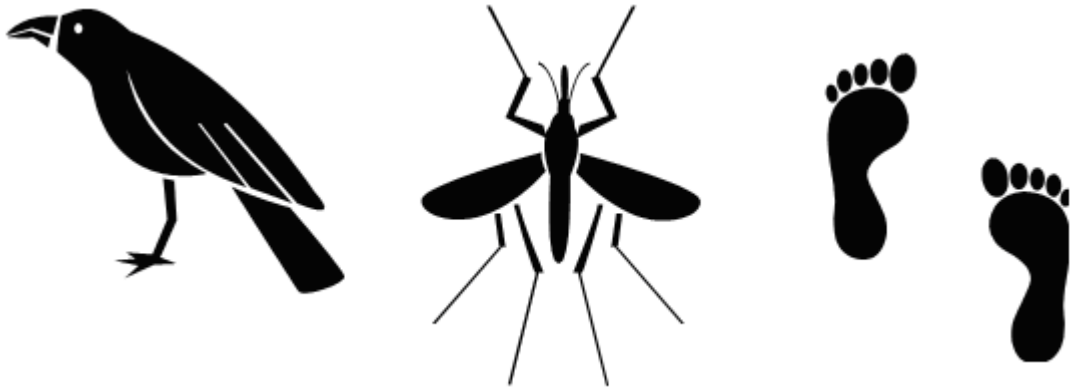
West Nile Virus Activity in British Columbia
Surveillance Program Results
2012



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Above photo: BC Centre for Disease Control, 655 West 12th Avenue, Vancouver BC V5Z 4R4

Date of publication: January 21, 2013

Report is available at www.bccdc.ca/westnile

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Executive Summary

There were no positive WNV indicators detected in BC in 2012 despite weather conditions in July and August that were ideal for mosquito growth. While large numbers of vector mosquitoes were found, a cold June resulted in delays in the second and third generation and this reduced the risk that these mosquitoes would be infected with WNV.

Across Canada, however, the highest number of WNV cases was reported since the large outbreak in 2007 with 433 cases reported in 2012. Infections were reported in Quebec (126), Ontario (249) Manitoba (39), Saskatchewan (9) and Alberta (9).

WNV activity in the United States in 2012 was highest since 2003 (Table 1). Washington State had some activity in 2012 but much less than 2009 (Figure 1).

Table 1: Human WNV Infections in North America, 2004-2012 (these numbers might not include deaths attributed to this disease)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Canada	25	225	151	2,215	36	13	5	101	433
United States	2,539	3,000	4,269	3,630	1,356	720	1,021	712	5,387

(PHAC, 2012, CDC, 2012)

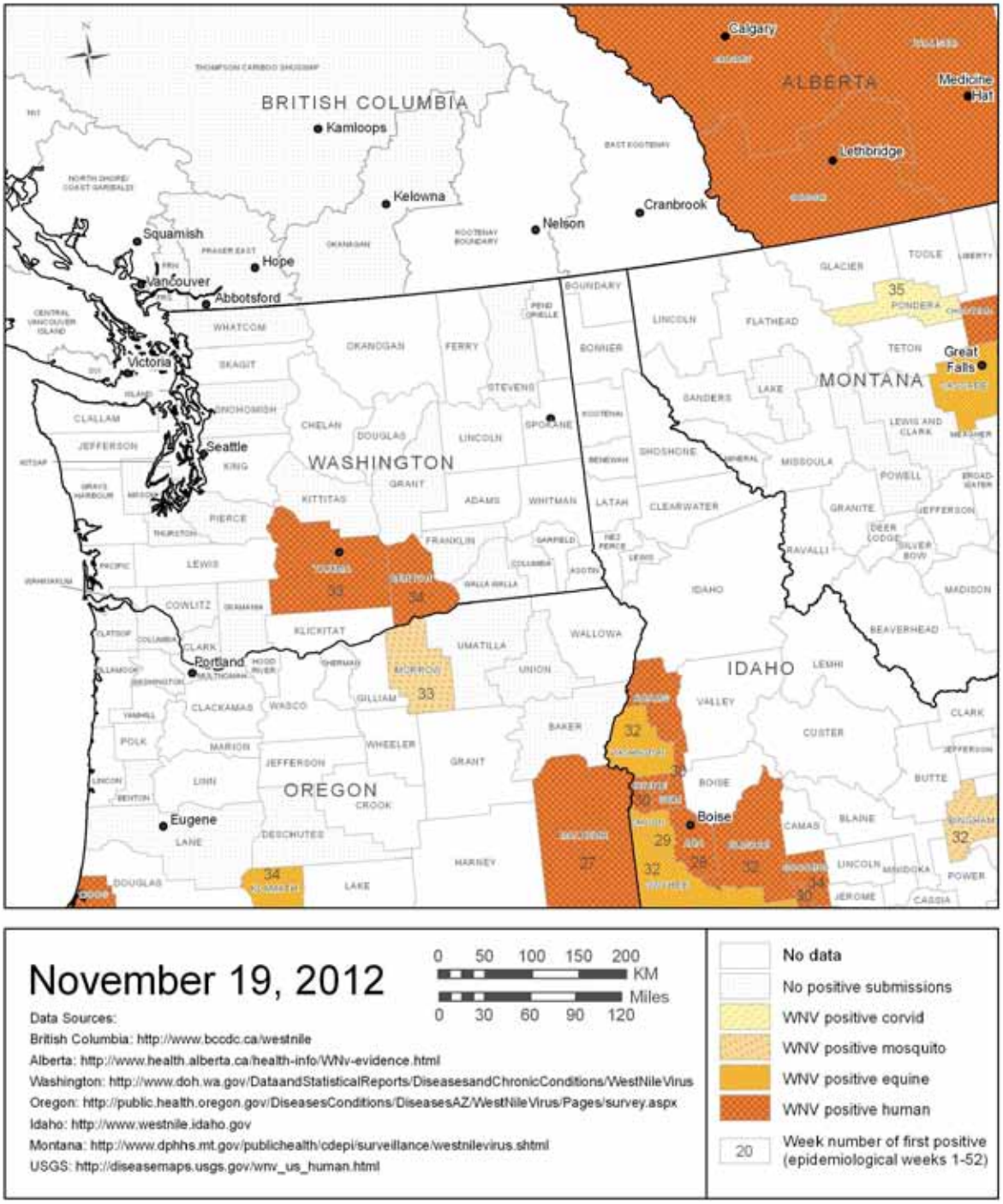
Corvid and mosquito surveillance in 2012 was focused on the higher risk areas of the province in the Fraser Health Authority (FHA), particularly the Fraser Valley and Interior Health Authority (IHA), particularly the South and Central Okanagan.

Twenty two corvids were collected for testing in 2012, a substantial decrease over 2011. 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 (238) was down slightly from the number reported in 2011 (267).

In addition to surveillance activities, in 2012 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 one news release.

Executive Summary

Figure 1: WNV Activity in the Pacific Northwest, 2012



Summary of Surveillance Activities

Active West Nile Virus (WNV) surveillance is carried out on both mosquitoes and dead birds belonging to the corvid family (crows, ravens, magpies and jays). Passive surveillance is focused on humans and horses. The objectives of WNV surveillance are two-fold:

1. To monitor WNV activity in various species in BC to:
    - Predict increased risk to human health
    - Inform public health decisions
    - Guide communication strategies
2. To optimize mosquito control decision-making by:
    - Identifying the geographic and temporal distribution of potential vector species in BC
    - Determining optimal climatic conditions for the incubation of the virus in vector species through our degree day forecast model

The partnering agencies who conduct human surveillance include the BCCDC Communicable Diseases Prevention and Control Services (CDPACS), 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 PHMRL 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. During the low risk period (December through April) only organs from donors with a travel risk are screened.

CBS performs year-round WNV nucleic acid testing on every donation. Although routine screening is performed in mini-pools of six specimens, more sensitive, single unit 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 2012 edition is available at http://www.pbco.ca/images/Home/2012_contingency_%20plan_for_west_nile_virus_and_the_blood_supply_2012_final.pdf

Summary of Surveillance Activities

In accordance with established practice, information on any probable human cases are communicated to the requesting physician as well as to the appropriate Health Authority 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/hmncasedef_e.html.

The human testing algorithm entails screening acute serum samples for Flavivirus enzyme immunoassays (EIA) – immunoglobulin M (IgM) and immunoglobulin G (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 which is currently being drafted.

