West Nile Virus Mosquito and Animal Surveillance, 2016-2020

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This report summarizes West Nile Virus surveillance data, including mosquitoes and non-human vertebrate hosts, from 2016 through 2020.

We would like to acknowledge and extend our sincere thanks and appreciation to our agency and external partners for their ongoing collaboration and contributions to mosquito surveillance. The following mosquito control districts and academic and military partners contributed data to this report:

- Adams County Mosquito Control
- Benton County Mosquito Control
- Clark County Mosquito Control
- Columbia Mosquito Control
- Cowlitz Mosquito Control
- Franklin County Mosquito Control
- Grant County Mosquito Control
- Dr. Krisztian Magori, Eastern Washington University
- Fairchild Air Force Base
- Department of Public Health, Joint Base Lewis-McChord
- Naval Base Kitsap

Many local health jurisdictions and unaffiliated individuals in these jurisdictions also participated in mosquito surveillance and gathered data that contributed to this report. Some are listed here:

- Clallam County Health & Human Services
- Grays Harbor County Public Health
- Island County Public Health
- Jefferson County Public Health
- Kittitas County Public Health
- Lincoln County Health Department
- Mason County Public Health
- Northeast Tri County Health District
- Public Health — Seattle & King County
- Skagit County Public Health
- Snohomish Health District
- Tacoma-Pierce County Health Department

Mosquito testing was conducted by mosquito control and military partners listed above. The following laboratories also contributed testing data to this report:

- Oregon Veterinary Diagnostic Laboratory
- Washington State Public Health Laboratories

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West Nile Virus Mosquito and Animal Surveillance, 2016-2020

West Nile virus (WNV) is transmitted to people and animals primarily through the bites of infected mosquitoes. Mosquitoes can become infected when they feed on infected birds. Additionally, mosquitoes can become infected via vertical transmission, and this mechanism is likely accountable for WNV maintenance over the winter in the Northern United States.[1, 2] However, it is not well understood how much vertical transmission impacts virus amplification and seasonal human risk.[1, 2, 3]

The principal vectors of WNV vary regionally across the United States. In Washington, the primary vectors are *Culex pipiens* and *Culex tarsalis*. Both species play an integral role in the natural maintenance and amplification of WNV.

Because patterns of transmission are associated with a variety of parameters including climate, habitat, human behavior, and socioeconomic factors, outbreaks of WNV prove difficult to predict. The unpredictability and sporadicity of human WNV case clusters necessitate the establishment and maintenance of surveillance systems capable of detecting increases in WNV transmission along with the ability to respond to surveillance data with effective, disease-reducing interventions. Though epidemiological surveillance is essential for understanding WNV disease burden, utilizing human case surveillance by itself is insufficient for predicting outbreaks. By monitoring WNV infection prevalence in mosquito vectors and incidence in non-human vertebrate hosts and comparing these indices to historical environmental and epidemiological surveillance data, conditions associated with increasing human risk can be detected in advance of human disease onset.[3]

Washington State agencies conduct surveillance for WNV infections in humans, birds, mosquitoes, horses, and other animals. Additionally, CDC has established a national surveillance system (ArboNET) to track disease-causing agents transmitted through arthropods, including WNV. State health agencies report WNV surveillance data on human disease cases, positive blood donors, veterinary disease cases, and infections detected in mosquitoes, birds, and sentinel animals to ArboNET.

This report reviews WNV surveillance data from mosquitoes and animals during 2016-2020.

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[1] Brittany M. Nelms, Ethan Fechter-Leggett, Brian D. Carroll, Paula Macedo, Susanne Kluh, William K. Reisen "Experimental and Natural Vertical Transmission of West Nile Virus by California *Culex* (Diptera: *Culicidae*) Mosquitoes," Journal of Medical Entomology, 50(2), 371-378, (1 March 2013)

[2] Anderson JF, Main AJ. Importance of vertical and horizontal transmission of West Nile virus by *Culex pipiens* in the northeastern United States. J Infect Dis. 2006; 194:1577–1579.

[3] Centers for Disease Control and Prevention, West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control. 4th Revision. Fort Collins, CO. June 14, 2013. Available from: https://www.cdc.gov/westnile/resources/pdfs/wnvGuidelines.pdf.

Surveillance Activities

The Washington State Department of Health (WA DOH), funded in part by CDC, has maintained surveillance for early detection of WNV in the environment since 2001. Surveillance efforts depend heavily upon a network of partners composed of local health jurisdictions; mosquito control districts; military partners; tribal, federal, and state agencies; and volunteers, including private citizens.

Surveillance involves trapping mosquitoes to evaluate populations, identify potential WNV vector species, and test for WNV in known vector mosquitoes. When resources allow, testing for two other arboviruses — Western equine encephalitis and St. Louis encephalitis viruses – may also occur. In the past, WA DOH maintained an online system for public reporting of dead bird sightings; however, monitoring of mosquitoes has proven to be a more reliable indicator of current WNV activity. Dead birds may still be reported to the Department of Fish & Wildlife on their wildlife observation reporting form linked here: https://wdfw.wa.gov/get-involved/report-observations. In coordination with the Washington State Department of Agriculture and the Washington Animal Disease Diagnostic Laboratory, WA DOH tracks veterinary reports of suspected cases of WNV infection in horses and other animals. Notification of environmental detections alert local public health and mosquito control authorities to initiate or strengthen educational outreach and mosquito control responses in efforts to minimize the health impacts of this disease on communities.

