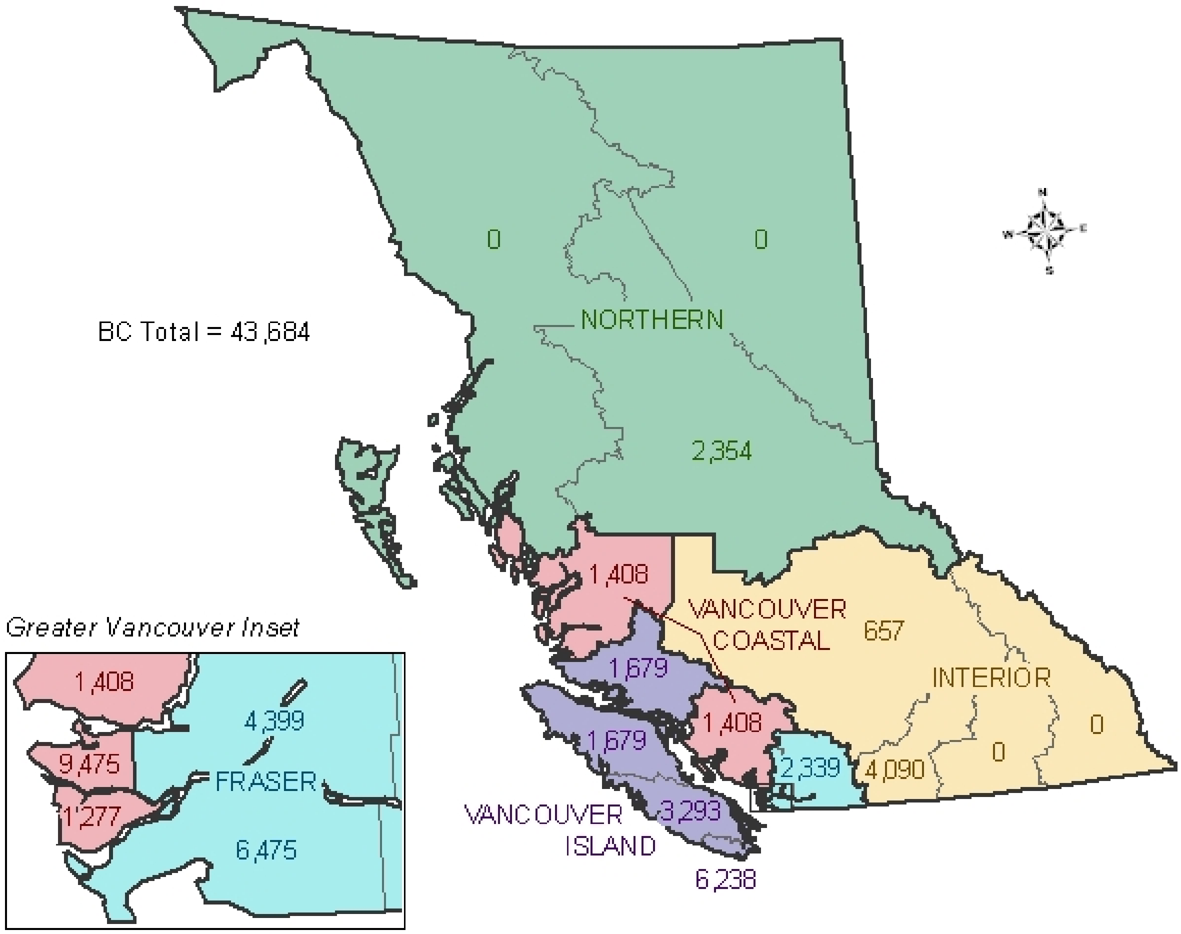
In BC, CBS, BCCDC and BC Ministry of Health Services (MoHS) continued their close co-operation in WNV planning, preparation and surveillance. A comprehensive WNV Action Plan is updated each year; the 2011 edition is available at www.pbco.ca.

From June 1 to Oct 12, 2011, BCCDC provided daily reports to CBS BC and Yukon Centre of WNV test requests received by BCCDC. This enabled rapid identification of donors who may have recently donated potentially WNV infectious blood, so that a product recall could be carried out on donations made within the previous 14 days. CBS was advised of 687 WNV test requests received by BCCDC; of these, there were 55 (8% of 687 reports) unique blood donors registered with CBS. None of these donors had donated a whole blood unit within 14 days of WNV testing at BCCDC so no product recall of in-date products was required.

Blood Donor WNV Screening

CBS, BC and Yukon Centre provided BCCDC with aggregate, regional blood donor WNV testing updates for BC collections throughout the WNV season. This reporting provides geographically comprehensive and timely ongoing human WNV surveillance data to public health. Between May 31 and October 12, 2011, there were 43,684 collections of blood in BC (Figure 2). There were no positive WNV screening test results from any blood donation in British Columbia in 2011.

Figure 2: Number of blood donor collections by HSDA, June 1-Oct 5, 2011



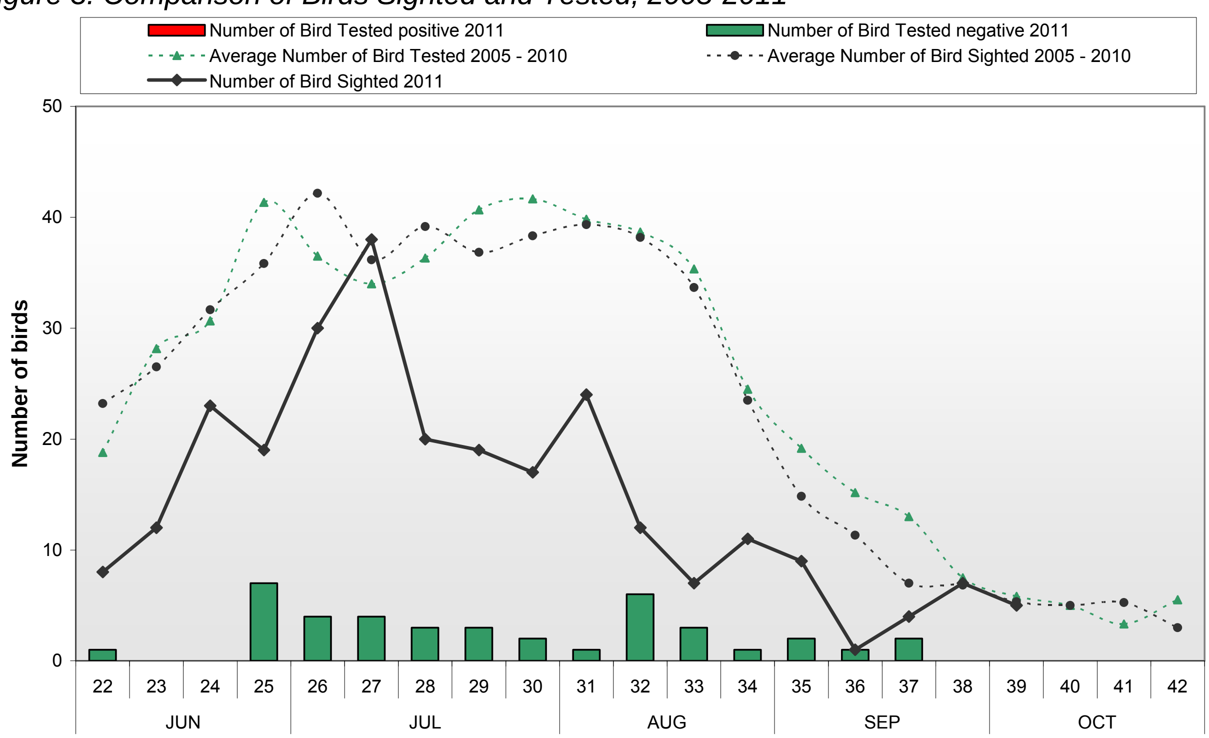
Across Canada, CBS WNV donor screening identified six WNV positive donors during 2011; all donations were made in Ontario. Hema Quebec also reported four WNV positive donors this year. As in the previous eight years, since donor WNV screening was implemented, no case of suspected transfusion-transmitted WNV was reported in Canada during 2011.