As per established protocols, corvid surveillance was achieved in 2012 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 polymerase chain reaction (PCR) only. Tissue samples from positive specimens would be sent to the PHSA PHMRL for confirmation.
- An online form was available on the BCCDC website (www.bccdc.ca/westnile) for the public to report sightings of dead corvids. Unusual clusters of corvid sightings are forwarded to the appropriate agency to determine if any follow up needs to occur.

Surveillance for WNV in horses is passive. 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), and rarely, serum neutralization tests. WNV can be 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.

Summary of Surveillance Activities

Mosquito surveillance is focused on identification and distribution of adult vector mosquitoes and PCR testing of female *Culex* mosquitoes for WNV. Mosquito surveillance activities started on June 1, 2012 in the two higher risk regional Health Authorities in BC. Interior Health Authority (IHA) focused trap locations in the Okanagan Valley and additionally placed one trap in Thompson River Valley. Fraser Health Authority (FHA) focused on south (FRS) and east (FRE) regions of the HA, deploying duplicate traps in each location. These decisions were based upon a risk assessment of the respective areas. Traps were run overnight and the catches sent 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 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 and all the female *Culex* mosquitoes were tested. 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 created 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 (http://www.bccdc.ca/wnvmaps). This was developed to assist stakeholders with geo-spatial risk assessment to help target appropriate mosquito control activities.

The provincial WNV program is based on a multiagency collaboration. 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 and available on the BCCDC website.

Surveillance Results

Results at a glance

Table 2: Summary of BC Surveillance Statistics, 2012

	Human samples [1]	Corvids Submitted [1]	Corvids Sighted [1]	Mosquito Pools [2]	Horses
# Tested	438	22	238	1912	-
# Positive	0	0	-	0	0

1. This table includes data from June 4 to October 5, 2012
2. A pool may contain up to 50 mosquitoes that are tested at one time.

Surveillance Results - Human

Epidemiology of Human Infections

In 2012, 438 human specimens were tested by PHSA PHMRL, with no positive results.

As of the 27th of October, 433 human infections were reported in Canada in 2012. Infections were reported in Quebec (126), Ontario (249), Manitoba (39), Saskatchewan (9) and Alberta (9). 139 (32%) were classified as neurological syndrome. Six deaths were reported. As of the 11th of December, 5387 human WNV infections and 243 deaths were reported in the US in 2012. The largest number of cases was reported from Texas (1739 cases and 76 deaths). Four human infections were reported from Washington State and 3 human infections were reported from Oregon State. In Canada the highest number of human infections was reported since 2007. In the US this is the highest number of cases reported in this time period since 2003. (PHAC, 2012, CDC, 2012)

Protecting the Blood Supply from WNV – Testing at Canadian Blood Services (CBS)

From June 1 to October 5, 2012, 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 708 WNV test requests received by BCCDC; of these, there were 65 (9% of 708 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. No WNV-positive blood donor was identified in BC and Yukon region during 2012.

Blood Donor WNV Screening

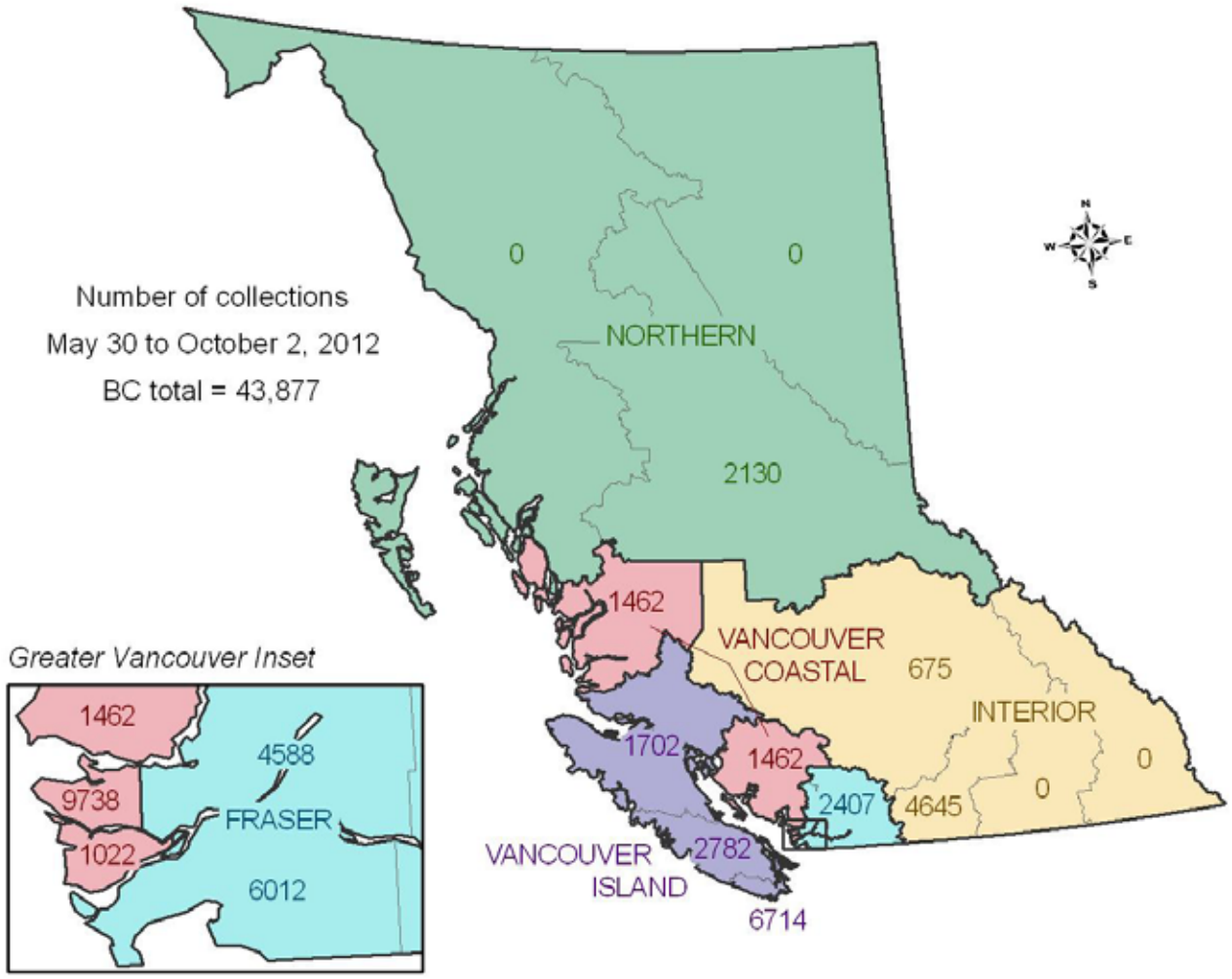
CBS, BC and Yukon Centre provided BCCDC with aggregate, regional blood donor WNV testing updates for BC collections throughout the WNV season. This reporting provides geographically comprehensive and timely ongoing human WNV surveillance data to public health. Between May 30 and October 2, 2012, there were 43,877 collections of blood in BC (Figure 2). There were no positive WNV screening test results from any blood donation in British Columbia in 2012. Blood donor WNV screening test data provide public health authorities with geographically diverse, timely human WNV surveillance data that complement other components of WNV surveillance.

Across Canada, WNV blood donor screening identified 38 WNV positive donors during 2012; CBS identified 15 from ON, 4 from MB and 1 from AB and 18 were identified by HemaQuebec.

Three cases of WNV occurring in recipients of blood were reported to CBS (one each from ON, MB and AB) this summer. Traceback investigation of the ON case definitively ruled out transfusion-transmitted WNV. Investigation of the other 2 cases suggested infection prior to transfusion.