Mosquito Surveillance

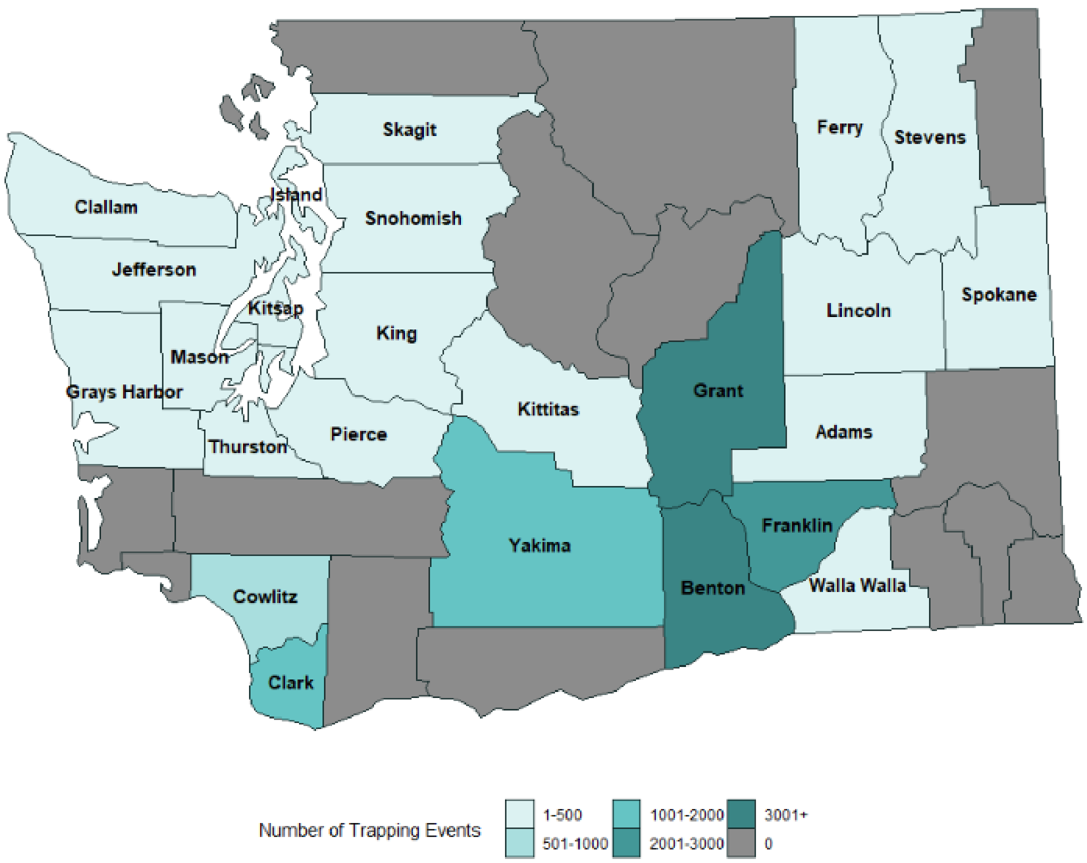
During 2016-2020, WA DOH field staff and surveillance partners collected adult mosquitoes from across 24 counties, primarily using carbon dioxide traps and on some occasions, gravid traps. The setting and collecting of a single trap was counted as one trapping event or one collection. Trapping events ranged from 3,144 events in 2017 to 4,691 events in 2020 and generally increased year to year. Seasonal surveillance across all 5 years resulted in a total of 18,647 trapping events, bringing in 2,073,549 mosquitoes for speciation.

Table 1: Number of Mosquito Trapping Events in Washington, 2016-2022

Year	Number of Trapping Events
2016	3,210
2017	3,144
2018	3,493
2019	4,109
2020	4,691

Trapping is unequally distributed throughout the state. Figure 1 displays the distribution and range of mosquito trapping events by county for the 2016-2020 surveillance seasons. Trapping is also unevenly distributed within counties and dependent on state and local resources. The vast majority of trapping events occurred within the boundaries of mosquito control districts, particularly in Grant, Benton, and Franklin Counties. Most districts are located east of the Cascade Mountains, where WNV is endemic. A more limited number of trapping events were reported from Western counties.

Figure 1. Distribution of Mosquito Trapping Events by County, Washington, 2016-2020



Overall, during this five-year period, a small increase in the number of trapping events was seen in Yakima County, while slightly fewer trapping events occurred over time in Thurston County. Trapping by local health jurisdictions was disrupted by the SARS-CoV-2 pandemic in 2020, but continued at high levels by mosquito control districts. The higher number of trapping events in 2020 was due in part to a sharp increase in trapping events from Franklin County Mosquito Control District and overall increased reporting that year.

Large numbers of the primary WNV vectors, *Culex pipiens* and *Culex tarsalis*, were collected each year. Vector mosquito abundance can be calculated by dividing the total number mosquitoes collected by the number of traps per night in a specified period of time. Figures 2 and 3 describe show vector abundance by week. In general, vector mosquitoes were most abundant during MMWR weeks 23 through 35 (corresponding to mid-June through early September) in Western WA, and weeks 21 through 36 (late May through early to mid-September) in Eastern WA (Figures 2 and 3). The length of the vector mosquito season appeared mostly comparable in Eastern and Western WA, lasting approximately 20 weeks in both regions. However, comparisons between Eastern and Western WA are limited due to large differences in trapping capacity between the regions.

Figure 2: Abundance of Vector Mosquitoes (*Culex pipiens and Culex tarsalis*) Collected in Western Washington, By Week