Surveillance of WNV in Corvids

During the 2011 surveillance season 40 corvids were collected and tested with no positive results. The number of corvids tested in 2011 remains significantly below the average number tested between 2005 and 2009. This decrease compared to historical seasons may be due to changes in public interest and in surveillance program participation (HAs shifted focus from corvid collection onto mosquito collection). The number of birds submitted and tested by week over the WN season was consistent and low.

A total of 267 dead birds were sighted and reported online to BCCDC. This number is much lower than the historical average of 425 reported between 2005 and 2010. The number of birds sighted peaked at the beginning of July and the beginning of August (weeks 27 and 31) (Figure 3). These peaks likely reflect increased public attention due to media releases done by the RHAs and BCCDC.

Figure 3: Comparison of Birds Sighted and Tested, 2005-2011



Average number of birds sighted in 2005 - 2010: 475

Average number of birds tested in 2005 - 2010: 425

Total number of birds sighted in 2011: 267

Total number of birds tested Negative in 2011: 40

Total number of birds tested Positive in 2011: 0

Data up to and including Oct 12, 2011

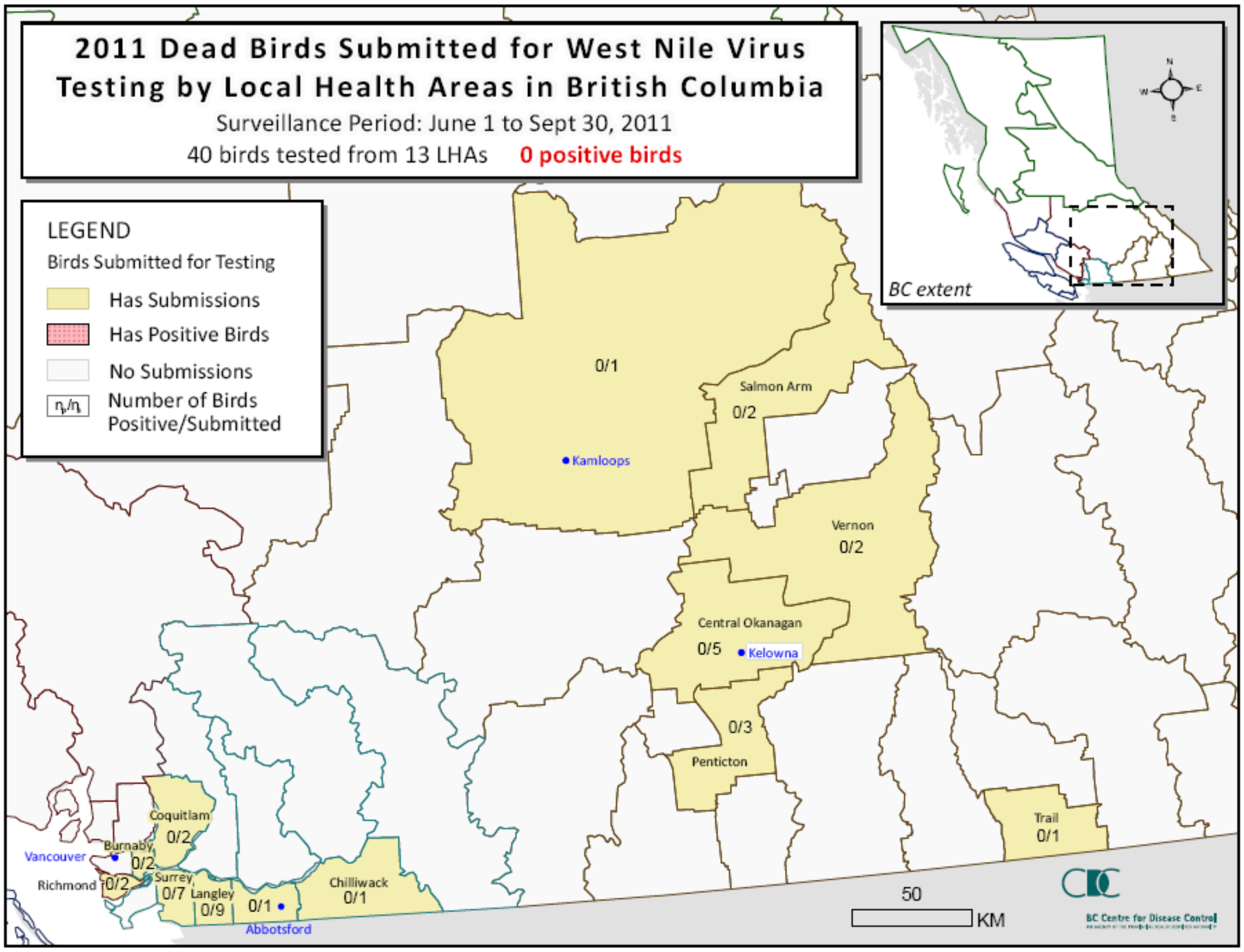
Weeks run Sunday to Saturday

The spatial distribution of dead corvid submissions was limited to the areas that participate in corvid collection (Richmond, FHA and IHA). The majority of birds were collected in Metro Vancouver, Fraser Valley, Okanagan Valley, and Kamloops (Figure

4). Similarly to 2010, no corvids were submitted for testing from the South Okanagan this year. Additional charts of weekly corvids submitted for testing and sighted in 2011 by HSDA can be viewed at www.bccdc.ca/westnile.

There were no identified clusters of crow die-offs as occurred in 2010.