Surveillance Results - Human

Figure 2: Number of blood donor collections by HSDA, May 30-Oct 2, 2012

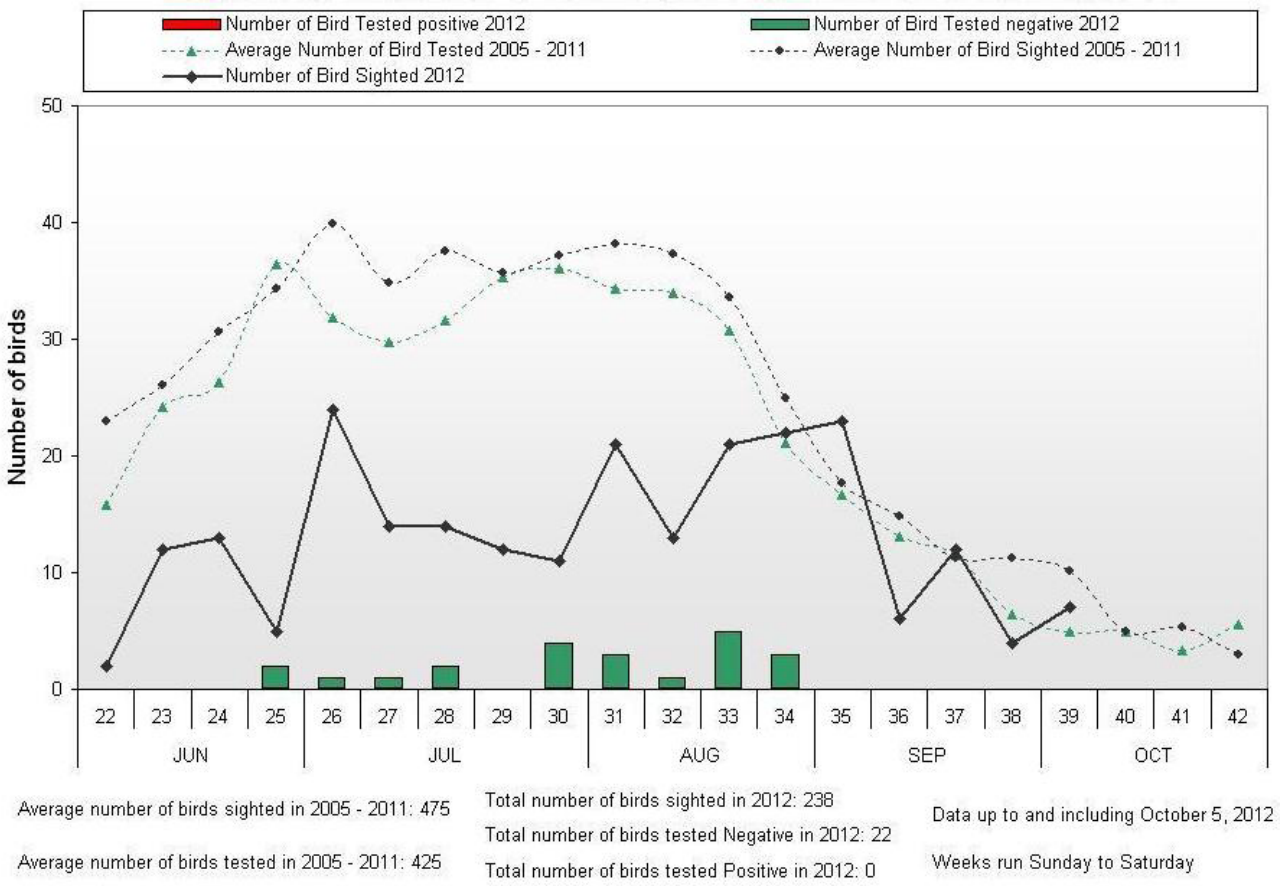


Surveillance Results - Covids

During the 2012 surveillance season 22 corvids were collected and tested with no positive results. The number of corvids tested each week was consistent and low and remains well below the average number tested between 2005 and 2011. The number of corvids tested has also decreased by nearly half from 2011, when 40 birds were tested. In 2011, a reduced corvid collection strategy was implemented in IHA. The further reduction in testing in 2012 is likely the result of the shift away from corvid testing in FHA and onto other WNV detection methods such as mosquito testing and climatic surveillance.

The only corvid submissions tested in 2012 were from the FHA. The majority of the 22 birds were from Surrey (7), Langley (4) and Burnaby (4), and there were no clusters of corvid die-offs identified (Figure 4).

Figure 3: Comparison of Birds Sighted and Tested, 2005-2012

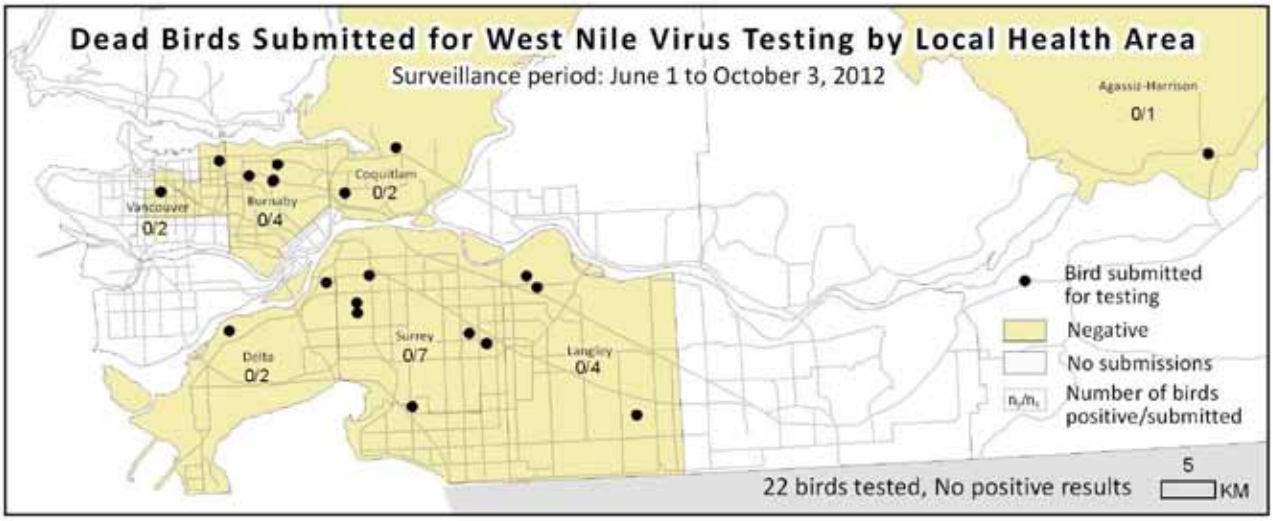


Surveillance Results - Covids

A total of 238 dead birds were reported online to BCCDC in 2012. The number of dead birds sighted was fairly constant around 10 to 20 per week during July and August; however most weeks in June and September had fewer sightings reported (Figure 3). The number of corvids reported by week ranged between 2 and 24, with an average of 12.5 over the surveillance period. The weekly average of corvid sightings is much lower than the historic data shown in Figure 3, but also lower than the number sighted in 2011, when an average of 30.5 corvids were reported each week during the surveillance period. This difference may be due to lack of public awareness of the online reporting tool.

Maps and charts of weekly corvids submitted for testing and sighted in 2012 can be viewed at www.bccdc.ca/westnile.

Figure 4: Geographic Distribution of Corvid Test Results, 2012



Surveillance Results - Horses

There were no horses reported as positive for WNV in 2012. 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.

Surveillance Results - 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. Sampling in areas with potentially endemic WNV activity may give an early warning of the arrival of the virus before other animals or humans become sick. Mosquito sampling in known endemic areas provides population estimates of vector species and insight into WNV risk potential. Mosquito infection rates can be calculated which gives an indication of risk to people.

In 2012, there was a total of 870 submissions from miniature CDC mosquito light traps baited with dry ice (to produce CO_2), resulting in 1,912 pools tested. A total of 175,748 mosquitoes were collected by FHA and IHA. There were high numbers of the nuisance *Aedes* species in many of the traps in IHA this year. The provincial average of *Culex* per trap night was 56.7 (all *Culex* species, including males). This was higher than last year's average *Culex* count of 32.2. Both WNV vector species, *Culex pipiens* and *Culex tarsalis*, were higher than in any of our previous 7 years of surveillance (Table 3). The most likely explanation is better trap locations for these species , as well as favorable weather conditions for mosquito growth. No mosquitoes tested positive in 2012 (Table 2).

The WNV Program has been monitoring mosquitoes in BC since 2003. Testing has been focused on *Culex* species only, since 2006. *Cx. tarsalis* in traps from the South Okanagan were first identified as infected with the virus in 2009. *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 virus's cycle here in BC. Location of surveillance traps is mostly based on the presence of these species based on previous surveillance findings.

Trap Coverage

Figure 5 depicts the geographic distribution of adult mosquito traps in 2012. The geographic coverage has changed since adult mosquito surveillance began in 2003, and the strategic placement of traps in mosquito rich environments has improved the catch of high risk species like *Cx. pipiens* and *Cx. tarsalis*, reducing the number of low yield traps (Table 3). This year surveillance was focused only on regions with high potential risk based on a model using geography, temperature, and known occurrence of mosquito species. In the FHA this included Delta, Surrey, Abbotsford/Mission, and Chilliwack region, while in the IHA we focused on the Okanagan Valley with one trap extending into the Thompson River Valley. Mosquito surveillance started in the 1st week of June in FHA and the 2nd week of June in IHA and ended in the beginning of September in IHA and middle of September in FHA. This window of time covers the period of WNV activity.