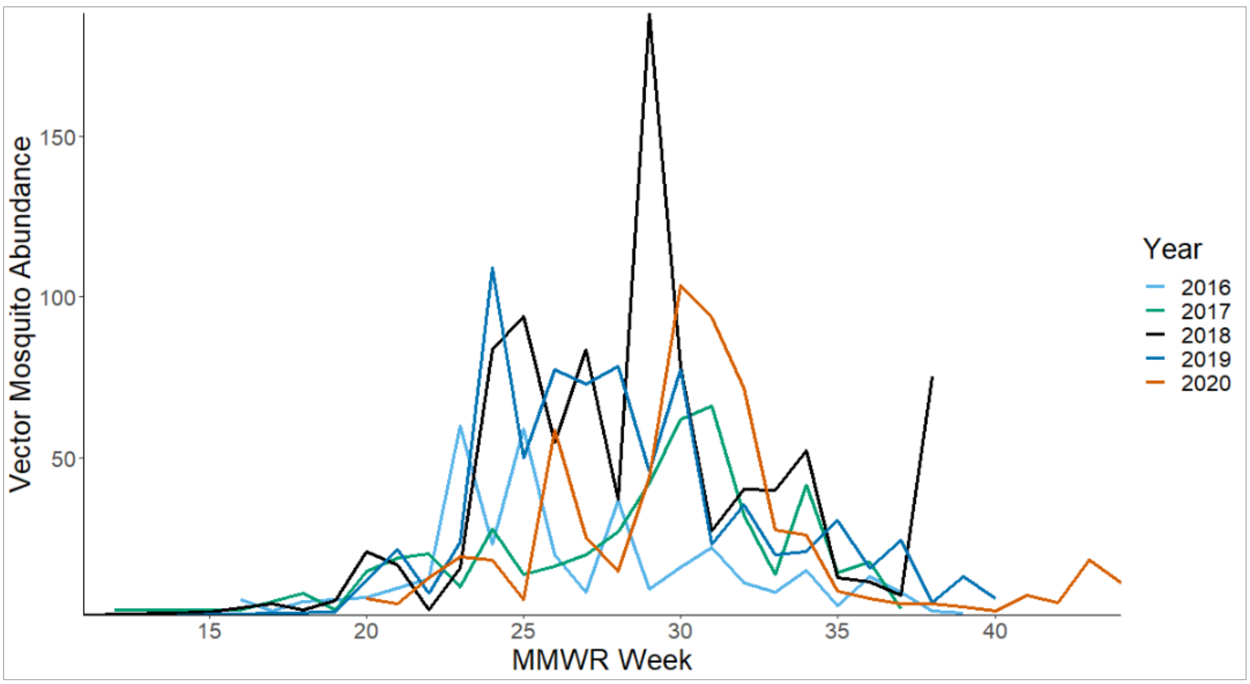
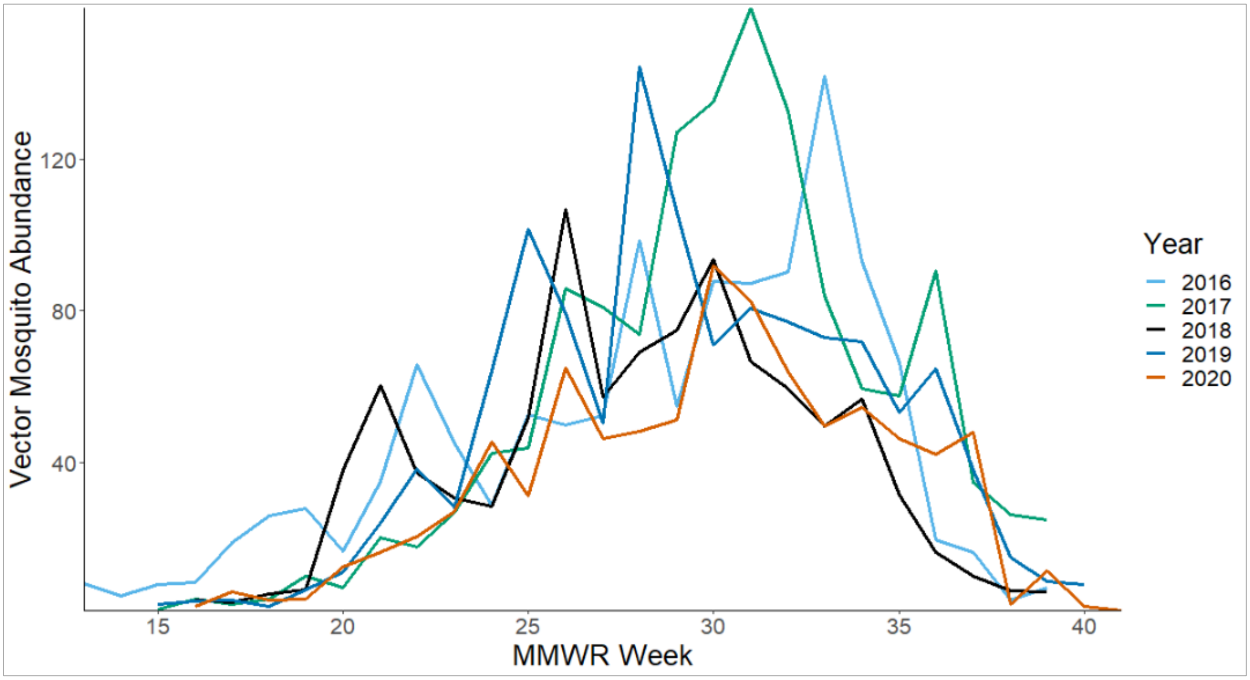


Figure 3: Total Number of Vector Mosquitoes (*Culex pipiens and Culex tarsalis*) Collected in Eastern Washington, By Week



Once trapped, vector mosquitoes were speciated and tested for WNV. Testing for WNV was conducted by mosquito control districts using the commercial assay RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp); and by the Oregon Veterinary Diagnostic Laboratory, the U.S. Army Joint Base Lewis-McCord Washington-Public Health Command Region-West, and WA DOH, using reverse transcriptase-polymerase chain reaction (RT-PCR). Laboratories performing RT-PCR also analyzed samples for St. Louis encephalitis and Western equine encephalitis viruses.

Over the five years, 456,940 vector mosquitoes, batched into 6,859 mosquito pools, were tested for WNV. Of the pools tested for WNV, 219 (3.2%) were positive. In addition, 2,082 of these pools were also tested for St. Louis encephalitis and Western equine encephalitis; no samples were positive for either St. Louis encephalitis or Western equine encephalitis virus. Figure 4 depicts the number of years in which at least one WNV-positive mosquito pool was detected, by county.

Detections of four WNV-positive mosquito pools in Pierce County occurred in August 2018 and represented the first ever detection of WNV in mosquitoes trapped in Western WA. Following this detection, WA DOH set up five additional temporary trap sites throughout the county, but no additional positive pools were detected.

Figure 4: Number of Years West Nile Virus-Positive Mosquito Pool Detected by County, Washington, 2016-2020