Figure 4: Geographic Distribution of Corvid Test Results, 2011



Surveillance of WNV in Horses

There was one horse from the Central Okanagan which met the case definition for WNV. Surveillance for WNV in horses was enhanced in 2010 when the Animal Health Centre started offering serologic testing for horses in BC with compatible clinical signs in addition to diagnostic testing at necropsy; however there have been ongoing challenges for equine practitioners to use this new service.

Surveillance of WNV in Mosquitoes

The collection and testing of mosquitoes for the presence of WNV is a key component of regional arbovirus surveillance, and is the cornerstone of many WNV programs. Random sampling in areas with potentially endemic WNV activity may give an early warning of the arrival of the virus before other animals become sick. Mosquito sampling in known endemically infected areas can also offer vector population estimates and provide insight into future WNV risk. In addition to information about the spread of the virus, an active mosquito surveillance program can both identify which species are present, and determine the type of habitat producing that species.

In 2011, there was a total of 1,289 submissions from miniature CDC mosquito light traps baited with dry ice (to produce CO_2), resulting in 2,282 pools tested. A total of 388,082 mosquitoes were collected from these trap locations. There were higher numbers of the nuisance *Aedes* species in all regions of surveillance this year. The provincial average of *Culex* per trap night was 32.2 (all *Culex* species, including males). This was higher than last year's average *Culex* count of 27.5) (Table 3).

Trap Coverage

The WNV Program has been monitoring mosquitoes in BC since 2003. Testing has been focused on female *Culex* species only, since 2006, and it was *Culex* species in traps from the South Okanagan that were first identified as positive.

Figure 5 depicts the locations of adult mosquito traps in 2011. Since adult mosquito surveillance began in 2003, the geographic coverage of traps has changed and the strategic placement of traps in mosquito rich environments has improved, reducing the number of low yield traps and providing better capture of high risk species like *Cx. pipiens* and *Cx. tarsalis* (Table 3). This year we focused surveillance on regions with highest potential risk based on a model using geography, temperature, and known occurrence of species. In the Fraser River Lower Mainland this included Delta, south Surrey and Abbotsford/Mission region, while in the interior of the province we focused on the Okanagan Valley with some traps extending into the Thompson River Valley and Shuswap Lake region. Traps began running in the first week of June and continued until the last week of September. This is the window of time that covers the period when WNV is active in North America rather than the entire season when mosquitoes are active.

Figure 5: Geographic Distribution of Mosquito Traps in BC, 2011

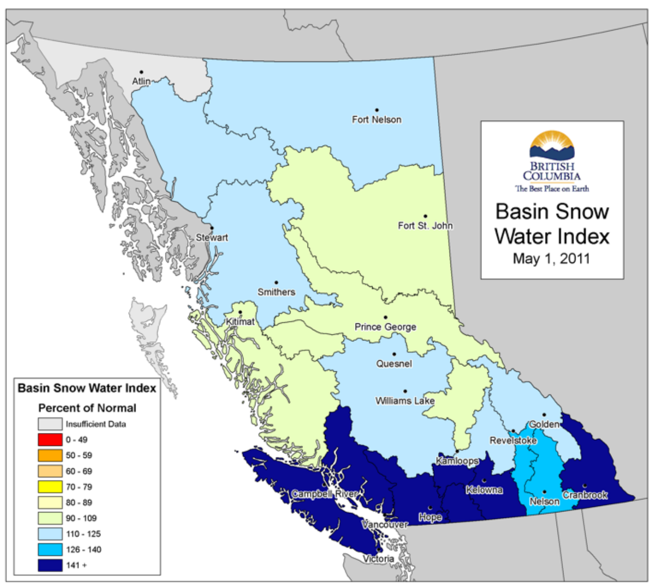
Table 3: Changes in Mosquito Trap Operations, 2005-2011

Parameter	2005	2006	2007	2008	2009	2010	2011
# Permanent locations	189	148	155	98	91	101	75**
# Mosquitoes	198,228	394,047	242,215	202,460	182,063	203,753	388,082
# Pools tested	6,631	2,329*	2,568*	1,873*	2,482*	2,092*	2,282*
Submissions	2,778	2,287	2,365	1,471	1,536	1,421	1,289
Ave # *Cx. tarsalis*^	1.9	4.8	3.5	1.4	11.8	4.9	9.3
Ave # *Cx. pipiens*^	5.1	8.6	14.3	10.5	21.1	23.7	27.6

** Only Culex species tested for WNV.*
*** FHA operated paired traps, so 75 traps were operated in 52 locations.*
^ Including male and female mosquitoes during the season. It is calculated by:
Total number of *Culex* ÷ total number of trap submissions = # per trap-night.

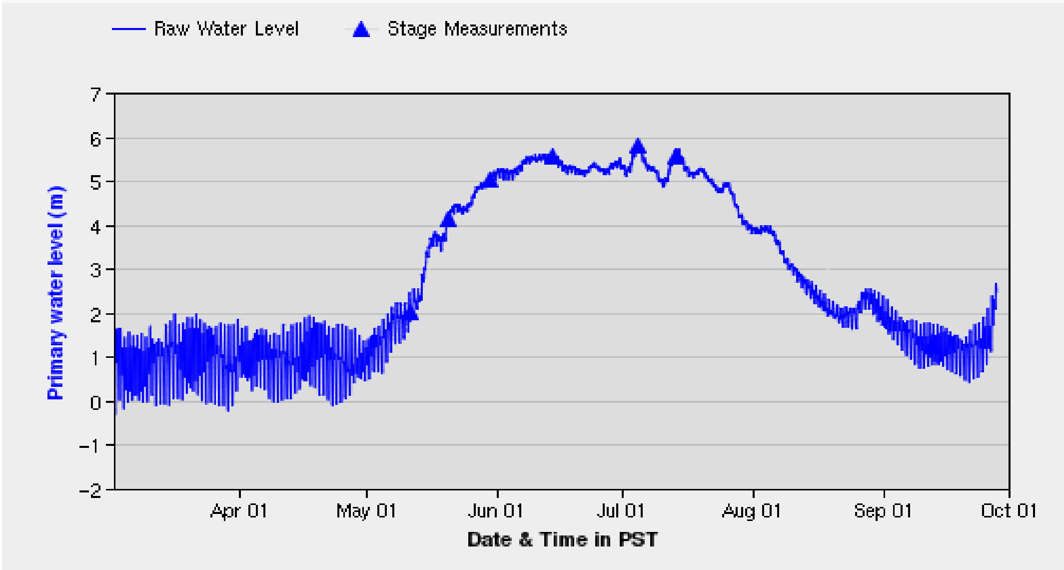
The Effect of Rainfall and Snowpack on Mosquito Abundance

Figure 6: Ministry of Environment Basin Snow Water Index Map for 2011 (MoE, 2011)