Surveillance Results - Mosquitoes

Figure 5: Geographic Distribution of Mosquito Traps in BC, 2012

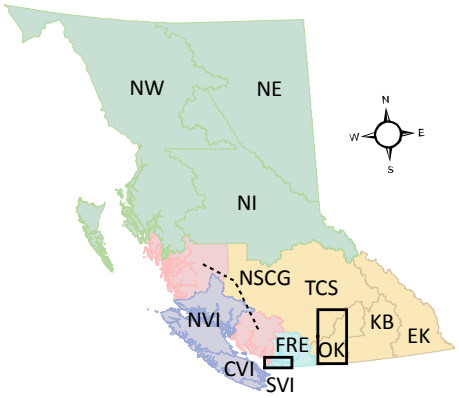
2012 Mosquito Trap Locations and Results

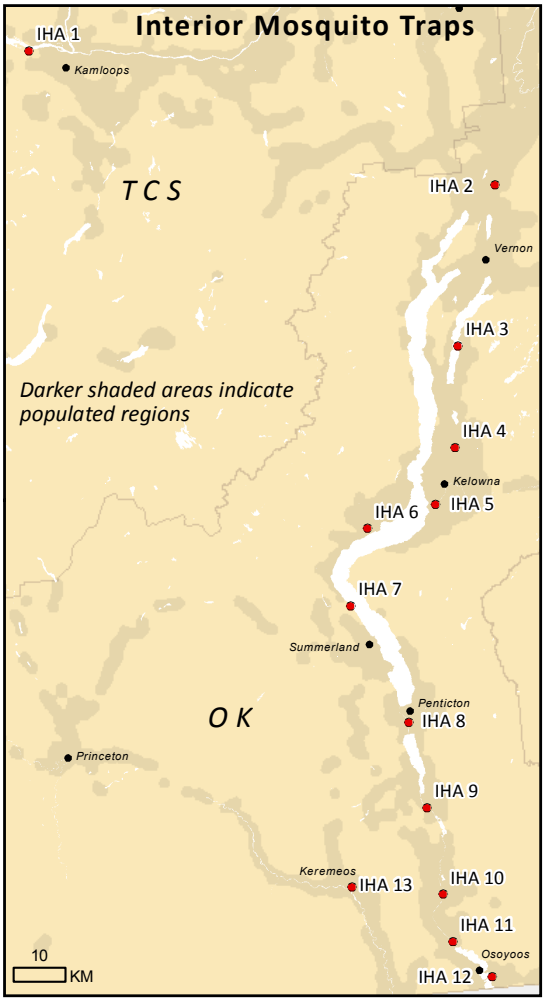
Unique trap locations (n=38)
(# of traps operated = 63)

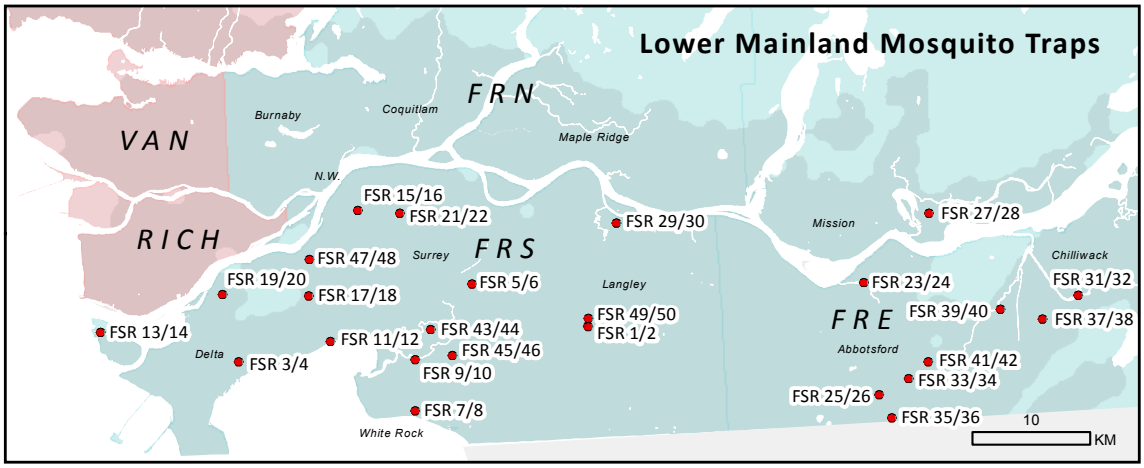
Mosquito Submissions June 4 - Sept 14, 2012

HSDA	*Aedes*	*Anoph.*	*Coqui.*	*Cx.pipi.*	*Cx.tars.*	*Culis*
FRE	3,685	228	1,102	15,924	2,172	243
FRS	2,643	17	4,091	22,237	4,575	1,823
OK	104,953	692	5,644	643	3,522	547
TCS	936	-	1	18	40	11
BC	112,217	937	10,838	38,822	10,309	2,624

175,748 mosquitoes caught, none tested positive







Surveillance Results - Mosquitoes

Table 3: Changes in Mosquito Trap Operations, 2006-2012

Parameter	2006	2007	2008	2009	2010	2011	2012
# Permanent locations	148	155	98	91	101	75**	52***
# Mosquitoes	394,047	242,215	202,460	182,063	203,753	388,082	175,748
# Pools tested	2,329*	2,568*	1,873*	2,482*	2,092*	2,282*	1,912*
# Submissions	2,287	2,365	1,471	1,536	1,421	1,289	870
avg # *Cx. tarsalis* ^	4.8	3.5	1.4	11.8	4.9	9.3	11.9
avg # *Cx. pipiens* ^	8.6	14.3	10.5	21.1	23.7	27.6	45.3

** Only Culex species tested for WNV.*

*** FHA operated paired traps at some sites, so 50 traps were operated in 38 locations.*

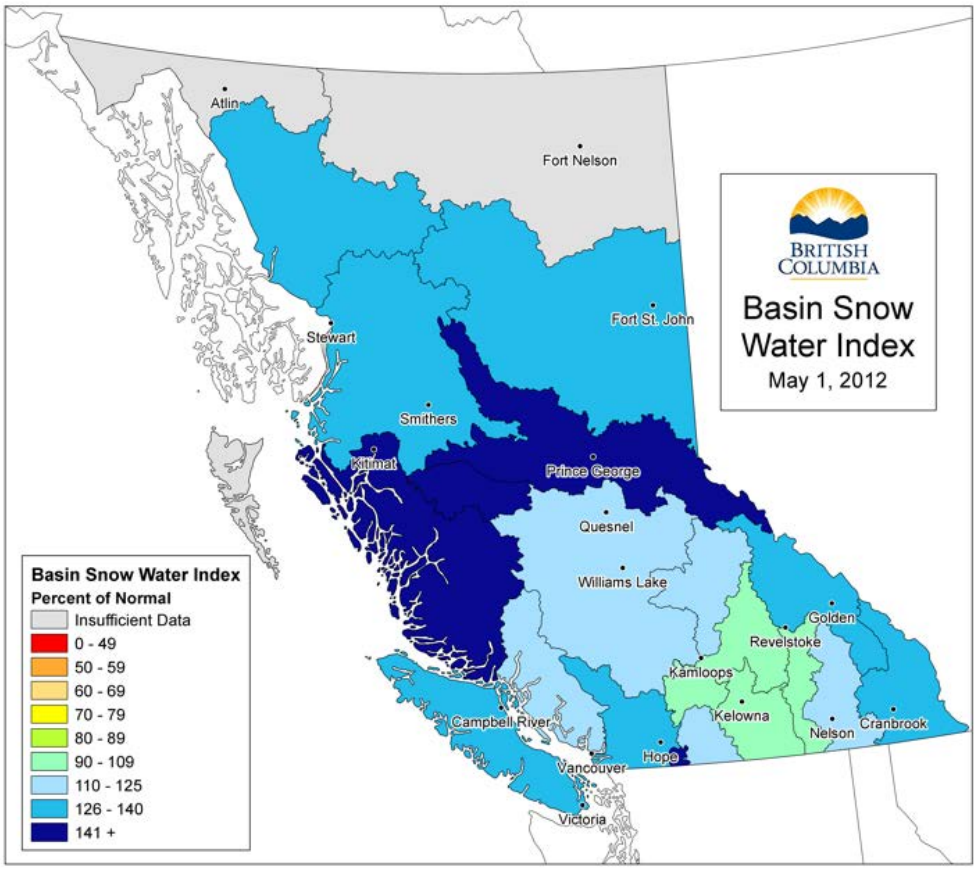
**** FHA operated paired traps; 50 traps were operated in 25 locations.*

^ Including male and female mosquitoes during the season. It is calculated by:

Total number of Culex ÷ total number of useable trap submissions = # per trap-night.