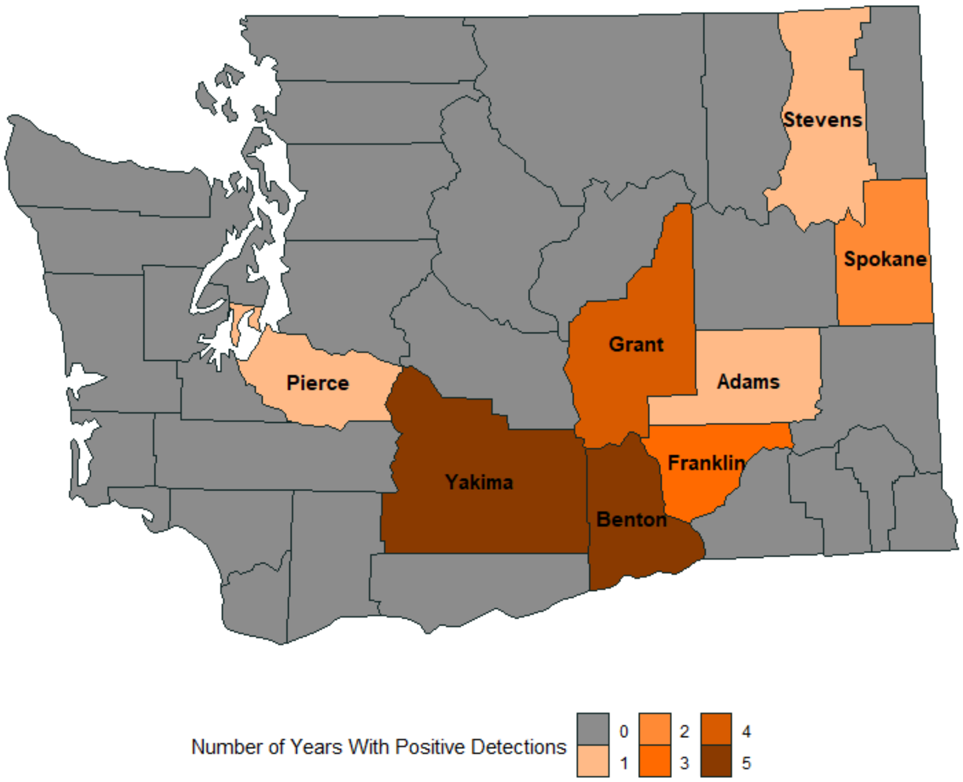


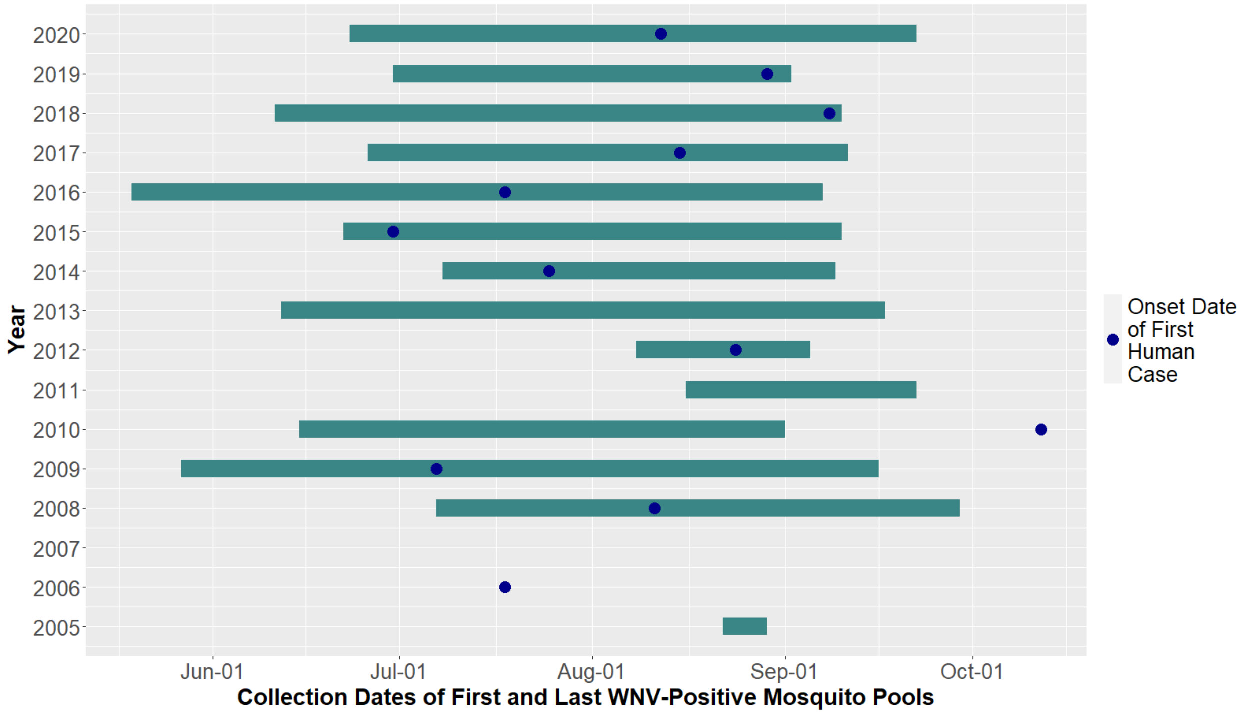
Table 2 lists the number of positive mosquito samples by year and county.

Table 2: West Nile Virus Detections in Mosquitoes 2016-2020, by County

Year	# Positive Samples, By Year	County	# Positive Samples, by County
2016	95	Adams County	1
		Benton County	25
		Franklin County	6
		Grant County	51
		Stevens County	1
		Yakima County	11
2017	34	Benton County	9
		Grant County	14
		Spokane County	1
		Yakima County	10
2018	52	Benton County	9
		Franklin County	1
		Grant County	29
		Pierce County	4
		Spokane County	3
		Yakima County	3
2019	27	Benton County	9
		Grant County	16
		Yakima County	2
2020	14	Benton County	8
		Franklin County	1
		Yakima County	5

During 2016-2020, most initial detections of WNV in mosquitoes for the season occurred in June and in regions of south-central Washington. The length of time between the first and last detections of WNV-positive mosquito pools each year ranged from 9 to 16 weeks, averaging 12.4 weeks (Figure 5). The timing of initial detections and season lengths have not shown significant yearly change since the first detection of WNV in Washington, in 2005, but may be influenced by the number and distribution of mosquito collections performed each year. Environmental conditions, including temperature, rainfall, and snow melt, also impact seasonal or temporal mosquito distribution, which can then impact viral amplification rates.