Environmental factors can be used to assist in predicting mosquito populations, and subsequent risk for arboviral diseases. In BC, snow accumulation and melting of the snowpack affects the hydrology along the mountainous corridors as spring unfolds. Accumulated snow by the beginning of May is linked to the amount standing water for mosquito development. In 2011 we had a large snowpack throughout the southern portion of the province (Figure 6). The Fraser River remained high as measured at the Mission gauge (Figure 7) from the end of June until the beginning of August, with a peak at approximately 5.85 meters on July 4 (Environment Canada, 2011). This resulted in a high potential for flooding in select areas. Fortunately temperatures during spring remained cool and the water gradually receded as the season progressed. An

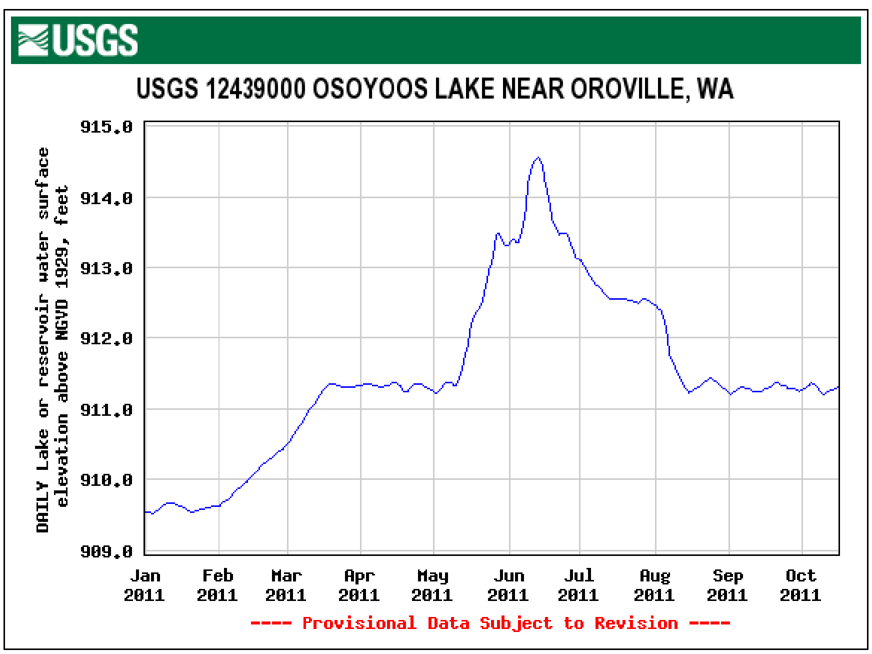
Figure 7: Fraser River Water Level as Recorded at Mission (May- August 2011)



(Environment Canada, 2011)

extended period of high water resulted in many seepage pools in low areas along the dyke. The moisture resulted in the hatching of eggs that had lain dormant for years. High water levels in the lower Fraser resulted in a boom of floodwater species of the *Aedes* along the waterways. This was also the case for the Interior of the province. In Osoyoos, the lake usually sits between 911 and 912 feet above sea level, but in 2011 the lake rose to around 914.5 during the middle of June (Figure 8). The high water flooded the wetlands at the north end of the lake.

Figure 8: Water Levels at Osoyoos Lake, 2011



(USGS, 2011)

The Effect of Temperature on Mosquito Abundance

Ambient temperature plays a key part in the emergence, development, activity and abundance of mosquitoes. For instance, Bailey *et al*. (1965) noted that *Cx. tarsalis* were observed in flight starting at ~13^{o}C and biting activity starting at ~15^{o}C. As temperature increases (and as long as there is moderate humidity to avoid desiccation), the flying and biting activity of mosquitoes will increase as well. Also, in warmer temperatures, the time required for a mosquito to develop from egg to adult life stages is shortened from a few weeks to as little as five days, thereby enabling development of multiple generations of mosquitoes, and resulting in greater mosquito abundance during the short growing season.

Spring temperatures in 2011 were the coolest experienced in BC in the last eight years. Furthermore, almost every region of the province continued to experience below normal temperatures well into the end of July. It was not until the beginning of August that sustained heat was experienced in southern BC.

This was a unique opportunity to observe the effect of cooler temperature on overall mosquito abundance. Unexpectedly, we collected more mosquitoes per trap than any other year of our surveillance program making it difficult to generalize that warmer temperature is a critical factor for mosquito abundance. Temperature does affect mosquito feeding activity as previously noted, but these findings indicate that other environmental factors are likely important to their success.

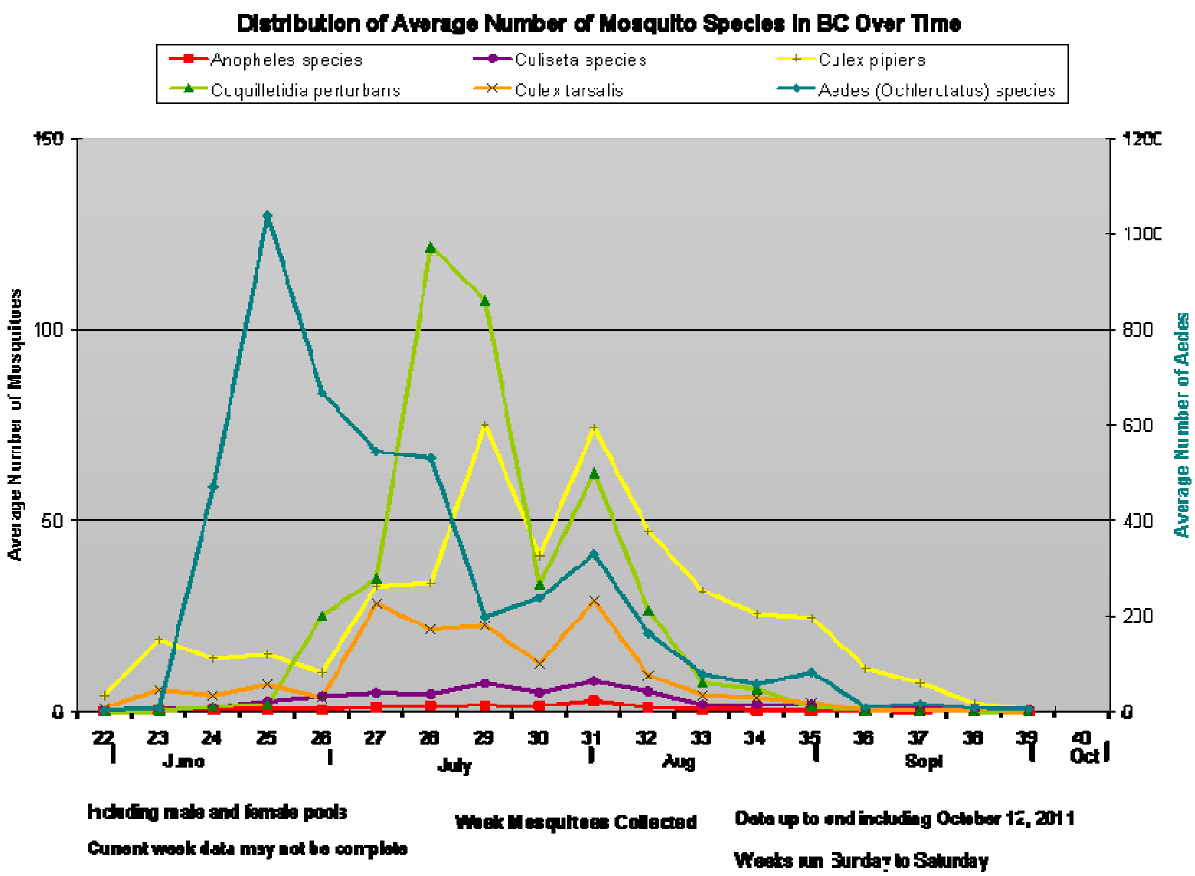
Please refer to the Surveillance of Climatic Factors for WNV Risk section of this report (page 22) for further discussion of the effect of temperature on WNV in BC in 2011.