The Effect of Rainfall and Snowpack on Mosquito Abundance Surveillance of WNV

Figure 6: Ministry of Environment Basin Snow Water Index Map for 2012



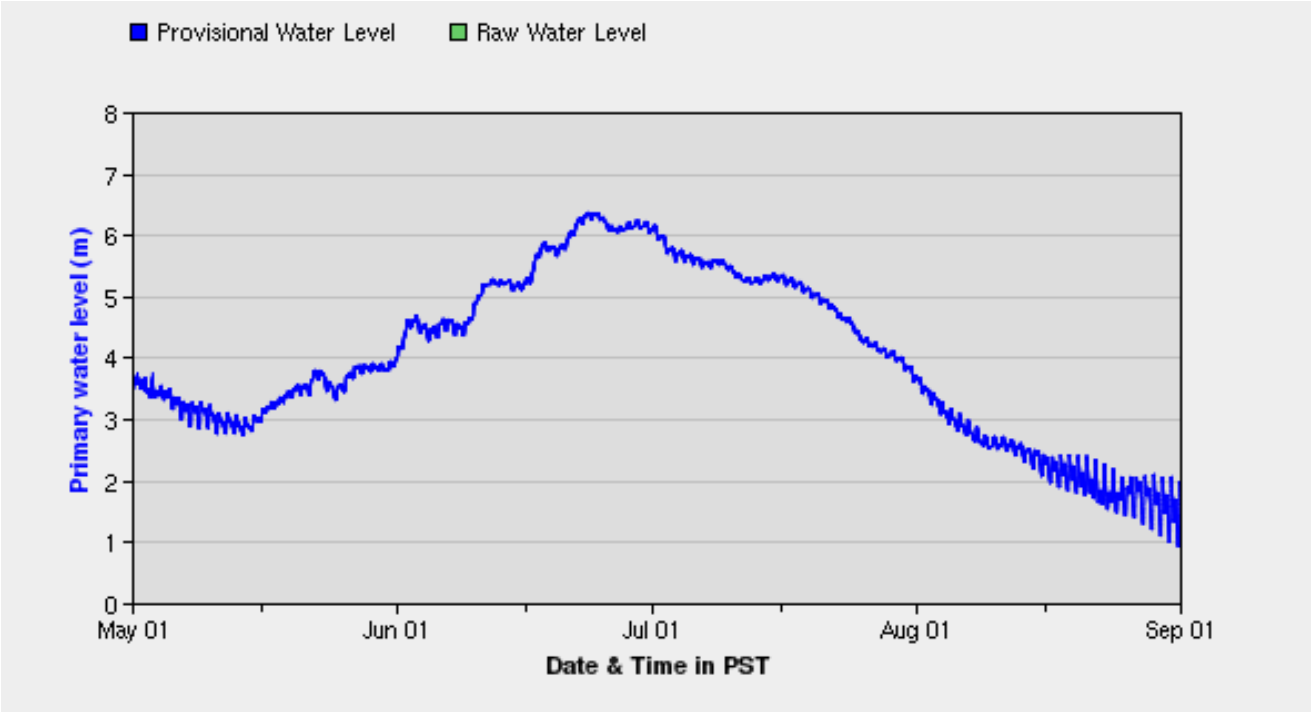
[MoE, 2012]

Surveillance Results - Mosquitoes

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 river valleys as spring unfolds. Accumulated snow by the beginning of May is linked to the amount of standing water for mosquito development. In 2012, the snowpack was above average throughout most of the province and around normal for the central Interior (Figure 6). The large snowpack in the upper Fraser River basin would have caused serious flooding if the weather had been warm, but cool June temperatures resulted in a gradual melt. In the Lower Mainland when the Fraser River at the Mission gauge exceeds 6 metres (Figure 7) water levels are close to breaching the dykes. This year, only small pockets of land were seriously flooded in Langley and Chilliwack. The high water levels generated plenty of seepage pools and habitat for the development of large populations of mosquitoes. We did not observe a large nuisance *Aedes* mosquito population but the number of *Cx. pipiens* were very high.

The central Interior had normal snowpack but a cool June resulted in significant delay in melting until the beginning of summer. The surge of water caused serious flooding and damage in the Shuswap and Okanagan Valley. We recorded high numbers of the nuisance *Aedes* throughout these regions but very few *Cx. pipiens*.

Figure 7: Fraser River Water Level as Recorded at Mission (May- August 2012)

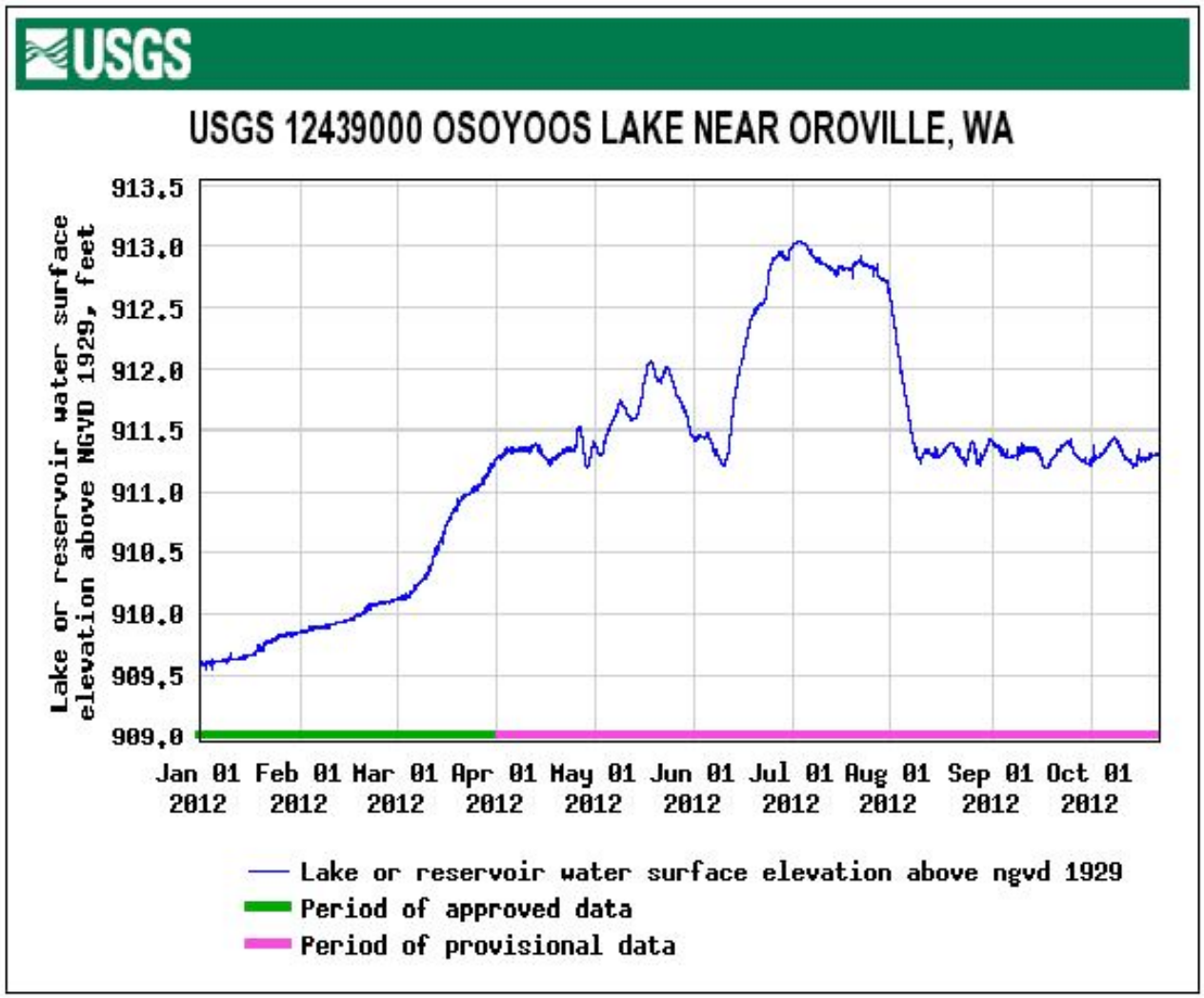


[Environment Canada, 2012]

Surveillance Results - Mosquitoes

In Osoyoos, the lake usually sits between 911 and 912 feet above sea level, but in 2012 the lake rose to around 913.0 at the beginning of July (Figure 8). The high water flooded the wetlands at the north end of the lake. The trap in this location (IHA 11) had the greatest number of *Aedes* in our surveillance program.