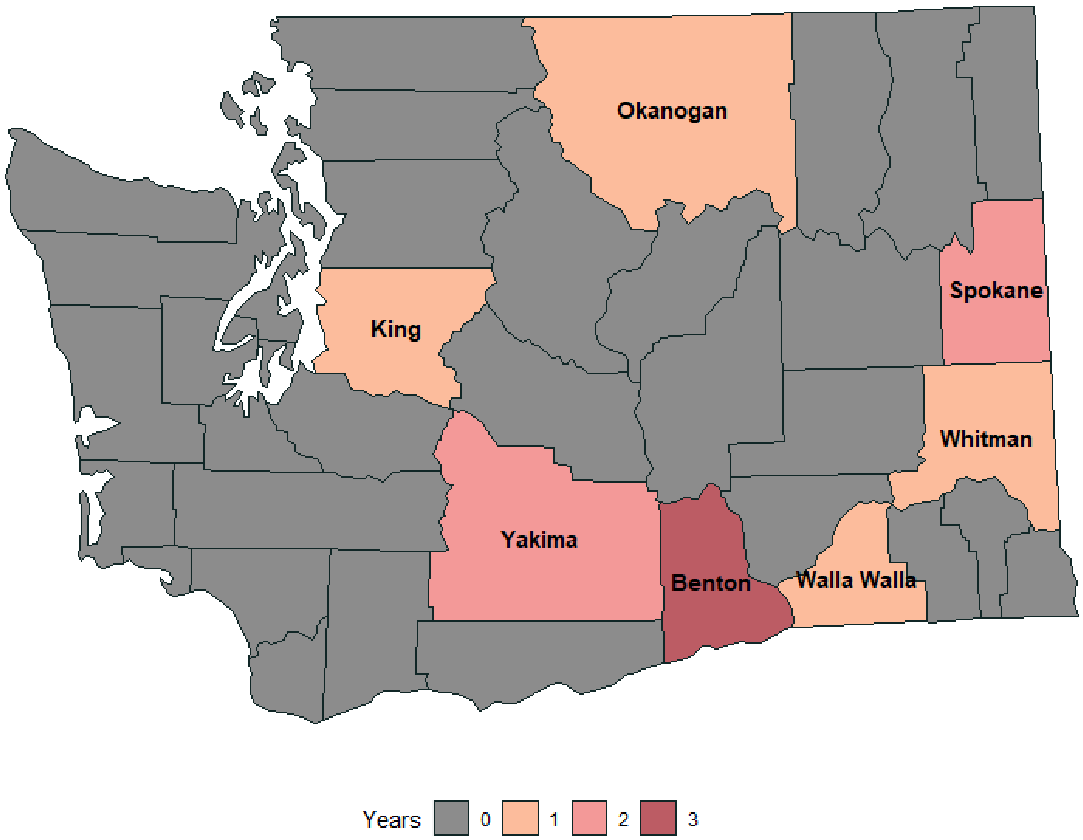
Figure 5. Timing of West Nile Virus Detections in Mosquitoes and First Locally-Acquired Human West Nile Virus Case by Year, Washington, 2001-2020



Human Surveillance

During 2016-2020, 2-13 cases of human WNV infection were reported each year, and for the entire five-year period, 32 human cases were reported. Of these, 24 (75%) were acquired in Washington. Figure 6 depicts the number of years human cases were detected, by county of exposure, from 2016-2020. On average, the first locally-acquired human case of each season followed initial detections of WNV in mosquitoes in Washington by an estimated 8 weeks (Figure 5).

Figure 6: Number of Years Human Cases of West Nile Virus Detected, By County of Exposure, Washington, 2016-2020



* Except for Western Washington, cases that were exposed in multiple counties are excluded.

Except for one case in a King County resident, the 24 locally-acquired human WNV cases reported during this period were exposed in Eastern WA. This one case was reported in 2018 in a King County resident who tested positive for WNV after having spent time in only King and Kitsap Counties. Based on the timing of their symptom onset, it is believed that this is the first human WNV case with clear exposure in Western WA and either King or Kitsap County. While WNV-positive mosquitoes have never been captured in either of these counties, mosquito surveillance in these counties is inconsistent and not widespread and likely does not provide a complete picture of WNV risk.

Mosquito surveillance data were not available for Okanogan and Whitman counties, although each county reported a case of local exposure.

WNV can be transmitted via blood transfusion, although this route of transmission is uncommon. Blood donation agencies screen all donated blood for WNV to minimize the risk and occasionally, asymptomatic donors are found to be infected. Each year during 2016-2020, WNV was detected in 0-3 asymptomatic donors: 2016 (3), 2017 (1), 2018 (2), 2019 (2), 2020 (0).

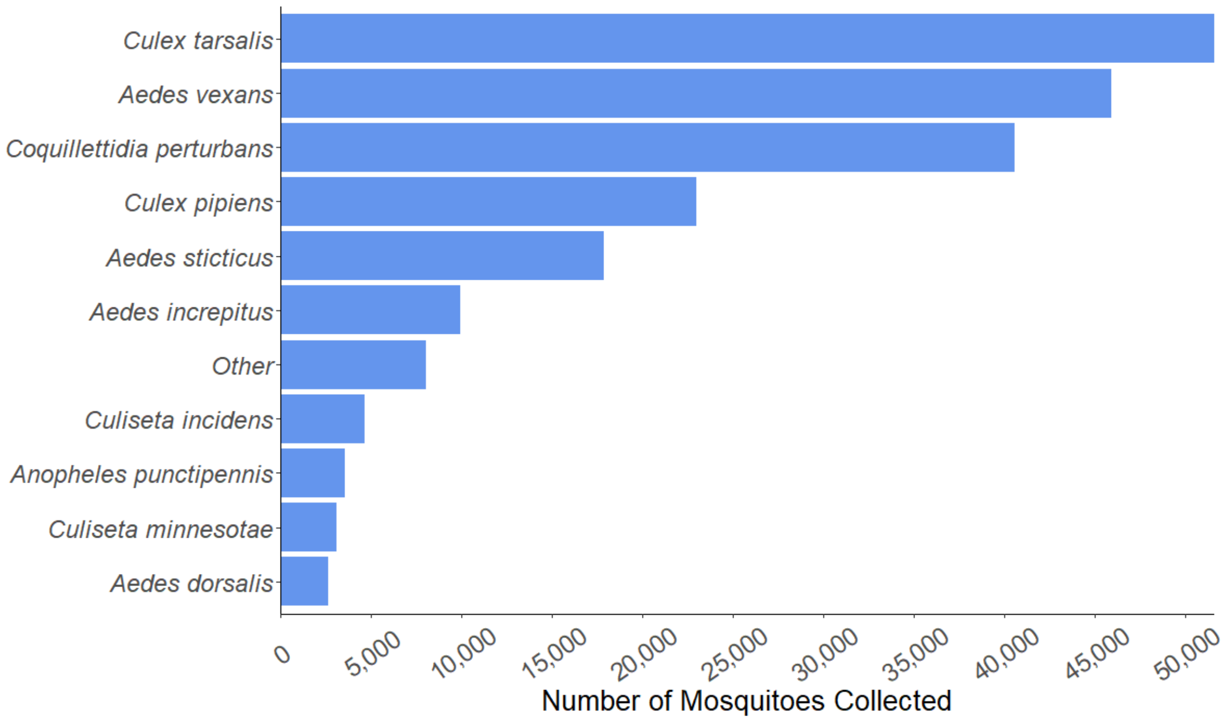
These findings are not incorporated into total counts of human WNV cases because they are not cases of WNV disease and, as incidental detections, do not reliably provide information about the population burden of WNV infection.