Temporal Distribution of Mosquitoes

Mosquito species differ in their environmental requirements, and the cool temperatures observed in 2011 likely affected some species groups differently than others. Figure 9 illustrates the changes of species groups in BC over time for all traps.

The snowmelt and floodwater *Aedes* appeared in large numbers after the middle of June and this is typical for these mosquitoes. This group of mosquitoes is influenced by the amount of standing water which floods the eggs that have lain dormant on dry ground from previous seasons. The numbers of adult *Aedes* recorded from our traps were higher this year because many of these traps, especially in the interior of the province, are close to major river systems that had high water levels. Cool summer temperatures may influence the daily biting activity, but the overall abundance of floodwater species is more related to the number of development sites for the larvae. *Coquillettida perturbans* is a species that overwinters as larvae submerged below the surface of the water, meaning that water temperature determines their final stages in spring metamorphosis. *Cq. perturbans* did not appear in any great abundance in 2011 until week 27, but by the beginning of July they were, as in previous seasons, the second most common species caught in our traps. *Cx. pipiens* was the third most abundant species but this was primarily in regions with urban development. In 2009 they were much more common in our traps earlier in the season. In 2009 the Fraser Valley was warmer, which probably contributed to their success given that they over winter as an adult and rely on warmer temperature for overwinter survival. The next most common species collected in our traps was *Cx. tarsalis*. This species is considered the primary vector of WNV in northern latitudes. Ample surface water created ideal habitat for this species to develop, but the cool temperature likely reduced the rate of viral replication. One trap in the Okanagan collected over 5000 specimens during the season. Both *Anopheles* and *Culiseta* were not commonly collected in our traps as we have seen in previous years.

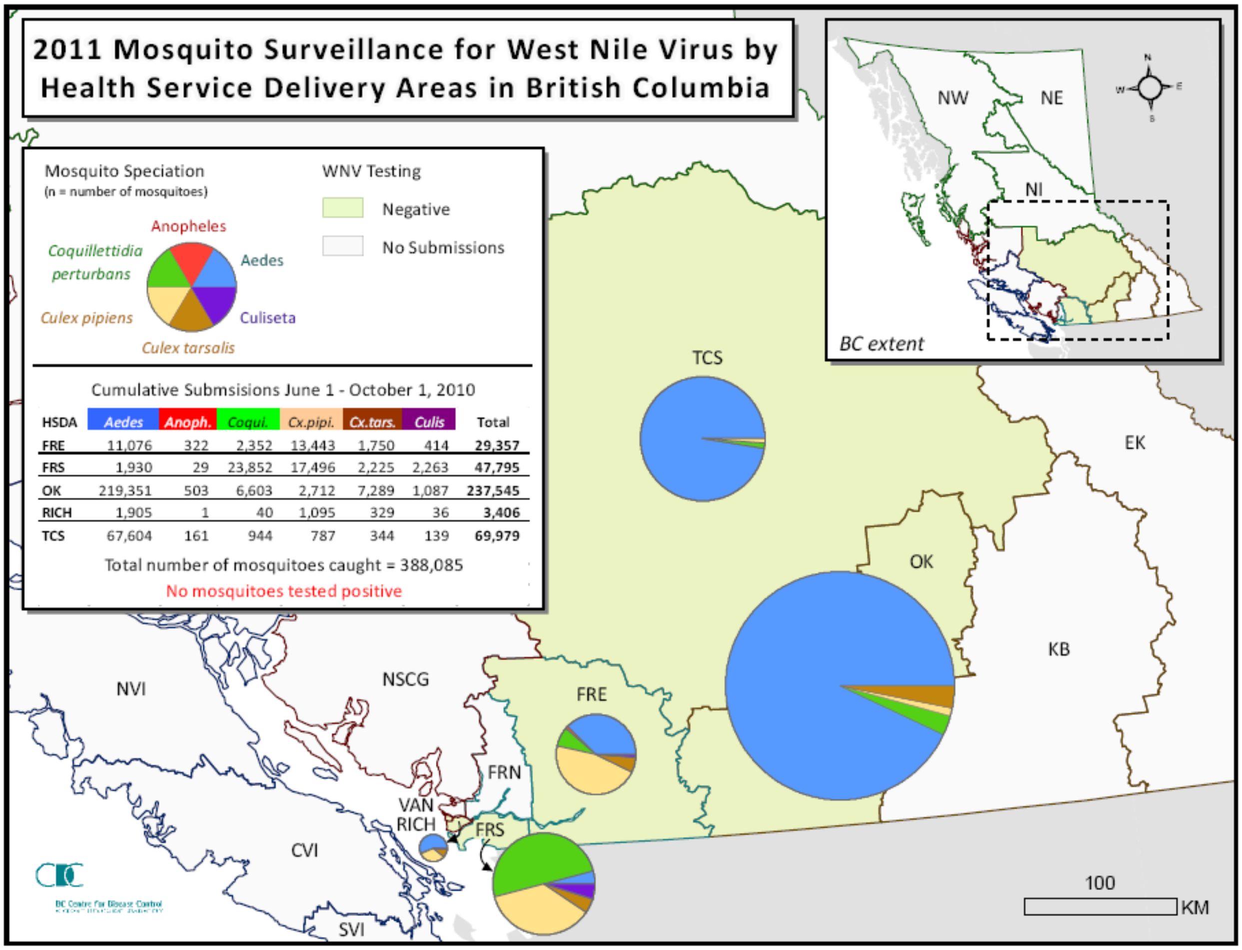
Figure 9: Average Number of Mosquito Species Trapped per Week, 2011



Cx. territans is often collected in surveillance of larvae but does not seem to be attracted to the CO_2-baited light traps. We collected only three specimens in 2011 from the interior of the province.

Relative Abundance of Mosquito Species in specific Health Authorities

Figure 10: Geographic Distribution of Mosquito Species in BC, 2011



Fraser Health Authority

Trapping occurred in two general regions (Figure 5) based on the most likely risk determined by our model; these were south Surrey (FRS) and Mission/Abbotsford regions (FRE). In each location, duplicate traps were run on the same night.