Figure 8: Water Levels at Osoyoos Lake, 2012



[USGS 2012]

Surveillance Results - Mosquitoes

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 started 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. 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.

in 2012, large numbers of mosquitoes did not appear in traps until after the first week of July when the temperature rose. The late accumulation of temperature in July correlated with development of *Coquillettidia perturbans*. This is usually the second most abundant species in our surveillance from the middle of June to the end of July but this year they did not emerge in significant numbers until the beginning of July. The cool June weather likely inhibited an earlier emergence during that month.

For *Cx. pipiens*, which overwinter as adults, the first generation was not complete until the beginning of July. Although a total of 233 were caught over the season, only 5 males were caught in June in FHA and none were caught in IHA. These early males do not overwinter therefore are an indication of the first generation emergence for this species. Only 4 of the 332 male *Cx. tarsalis* caught in 2012 were in the month of June, and in IHA they did not appear until the last week of the month .

Please refer to the Surveillance of Climatic Factors for WNV Risk section of this report for further discussion of the effect of temperature on WNV in BC in 2012.

Temporal Distribution of Mosquitoes

Mosquito species differ in their environmental requirements, and the cool June temperatures observed in 2012 likely affected some species groups differently than others. Figure 9 illustrates the changes of species groups in BC over time for all traps.

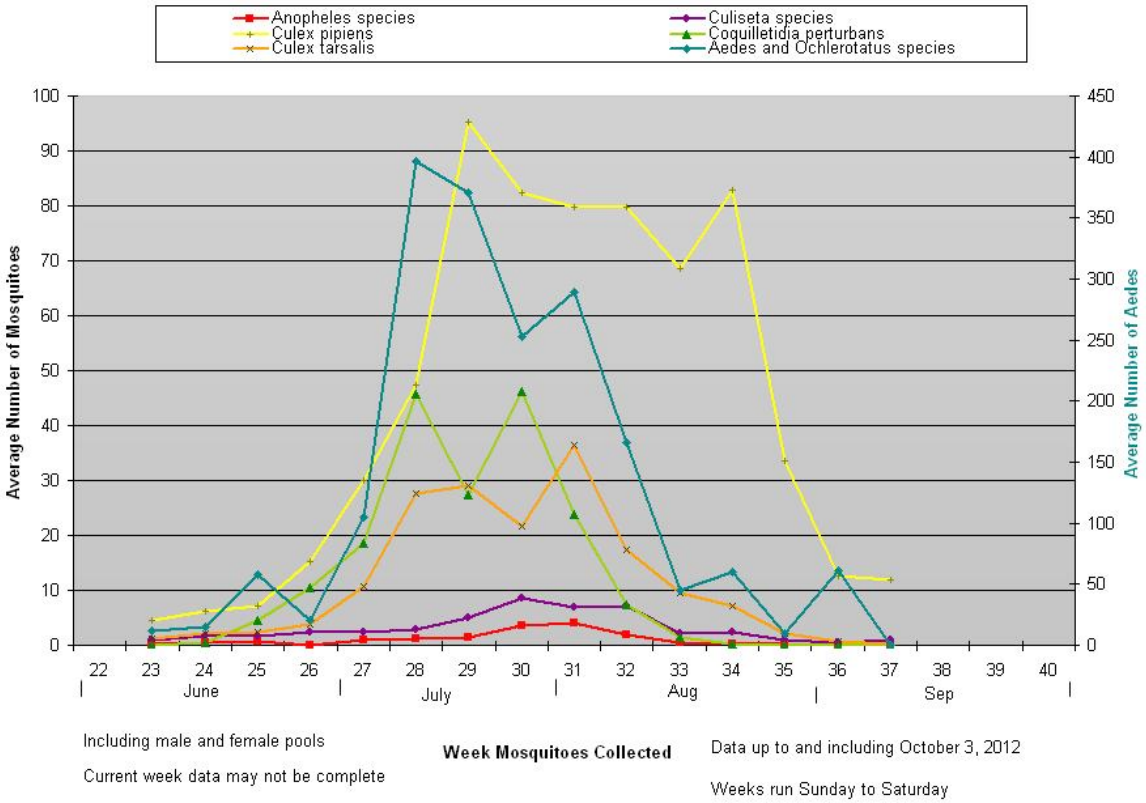
The snowmelt and floodwater *Aedes* did not appear in large numbers until after the beginning of July; usually they are abundant in the middle of June. In the FHA we collected the most *Aedes* in the eastern communities where the most flooding occurred. Most specimens from this group of mosquitoes are influenced by the amount of standing water which floods the eggs that have lain dormant on dry ground from previous seasons. In the IHA the highest counts were from Kelowna and the south end of the Okanagan River near Oliver and Osoyoos.

Coquillettidia perturbans is a species that overwinters as larvae submerged below the surface of the water. The water temperature determines their final stage in spring when metamorphosis is complete. *Cq. perturbans* is usually the second

most common species caught during July and this was true for the Interior traps but in the FHA *Cx. pipiens* were more common in 2012. A small number of mosquitoes were collected from the beginning of June but larger numbers were not recorded until the beginning of July. Cooler temperatures in June delayed the major emergence for several weeks. In 2009, May was much warmer and we had a major emergence of this species 2 weeks earlier (archival data available at www.bccdc.ca/westnile). *Cx. pipiens* was the most abundant species caught in the FHA but was almost absent from the IHA traps. This species is most successful in regions with dense urban development because they colonize storm water catch basins. The next most common species collected was *Cx. tarsalis*, which is considered the primary vector of WNV in northern latitudes. In 2012, ample surface water created ideal habitat for this species to develop, but the cool temperature likely reduced the rate of viral replication. In the Fraser South (FRS) region we collected more *Cx. tarsalis* than *Coquillettidia*. Both *Anopheles* and *Culiseta* were present but not as common as we have seen in previous years.

Cx. territans is often collected in surveillance of larvae but does not seem to be attracted to the CO_2-baited light traps; Only one specimen was collected in 2012 from the most western trap in FRS.

Figure 9: Average Number of Mosquito Species Trapped per Week, 2012



Surveillance Results - Mosquitoes

Relative Abundance of Mosquito Species in specific Health Authorities

Fraser Health Authority

Trapping occurred in two general regions (Figure 5) based on the most likely risk determined by our model; these were Delta, Surrey, and Langley (FRS) and Mission, Abbotsford, and Chilliwack regions (FRE). In each location, duplicate traps were run on the same night, in about half of the locations the second trap was elevated into the tree canopy.

Cx. pipiens was the most common species collected in both the FRS and FRE regions, although *Aedes* were more abundant in some traps closer the Fraser River because of the influence of flooding. Control of nuisance species, like *Aedes vexans*, is the reason for well established programs in this region of FHA. Figure 5 shows that *Cx. pipiens* were caught more often in the FHA than *Aedes* in 2012. The next most common species was *Cx. tarsalis*, especially in the FRS traps. Both of these species are known vectors for WNV.

In FHA a subset of traps were elevated in the tree canopy. This method has been suggested to increase the number of bird-biting mosquitoes caught such as *Cx. pipiens* (Anderson et al., 2004). At each of five locations one trap operated at ground level and another was placed in the tree canopy. Comparing the elevated traps with ground level traps we captured 22,592 *Cx. pipiens* in elevated traps and 3,053 in the ground level traps. As a percent of the total catch in elevated traps 87% were *Cx. pipiens* versus 54% in the ground traps set at the same site. Accepting that elevated traps have been shown to improve collection of more bird feeding species than ground placed traps. *Cx. pipiens* has a worldwide distribution and there is variation in the types across the globe. Some prefer feeding on an avian host while others act as a bridge vector that infects mammalian hosts (Kramer, 2008). We have never examined the genetics of the *Cx. pipiens* in our region but this data tends to indicate our representatives of this species are more like the enzoonotic form that prefers an avian host.