Mosquito Species Findings

In addition to improving knowledge of the geographic distribution of environmental WNV virus risk, surveillance contributes to our understanding of the distribution and abundance of mosquito species, the impact of climate change on this changing distribution, and the emergence of mosquito populations with the potential to serve as vectors of disease.

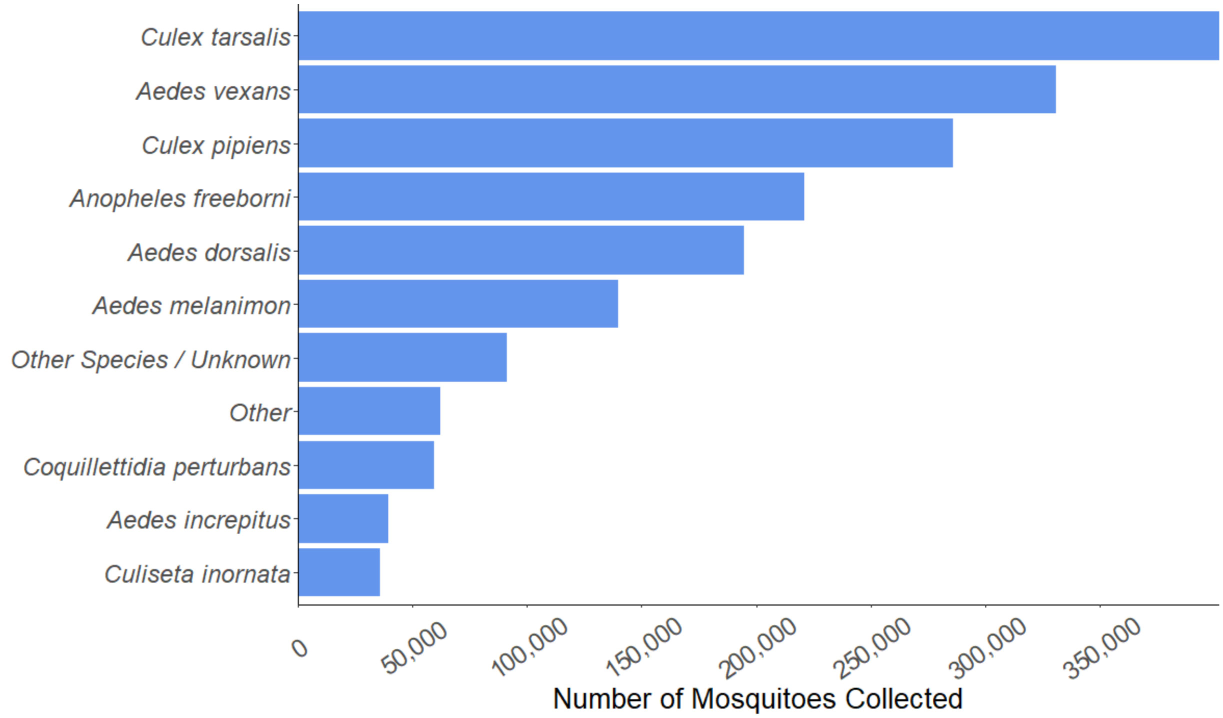
Mosquito species varied by geography. Figures 7 and 8 depict the distribution of species collected in Eastern and Western WA. Note that the scale for the number of mosquitoes collected on the Eastern WA chart is an order of magnitude higher than that on the Western WA chart. In both figures, the largest numbers of collected mosquitoes reported are *Culex tarsalis*. These results are unexpected because, historically, *Aedes vexan*s has been the predominant species in Eastern WA, while *Coquillettidia perturbans* has been the predominant species in Western WA. It is possible that the findings for 2016-2020 may be the result of bias in surveillance efforts, which focus on detecting and evaluating vector species for WNV, such as *Culex*, over other mosquito species.

Figure 7. Number of Mosquitoes Collected by Species in Western Washington, 2016-2020



Note: "Other" includes *Aedes aboriginis, Aedes aloponotum, Aedes cinereus, Aedes communis, Aedes excrucians, Aedes fitchii, Aedes intrudens, Aedes j. japonicus, Aedes melanimon, Aedes nigromaculis, Aedes sierrensis, Aedes sp., Aedes ventrovittis, Anopheles earlei, Anopheles freeborni, Anopheles occidentalis, Anopheles sp., Culex salinarius, Culex sp., Culex territans, Culiseta impatiens, Culiseta inornata, Culiseta morsitans, Culiseta particeps, Culiseta sp.*, and Other Species / Unknown.

Figure 8. Number of Mosquitoes Collected by Species in Eastern Washington, 2016-2020



Note: "Other" includes *Aedes aboriginis, Aedes campestris, Aedes cinereus, Aedes communis, Aedes excrucians, Aedes fitchii, Aedes flavescens, Aedes hendersoni, Aedes implicatus, Aedes intrudens, Aedes nigromaculis, Aedes provocans, Aedes sierrensis, Aedes sp., Aedes sticticus, Anopheles earlei, Anopheles occidentalis, Anopheles punctipennis, Anopheles sp., Culex sp., Culex territans, Culiseta impatiens, Culiseta incidens, Culiseta minnesotae, Culiseta morsitans,* and *Culiseta sp.*

During 2016-2020, surveillance identified new mosquito species findings in 11 counties. Nine species were newly-identified in Western WA and are listed with their first month and year of collection in Table 3, below.

Table 3: Newly-Detected Species in Western Washington, by County

County	Species	Collection Date
Clallam	*Culiseta particeps*	2019-Jul
Clark	*Aedes aboriginis*	2019-May
	Aedes fitchii	2018-May
	Culiseta minnesotae	2018-Aug
	Culiseta morsitans	2017-Aug
Cowlitz	*Aedes nigromaculis*	2017-May

County	Species	Collection Date
Jefferson	*Anopheles freeborni*	2017-Jun
	Culiseta minnesotae	2019-Jul
Skagit	*Culiseta particeps*	2019-Sep
Thurston	*Aedes j. japonicus*	2016-Apr
	Culex salinarius	2016-Jun

In Eastern WA, seven species were newly-identified. They are listed in Table 4 with the month and year of their first collection.