Cx. pipiens was the most common species collected in the FRE region, although Aedes were more abundant in traps closer the Fraser River because of the influence of flooding. *Cx. tarsalis* were about as common as *Coquillettidia,* but this was due to traps just north of Hatzic Lake that collected between 50 to 100 per night during July. The other traps with numerous *Cx. tarsalis* were on south side of Sumas Mountain by the Vedder Canal and collected about 30 to 50 per night during July. Most of the other traps yield only about 20 to 40 *Cx. tarsalis* during the entire season.

In the FRS region, *Coquillettidia* was the most common species collected but *Cx. pipiens* was also very abundant. The highest counts of *Coquillettidia* came from the traps surrounding Burns Bog and another in Delta near costal marshes. Several of the

FRS traps were located along the slow meandering Nicomekl River and Serpentine Rivers which empty in the ocean at Mud Bay. More *Cx. pipiens* and *Cx. tarsalis* were collected in these traps than either *Aedes* or *Coquillittidia*. In 2009 the traps surrounding burns Bog yield the most *Cx tarsalis* but this year the traps along the smaller rivers in south Surrey had the most *Cx tarsalis*.

A subset of traps in FHA were elevated in the tree canopy. This method has been suggested to increase the number of bird-biting mosquitoes caught such as *Cx. pipiens* (Crisp and Knepper, 2003). At each of five locations one trap operated at ground level and another was placed in the tree canopy. The elevated traps captured 7,199 specimens of which 64% were *Cx. pipiens* and the ground level traps captured 2,571 specimens of which 26% were *Cx. pipiens*. The greater proportion of *Cx. pipiens* in elevated traps is not unexpected because this species feeds more on birds than mammals so would have a higher chance of getting a blood meal in the trees where the birds reside.

Vancouver Coastal Health Authority

In the VCHA mosquitoes were only collected in Richmond because it is close to Washington State and some WNV activity has been recorded as close as Whatcom and Island County. Furthermore, landuse in Richmond is quite unique in that highly populated urban areas boarder an agricultural area. The two most common groups of mosquitoes are *Aedes* and *Cx. pipiens. Aedes dorsalis* is very abundant in the coastal salt marsh off Sturgeon Banks and the trap located there collect most of the *Aedes* from these traps in Richmond.

Cx. tarsalis was most abundant around a small subdivision surrounded my agricultural lands. During the middle of July this trap collected between 10 to 20 *Cx. tarsalis* per night. The trap south of Quilchena Golf Course often caught 10 or more *Cx. tarsalis* per night. Although not recorded in high numbers this species is present in the region.

Interior Health Authority

This region of the province had large numbers of *Aedes* due to the high water along the river corridors. The water equivalent snowpack for May 1st (Figure 6) is the highest noted since we began surveillance for WNV in BC. The high water produced enough flooding to yield over 35,000 specimens in one night from the trap at the north end of Osoyoos Lake in late June. By the end of the surveillance season over 130,000 Aedes were collected in that trap. As previously noted the high water in the lake (Figure 8) can account for the environmental factors leading to this result. The North Okanagan and Shuswap region had traps that collected up to 6,000 to 7,000 *Aedes* per night.

Our major focus is to determine where *Cx. tarsalis* are most abundant because they are the primary vector for WNV. The largest numbers were recorded in the South Okanagan with the most being collected from the Osoyoos trap and much lower numbers in Cawston and Oliver traps. The peak came during the month of July and then dropped off after the first week of August. In the North Okanagan/Shuswap region we had several traps where *Cx. tarsalis* were collected at 100 to 200 per night. These traps were in Sicamous, Mara and Spallumcheen.

Cx. pipiens is one of the primary vectors for WNV in the northeastern part of the continent and may well serve as an important host in the enzoonotic part of the viruses cycle here in BC. This was the 4th most common group of mosquitoes collected in the interior traps. The more urban traps in Kelowna and Penticton caught the most *Cx. pipiens* along with the trap in Sicamous The Sicamous trap is less than ½ Km from the sewage retention plant which may have been a mosquito development site, whereas the larger cities have more sewer water and catch basins which *Cx. pipiens* use in their early development stages.

Summary

WNV was present in the Okanagan in 2011 but not detected by mosquito surveillance. The primary vector of WNV is *Cx. tarsalis* in BC and this was the second most common mosquito collected in the Okanagan in 2011. We see pockets where this species is abundant: one in Osoyoos and others in the North Okanagan. In the larger urban centres we find *Cx. pipiens* in greater abundance. Targeting analysis of these species remains the focus of surveillance in this region of the province.

In the Fraser River Lower Mainland *Cx. pipiens* is still the most common known vector of WNV collected throughout the region. Unlike previous years they were not the most common species collected in the surveillance of mosquitoes, we can reasonably speculate that the cool spring temperatures kept this species from being as prevalent as in previous seasons. Using a combination of temperature and virus surveillance, through mosquitoes, birds and horses, we are developing an understanding of WNV risk in this region.

Additional charts of weekly mosquito catch by HSDA in 2011 can be viewed at www.bccdc.ca/westnile, along with previous archived surveillance reports.

Surveillance of Climatic Factors for WNV Risk

Temperature plays a key part in WNV biology, ecology and epidemiology. WNV amplification and rate of mosquito development occurs more rapidly with warmer temperatures, resulting in development of multiple generations of *Culex* mosquitoes and a larger number of infectious mosquitoes during the season. Warmer temperatures also increase mosquito biting activity, thereby increasing the risk of transmission to humans.