Interior Health Authority

IHA had large numbers of *Aedes* due to the high water along the river corridors. The water equivalent snowpack for May 1st (Figure 6) were average for this period but the delay in melting, due to cool weather in June, resulted in a surge of discharge when temperatures rose in July. Mission Creek in Kelowna flooded several areas along its course. Trap IHA 5, located along Mission Creek, collected around 500 to several thousand *Aedes* per week throughout most of the season. The other areas with high *Aedes* counts were IHA 9 in Okanagan Falls, IHA 10 in Oliver and IHA 11 in Osoyoos. Trap IHA 11 collected between 8,000 and 18,000 *Aedes* per night during July. This high *Aedes* catch is expected with the flooding of Haynes Landing due to high water levels in Osoyoos Lake in 2012. *Coquillettidia perturbans* was the second most common mosquito collected in IHA traps in 2012 which is primarily due to the large numbers collected in trap IHA 6 in West Kelowna and IHA 9 in Okanagan Falls.

Surveillance Results - Mosquitoes

Our major focus is to determine where *Cx. tarsalis* are most abundant because they are the primary vector for WNV and tested positive for the virus in 2009. *Cx. tarsalis* was the third most abundant group of mosquitoes collected in 2012 in IHA. The traps with the highest counts were in IHA 10 in Oliver and IHA 11 in Osoyoos in 2012. The highest daily counts were in the middle of July when the temperature exceeded the extrinsic incubation threshold but no virus was detected.

In 2012, *Cx. pipiens* counts were very low with an average of only 4.2 per night in the IHA traps. The highest counts were recorded in Penticton. More *Cx. pipiens* can be expected in the most urbanized regions because they use storm sewer, catch basins as larval development sites. One possible reason WNV activity was not detected in the Okanagan in 2012 is due to the small population of this species and therefore the lack of an established enzoonotic cycle for the virus.

There was only one trap outside the Okanagan Valley and it was located in Kamloops. This region is warm enough to allow mosquitoes to incubate this virus. This trap collected only 40 *Cx. tarsalis* over this season. One possible reason for the low numbers is the active nuisance mosquito control program in this region.

Summary

WNV was not detected by mosquito surveillance in 2012. The primary vector *Cx. tarsalis* was present in most locations and the average indicated that there were more than previous years. This increase was likely due to improved trap placement in areas where this species is most abundant. *Cx. pipiens* maybe the primary enzoonotic vector and it was significantly greater in the FHA but almost absent from the IHA. The use of elevated traps in FHA which caught more *Cx. pipiens* may have been part of the reason for this increase. Targeting analysis of these species remains the focus of surveillance in the province.

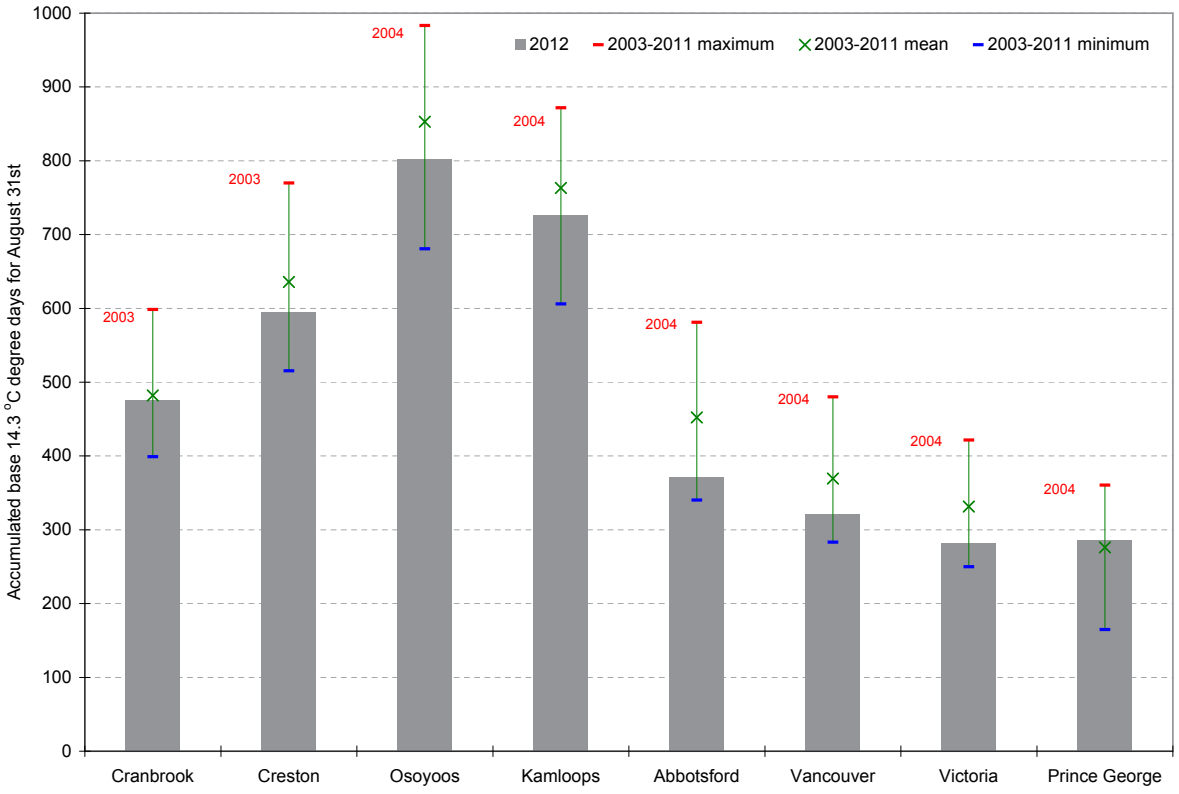
Additional charts of weekly mosquito catch by HSDA in 2012 can be viewed at www.bccdc.ca/westnile, along with previous archived surveillance reports.

Surveillance Results - Climatic Factors

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 14.3ºC growing degree days model has been used to forecast *Cx. tarsalis* mosquito development and corresponding WNV risk in BC. 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 (Figure 10). A spatial model was also developed to create a continuous surface map for the entire province (Figure 11).

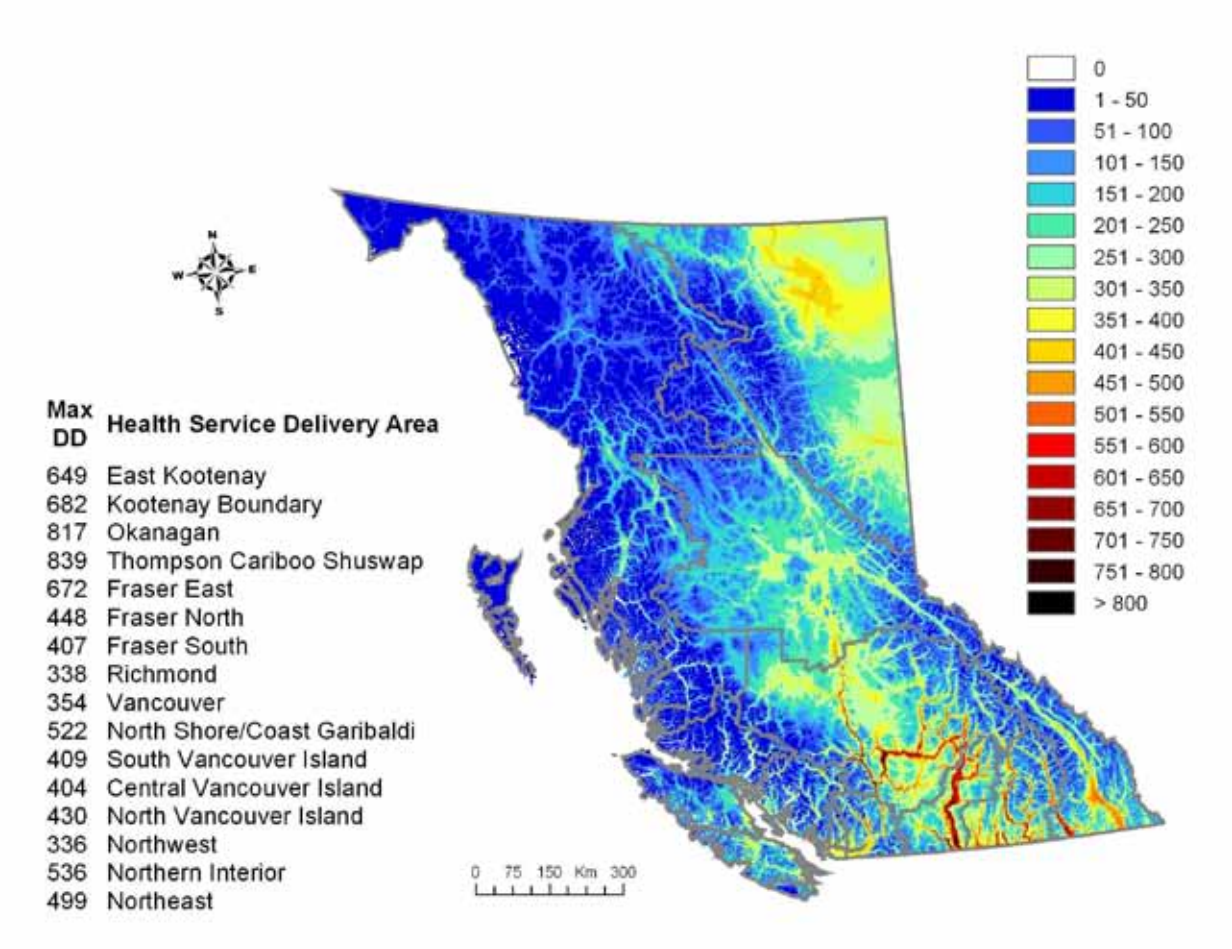
Figure 10: Accumulated Base 14.3ºC Growing Degree Days for Select Communities up to August 31st – 2012 vs. Past 9 Years