Table 4: Newly-Detected Species in Eastern Washington, by County

County	Species	Collection Date
Franklin	*Aedes communis*	2018-Aug
	Aedes implicatus	2017-May
Grant	*Aedes aboriginis*	2017-Jun
	Culiseta impatiens	2017-Jun
Lincoln	*Coquillettidia perturbans*	2019-Jul
Spokane	*Aedes provocans*	2017-May
	Culiseta impatiens	2017-Jun
Stevens	*Aedes hendersoni*	2016-Jun

In the Appendix, Tables 10 and 11 provide geo-temporal information about novel detections of 45 species of mosquitoes endemic in Washington and an additional 13 species that are rarely reported in Western WA and 8 that are rarely reported in Eastern WA. These tables illustrate the progression of mosquito species in Washington as they become identified in counties through time.

Veterinary Surveillance

From 2016-2020, local veterinarians in Washington submitted specimens from 148 suspected WNV equine cases to the Washington Animal Disease Diagnostic Laboratory (WADDL) in Pullman, Washington. Forty (27%) of these suspected cases were confirmed to be positive for WNV. All of the horses were located in Eastern WA counties upon diagnosis: Benton (2), Franklin (2), Grant (2), Kittitas (2), Klickitat (1), Lincoln (3), Okanogan (4), Pend Oreille (2), Spokane (14), Stevens (7), and Yakima (1). Thirty-five (88%) of these horses had not been vaccinated for WNV. Twenty-seven (68%) of the cases occurred in 2016.

County-level summary tables of WNV detections reported by veterinarians for 2016-2020 are in the Appendix (Tables 2 through 6).

Bird Surveillance

WA DOH no longer maintains a system for public reporting of dead bird sightings. Bird surveillance now relies on reports of WNV detected in birds submitted for testing by partners such as WADDL. The number of birds submitted for testing is no longer tracked. In total, 6 birds tested positive for WNV in 2016-2020. These birds were collected in 2016 (2 birds, Spokane) and 2017 (4 birds, Lincoln, Spokane, and Walla Walla).

Appendix

Table 5. West Nile Virus Environmental Detections by County, Washington, 2016

	Horse/Other Mammal		Bird		Mosquito Pool	
County	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**
Adams	0	0	0	0	1	1
Asotin	0	0	0	0	0	0
Benton	5	1	0	0	197	25
Chelan	2	0	0	0	0	0
Clallam	0	0	0	0	0	0
Clark	0	0	0	0	122	0
Columbia	0	0	0	0	0	0
Cowlitz	0	0	0	0	23	0
Douglas	1	0	0	0	0	0
Ferry	0	0	0	0	0	0
Franklin	1	1	0	0	118	6
Garfield	0	0	0	0	0	0
Grant	4	1	0	0	523	51
Grays Harbor	0	0	0	0	0	0
Island	0	0	0	0	0	0
Jefferson	0	0	0	0	9	0
King	1	0	0	0	0	0
Kitsap	0	0	0	0	7	0
Kittitas	4	1	0	0	1	0
Klickitat	2	0	0	0	0	0
Lewis	0	0	0	0	0	0
Lincoln	4	2	0	0	0	0
Mason	0	0	0	0	0	0
Okanogan	6	4	0	0	0	0
Pacific	0	0	0	0	0	0
Pend Oreille	2	2	0	0	0	0
Pierce	1	0	0	0	13	0
San Juan	0	0	0	0	0	0
Skagit	0	0	0	0	0	0
Skamania	0	0	0	0	0	0
Snohomish	0	0	0	0	16	0
Spokane	14	8	2	2	2	0
Stevens	7	6	0	0	8	1
Thurston	0	0	0	0	34	0
Wahkiakum	0	0	0	0	0	0
Walla Walla	1	0	0	0	0	0
Whatcom	1	0	0	0	0	0
Whitman	1	0	0	0	0	0
Yakima	1	1	0	0	187	11
Totals	**58**	**27**	**2**	**2**	**1261**	**95**

Table 6. West Nile Virus Environmental Detections by County, Washington, 2017

	Horse/Other Mammal		Bird		Mosquito Pool	
County	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**
Adams	1	0	0	0	6	0
Asotin	0	0	0	0	0	0
Benton	3	1	0	0	285	9
Chelan	0	0	0	0	0	0
Clallam	0	0	0	0	0	0
Clark	1	0	0	0	83	0
Columbia	0	0	0	0	0	0
Cowlitz	0	0	0	0	40	0
Douglas	1	0	0	0	0	0
Ferry	0	0	0	0	0	0
Franklin	0	0	0	0	85	0
Garfield	0	0	0	0	0	0
Grant	0	0	1	0	309	14
Grays Harbor	0	0	0	0	0	0
Island	0	0	0	0	0	0
Jefferson	0	0	0	0	21	0
King	3	0	1	0	0	0
Kitsap	0	0	0	0	46	0
Kittitas	1	1	1	0	39	0
Klickitat	0	0	0	0	0	0
Lewis	0	0	0	0	0	0
Lincoln	1	1	2	2	0	0
Mason	1	0	0	0	0	0
Okanogan	4	0	0	0	0	0
Pacific	0	0	0	0	0	0
Pend Oreille	0	0	0	0	0	0
Pierce	2	0	0	0	23	0
San Juan	0	0	0	0	0	0
Skagit	0	0	0	0	0	0
Skamania	0	0	0	0	0	0
Snohomish	4	0	0	0	0	0
Spokane	15	6	1	1	26	1
Stevens	3	0	0	0	21	0
Thurston	0	0	0	0	21	0
Wahkiakum	0	0	0	0	0	0
Walla Walla	1	0	1	1	0	0
Whatcom	1	0	0	0	0	0
Whitman	0	0	0	0	0	0
Yakima	2	0	0	0	216	10
Totals	**44**	**9**	**7**	**4**	**1221**	**34**