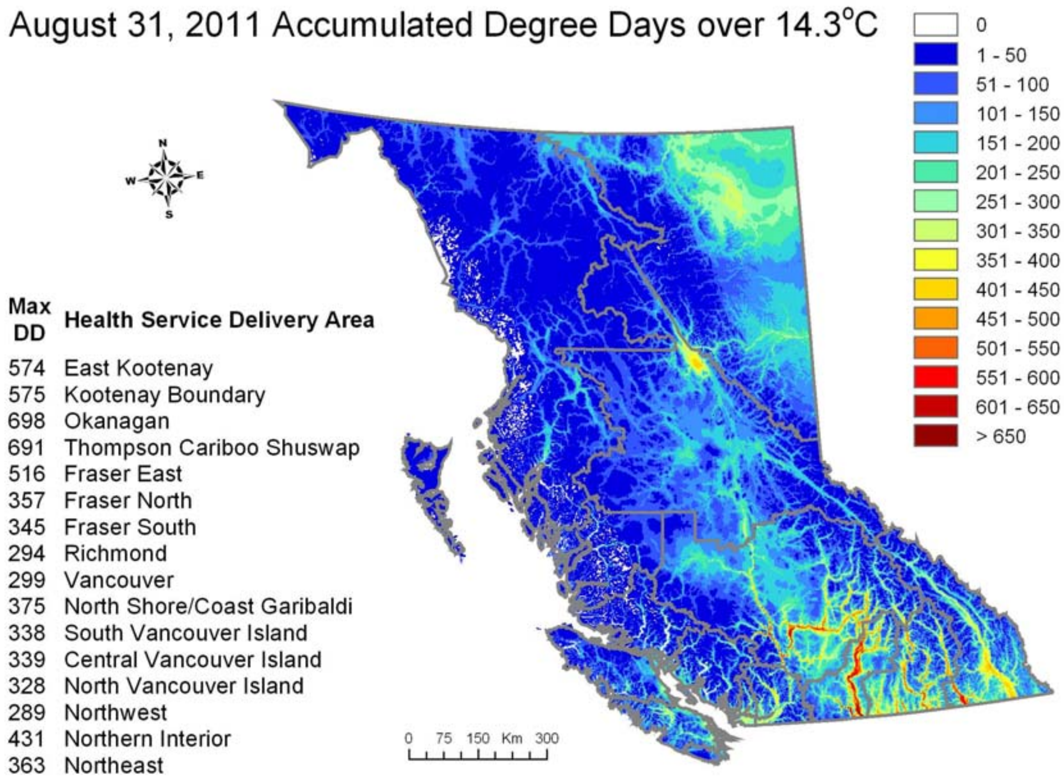
A base 14.3^{o}C growing degree days model has been used to forecast *Cx. tarsalis* mosquito development and corresponding WNV risk. The concept of growing degree days involves the amount of accumulated heat required for mosquitoes to complete their growth and development. Accumulated growing degree days were monitored on a weekly basis for select BC communities from various parts of the province (Table 4). A spatial model was also developed to create a continuous surface map for the entire province (**Figure 11**).

Table 4: Accumulated Base 14.3^{o}C Growing Degree Days for Select Communities up to August 31st, 2003-2011

Up to August 31st	2011	Average 2003-2010	Maximum 2003-2010	Minimum 2003-2010
Cranbrook	401	492	598	399
Creston	523	650	770	515
Osoyoos	681	874	983	761
Kamloops	606	783	872	687
Abbotsford	340	466	581	386
Vancouver	283	380	480	312
Victoria	250	342	422	277
Prince George	165	290	360	237

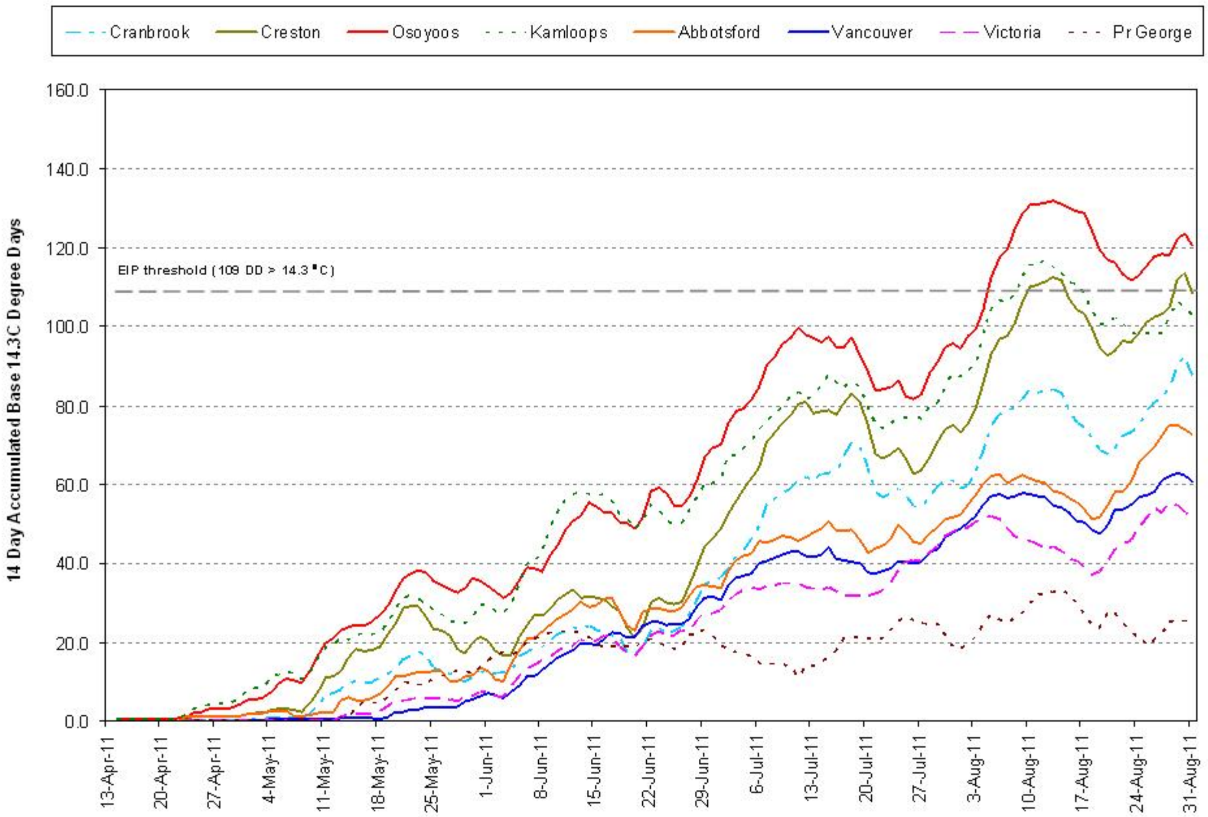
Note: Degree day calculations beyond August 31st are not meaningful for WNV risk prediction as newly emerged Culex will likely enter diapause (a state where they do not seek a blood meal) by this time, and therefore the effect of temperature on mosquito development and viral replication after this time does not contribute to WNV risk.

Figure 11: Accumulated Base 14.3°C Growing Degree Days in British Columbia up to August 31, 2011 by Health Service Delivery Area



During 2011, almost every region in the province experienced fewer accumulated degree days (i.e. heat) than compared to the past 8 years as monitored by the WNV Program (Table 4). Yet despite the relatively cool temperatures observed in 2011 and the late onset of sustained heat experienced in August, WNV activity was again detected in the Central Okanagan, thereby confirming that WNV is endemic in the hot interior regions of BC.

Figure 12: 14 Day Moving Window of Base 14.3°C Growing Degree Days for Select Communities up to August 31st, 2011



Note: The extrinsic incubation period (EIP) threshold of 109 base 14.3°C degree days reflects the point at which a female mosquito imbibing an infectious bloodmeal is able to transmit WNV.