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 date does not contribute to WNV risk.

Surveillance Results - Climatic Factors

Figure 11: Accumulated Base 14.3°C Growing Degree Days in British Columbia up to August 31, 2012 by Health Service Delivery Area



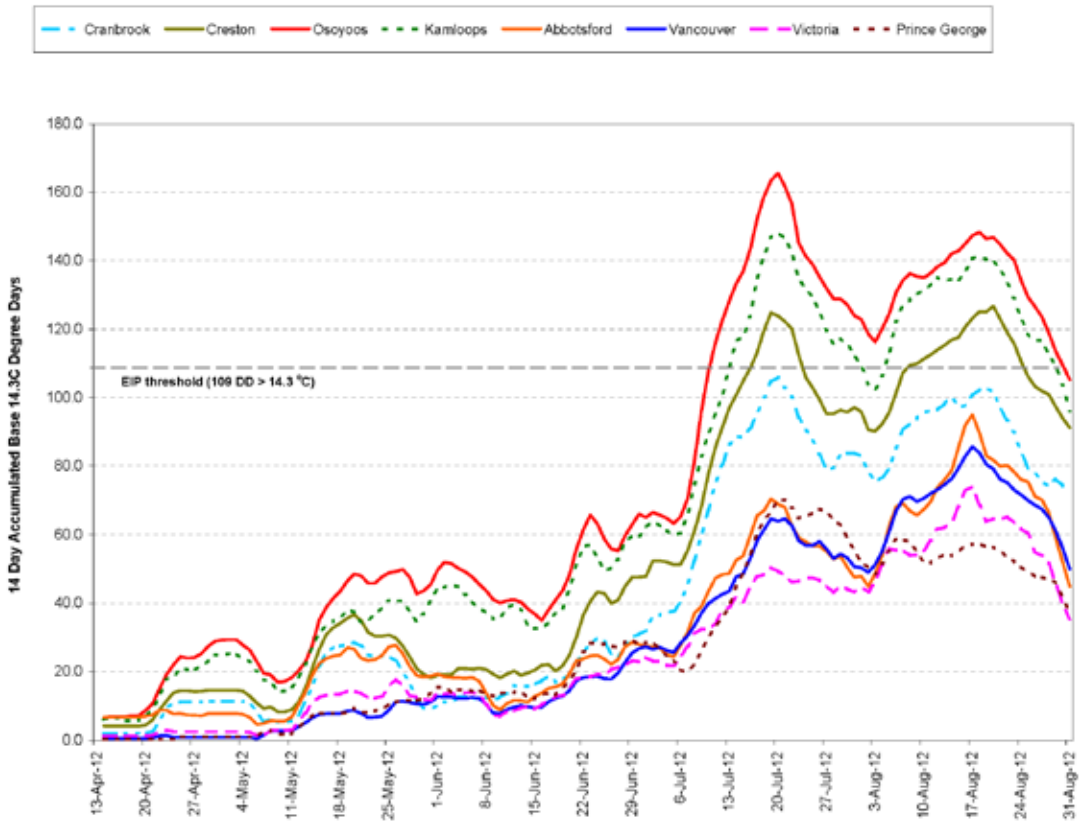
Max DD	Health Service Delivery Area
649	East Kootenay
682	Kootenay Boundary
817	Okanagan
839	Thompson Cariboo Shuswap
672	Fraser East
448	Fraser North
407	Fraser South
338	Richmond
354	Vancouver
522	North Shore/Coast Garibaldi
409	South Vancouver Island
404	Central Vancouver Island
430	North Vancouver Island
336	Northwest
536	Northern Interior
499	Northeast

The accumulated heat observed in 2012 was below average compared to the past 9 years as monitored by the WNV Program for almost every region of the province (Figure 10). In fact, temperatures in June 2012 were among the coolest observed on record for southern BC. Warm, dry weather was not experienced until the second week of July.

The Okanagan and Thompson Cariboo Shuswap regions consistently experience the greatest accumulation of degree days (i.e. heat) in BC (Figure 11). These regions are characterized by hot, dry summers with maximum daily temperatures often exceeding 35^{o}C and less than 100 mm of total precipitation between June and August. The Kootenay Boundary, East Kootenay and Fraser Valley regions also experience sufficient accumulated degree days to support multiple generations of *Culex* mosquitoes.

Surveillance Results - Climatic Factors

Figure 12: 14 Day Moving Window of Base 14.3ºC Growing Degree Days for Select Communities up to August 31st, 2012



Note: The extrinsic incubation period (EIP) threshold of 109 base 14.3ºC degree days reflects the time when a female mosquito, having ingested an infectious bloodmeal, is capable of transmitting WNV.

During the surveillance season we also use a 14 day moving degree day window model to monitor WNV risk related to climatic factors to predict when and where conditions reach a point where WNV activity is possible (Figure 12). This model indicates when sufficient degree days have accumulated to allow for a new 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 2012 the cold, wet spring punctuated by the coolest June on record for southern BC resulted in very low accumulation of degree days early in the season, and the potential for WNV activity in the second and third generation of mosquitoes was not realized until mid-July and August. The later onset of heat may have limited the amplification of WNV in birds and mosquitoes, and ultimately minimized the risk of WNV infection in humans this past year.

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:

- a new 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 determine baseline corvid density.
- 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 www.bccdc.ca/wnvmaps 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 the use of personal protective measures. Awareness is created through the distribution of resource materials (including brochures), news releases, fact sheets 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 routine surveillance reports and teleconferences.
- Respond to issues/inquiries and other correspondence as required.

Strategies

- Provincial coordination of surveillance, communications/public information through regular BC WNV meetings
- Press releases and support material distributed throughout summer months
- BCCDC Web site – updated with timely and consistent materials for public and professional use
- Cooperation with other provinces/territories and Public Health Agency of Canada in coordinating public information and education nationally.

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

2012 Communications Review

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

- Stakeholders across the province (e.g., parks, hospitals, tourist centers, veterinary offices, etc.) received brochures.
- News release issued and additional communications were done on an as needed basis by BCCDC and regional health authorities:
  http://www.bccdc.ca/resourcematerials/newsandalerts/news/Risk+of+West+Nile+Virus+increasing+due+to+warm+weather.htm
- Up-to-date information/resources including weekly reports were posted via the BCCDC website at www.bccdc.ca/westnile

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Animal Health Centre, BC Ministry of Agriculture

Dr. Victoria Bowes, Veterinarian Pathologist

Acknowledgements:

As with previous years, both field and laboratory workers have to be congratulated on making the WNV surveillance system operate efficiently. We would like to acknowledge Health Authority and seasonal WNV staff, particularly from Interior and Fraser Health who run the WNV programs in their respective jurisdictions; their contributions make this program work so well. Furthermore, we would like to acknowledge the work of AHC in carrying out prompt testing of corvid specimens and for their aid in the tracking of equine positives. We also acknowledge the efforts of CBS in testing blood donations, and for their participation in this program. We would like to thank all our partners for their efforts, without whom a comprehensive epidemiological approach to WNV would be impossible.