During this past surveillance season, we continued to use the 14 day moving degree day window model to monitor WNV risk related to climatic factors (Figure 12). This model indicates when sufficient degree days have accumulated to allow for a generation of mosquitoes to develop. Comparing these models to previous years (with and without endemic WNV activity in BC) allows for prediction of potential WNV activity during the current season. In 2011 the cold, wet spring meant that degree days did not accumulate early in the season and the potential for WNV activity in the second generation of mosquitoes was not realized until much later in the season. This corresponded with the time of year when *Culex* mosquitoes start to enter reproductive diapause due to reduced photoperiod meaning a reduction in biting activity and therefore a reduction in risk to humans.

The 2011 season highlighted the value of using the 14 day moving window degree day modeling to predict when and where conditions reach a point where WNV activity is possible. In future seasons the combination of the accumulated understanding of risk areas for WNV along with real-time use of the moving window degree day modeling and mosquito surveillance will allow us to tailor the focus and messaging of the WNV prevention program in BC.

Geographic Information Systems – Applications to WNV

Geographic information systems (GIS) mapping and analysis has been an integral tool for WNV surveillance and planning in BC. Data from a variety of sources (health-related events, field sampling, municipal infrastructure, environmental, etc.) and technologies (global positioning systems, remote sensing, databases, etc.) can be integrated in a GIS for visualization, analysis and modeling. In addition to the weekly summary maps posted on the WNV website, BCCDC has developed:

- an interactive web-based GIS mapping system for public health officials and members of the public to view WNV surveillance data in spatial format,
- a growing degree day model to forecast *Cx. tarsalis* mosquito development during the surveillance season,
- density maps of dead corvid sightings and submissions for WNV testing to detect hotspots of corvid die-offs,
- an assessment on the feasibility of adult mosquito control in select BC communities, and
- forecasted WNV risk models based on mosquito, temperature, geographic and environmental factors to inform WNV preparedness, surveillance and response.

Please refer to www.bccdc.ca/westnile and maps.bccdc.ca for all WNV mapping related content.

Communications

Communication Objectives

- Inform British Columbians and visitors to the province of the potential risk associated with WNV and to provide awareness regarding using personal protective measures. Awareness is created through the distribution of resource materials (including brochures), news releases, fact sheets, information bulletins and the BCCDC website.
- Inform stakeholders about specific strategies and responses by providing an up-to-date WNV resource plan and key messages.
- Provide up-to-date information on human WNV surveillance in BC through weekly surveillance reports.
- Respond to issues/inquiries via provincial spokespersons (Provincial Health Officer (PHO), BCCDC, regional MHOs), HealthLink BC, and other correspondence as required.

Strategies

- Provincial coordination of communications/public information through regular BC WNV communication group teleconference meetings
- Series of press releases and informational support material distributed throughout summer months with targeted timelines and key messages
- BCCDC Web site – updated with timely and consistent materials for public and professional use
- Regular conference calls between MHOs, BCCDC and other related professionals
- Cooperation with other provinces/territories and Health Canada in coordinating public information and education

Target Audiences:

- Home and property owners in both rural and urban areas
- People aged 50 years and older
- Physicians
- Public health nurses/HealthLink BC
- Provincial ministries, regional districts and municipalities
- General public who spend, or whose children spend a significant amount of time outdoors on a regular basis

2011 Communications Review

The public awareness campaign emphasized personal protection and the campaign consisted of several components, such as:

  - Stakeholders across the province (e.g., parks, hospitals, tourist centers, veterinary offices, etc.) received brochures.
  - News releases and information bulletins were done on an as needed basis.

    - Inquiries were directed through BCCDC via provincial spokespersons.
    - Up-to-date information/resources including weekly reports were posted via the BCCDC website at www.bccdc.ca/westnile

- News releases issued in 2011 included:
    - Be vigilant and take precautions to avoid WNV

2012 Communication Strategy

- The 2012 WNV campaign resources remain similar to those used during 2011. The activities for 2012 include:
    - Series of press releases and informational support material distributed throughout summer months with targeted timelines and key messages:
        - A news release in June encouraging British Columbians to prepare for the WNV season
        - A news release in August focused on personal protection.
- Provincial coordination of communications/public information through regular BC WNV communication group teleconference meetings
- BCCDC Web site – updated with timely and consistent materials for public and professional use
- Regular conference calls between MHOs, BCCDC and other related professionals
- Cooperation with other provinces/territories in coordinating public information and education

Media Inquiries

Media inquiries are handled by BCCDC (604-707-2412) and Health Authority Communications offices.

Provincial Spokespersons

Regional MHOs are the primary spokespersons for their jurisdictions, with PHO and BCCDC supporting these efforts.

Future Surveillance and Intervention Activities

In 2011, the BCCDC undertook a review of the WNV surveillance program in BC and presented this information in a briefing note to the BC Communicable Disease Policy Advisory Committee (CDP). The conclusions of the review were that the 2009 season likely represented a “perfect storm” of environmental and ecological conditions (elevated temperatures, high levels of activity in neighbouring states, and high *Cx. tarsalis* abundance) that allowed WNV to gain a foothold in BC. Continued activity in 2010 confirms that WNV has become endemic at least in the central Interior areas of BC; areas identified by relative risk maps as being at highest risk for activity. The low levels of WNV activity observed in BC in both 2009 and 2010 are similar to those observed in Washington State prior to 2009, during which time only sporadic human cases were observed (max=3) over several seasons. Given the similarities between the environmental and ecological conditions of BC and Washington, we likely can expect similar sporadic, low WNV activity in the future, primarily focused in the Okanagan Valley where temperatures are high and *Cx. tarsalis* abundant. What is less clear is the risk of outbreaks in the Fraser Valley areas of BC. While mosquito abundance is high, the species present is primarily *Cx. pipiens*, a less competent vector for WNV and the temperatures do not consistently reach the high levels seen in the Okanagan.

Given the data we have collected over the past eight years in BC we conclude it is unlikely that WNV levels in BC will ever reach those seen in areas of Canada or the US that have experienced large, protracted outbreaks (e.g. Saskatchewan, Manitoba, Idaho). It is much more likely that select risk areas of BC will experience low numbers of sporadic cases seasonally and in the worst case scenario (e.g. a repeat of 2009 conditions) potentially have a moderate outbreak of several dozens of cases as was experienced in Washington State in 2009.

The 2011 season highlighted the value of using the 14 day moving window degree day modeling to predict when and where conditions reach a point where WNV activity is possible. In future seasons the combination of the accumulated understanding of risk areas for WNV along with real-time use of the moving window degree day modeling and mosquito surveillance will allow us to tailor the focus and messaging of the WNV prevention program in BC.

Given our understanding of the risk of WNV outbreaks in BC relative to other areas of North America, restricting larviciding to the highest risk area of the province is reasonable when needed. Baseline mosquito surveillance in higher risk areas each season and continuing use of temperature models will allow a graded approach to risk communication and response as each season progresses.

CDP accepted these conclusions and advised that surveillance be continued in IHA focusing on the Central and South Okanagan and in the Fraser Valley but that preemptive larviciding be discontinued. Larviciding will be used only on a contingency basis if conditions indicate potential for a substantial outbreak.

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