Table 7. West Nile Virus Environmental Detections by County, Washington, 2018

	Horse/Other Mammal		Bird		Mosquito Pool	
County	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**
Adams	1	0	0	0	20	0
Asotin	0	0	0	0	0	0
Benton	1	0	0	0	234	9
Chelan	0	0	0	0	0	0
Clallam	0	0	0	0	0	0
Clark	0	0	0	0	125	0
Columbia	0	0	0	0	0	0
Cowlitz	0	0	0	0	23	0
Douglas	0	0	0	0	0	0
Ferry	0	0	0	0	0	0
Franklin	0	0	0	0	145	1
Garfield	0	0	0	0	0	0
Grant	4	1	0	0	522	29
Grays Harbor	0	0	0	0	0	0
Island	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0
King	0	0	2	0	0	0
Kitsap	0	0	0	0	0	0
Kittitas	1	0	0	0	33	0
Klickitat	2	0	0	0	0	0
Lewis	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0
Mason	0	0	0	0	0	0
Okanogan	0	0	0	0	0	0
Pacific	0	0	0	0	0	0
Pend Oreille	0	0	0	0	0	0
Pierce	1	0	0	0	84	4
San Juan	0	0	0	0	0	0
Skagit	0	0	0	0	0	0
Skamania	0	0	0	0	0	0
Snohomish	1	0	3	0	0	0
Spokane	1	0	0	0	16	3
Stevens	3	1	0	0	0	0
Thurston	1	0	0	0	23	0
Wahkiakum	0	0	0	0	0	0
Walla Walla	0	0	0	0	12	0
Whatcom	1	0	0	0	0	0
Whitman	1	0	0	0	0	0
Yakima	0	0	0	0	106	3
Totals	**18**	**2**	**5**	**0**	**1343**	**49**

Table 8. West Nile Virus Environmental Detections by County, Washington, 2019

	Horse/Other Mammal		Bird		Mosquito Pool	
County	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**
Adams	0	0	0	0	16	0
Asotin	0	0	0	0	0	0
Benton	1	0	0	0	92	9
Chelan	0	0	0	0	0	0
Clallam	0	0	0	0	0	0
Clark	0	0	0	0	70	0
Columbia	0	0	0	0	0	0
Cowlitz	0	0	0	0	53	0
Douglas	0	0	0	0	0	0
Ferry	0	0	0	0	0	0
Franklin	3	1	0	0	99	0
Garfield	0	0	0	0	0	0
Grant	1	0	0	0	779	16
Grays Harbor	0	0	0	0	0	0
Island	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0
King	1	0	0	0	11	0
Kitsap	0	0	0	0	0	0
Kittitas	0	0	0	0	22	0
Klickitat	1	1	0	0	0	0
Lewis	0	0	0	0	0	0
Lincoln	0	0	0	0	14	0
Mason	0	0	0	0	0	0
Okanogan	0	0	0	0	0	0
Pacific	0	0	0	0	0	0
Pend Oreille	0	0	0	0	0	0
Pierce	1	0	0	0	43	0
San Juan	0	0	0	0	0	0
Skagit	0	0	0	0	14	0
Skamania	0	0	0	0	0	0
Snohomish	0	0	0	0	0	0
Spokane	2	0	0	0	5	0
Stevens	1	0	0	0	0	0
Thurston	0	0	0	0	15	0
Wahkiakum	0	0	0	0	0	0
Walla Walla	0	0	0	0	0	0
Whatcom	0	0	0	0	0	0
Whitman	0	0	0	0	0	0
Yakima	1	0	0	0	424	2
Totals	**12**	**2**	**0**	**0**	**1657**	**27**

Table 9. West Nile Virus Environmental Detections by County, Washington, 2020

	Horse/Other Mammal		Bird		Mosquito Pool	
County	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**
Adams	0	0	0	0	16	0
Asotin	0	0	0	0	0	0
Benton	0	0	0	0	248	8
Chelan	0	0	0	0	0	0
Clallam	0	0	0	0	0	0
Clark	0	0	0	0	68	0
Columbia	0	0	0	0	0	0
Cowlitz	0	0	0	0	49	0
Douglas	0	0	0	0	0	0
Ferry	0	0	0	0	0	0
Franklin	0	0	0	0	87	1
Garfield	0	0	0	0	0	0
Grant	0	0	0	0	362	0
Grays Harbor	0	0	0	0	0	0
Island	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0
King	0	0	0	0	0	0
Kitsap	0	0	0	0	0	0
Kittitas	0	0	0	0	0	0
Klickitat	0	0	0	0	0	0
Lewis	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0
Mason	0	0	0	0	0	0
Okanogan	0	0	0	0	0	0
Pacific	0	0	0	0	0	0
Pend Oreille	0	0	0	0	0	0
Pierce	0	0	0	0	107	0
San Juan	0	0	0	0	0	0
Skagit	0	0	0	0	0	0
Skamania	0	0	0	0	0	0
Snohomish	0	0	0	0	0	0
Spokane	0	0	0	0	0	0
Stevens	0	0	0	0	0	0
Thurston	0	0	0	0	0	0
Wahkiakum	0	0	0	0	0	0
Walla Walla	0	0	0	0	85	0
Whatcom	0	0	0	0	0	0
Whitman	0	0	0	0	0	0
Yakima	0	0	0	0	355	5
Totals	**0**	**0**	**0**	**0**	**1377**	**14**

Table 10. Distribution of Mosquito Species in Western Washington

Distribution of Mosquitoes in Washington State

Western Washington Mosquito Species by County

County	*Aedes aboriginis*	*Aedes aloponotum*	*Aedes campestris*	***Aedes c. canadensis****	*Aedes cataphylla*	***Aedes cinereus****	*Aedes communis*	***Aedes dorsalis****	*Aedes excrucians*	***Aedes fitchii****	*Aedes flavescens*	*Aedes hexodontus*	*Aedes impiger*	*Aedes implicatus*	*Aedes increpitus*	*Aedes intrudens*	***Aedes j. japonicus****
Western Washington																	
Clallam		X						X	X	X					3		
Clark	14					X			X	13					X		
Cowlitz	X	X	X			X	X	X		X					X	X	1
Grays Harbor	X					5		X		X					X		
Island	X	X				X		X		X					X		
Jefferson	X					X	X	X	X	X	X				X		
King	X	X				X	X	X	X	X		X			X		X
Kitsap	X	X						X	X	X		X			X		
Lewis	X					X	X			X		X	X				
Mason	X	X				X		X	X	X					X		9
Pacific	X					X		X		X					X		
Pierce	X	X				X	X	X	X	X	X	X	X	X	X	X	X
San Juan	X							X		X					X		
Skagit	X	X						X	X	X		X		X	X		
Skamania	X					X	X		X	X		X	X	X	X		
Snohomish	X	6				X	1	X	X	X					X	6	X
Thurston	X	X				X		X	X	X					X		11
Wahkiakum	X									X					2		
Whatcom	X	X				X	X	X	X	X		X	X		X	X	

County	***Aedes melanimon****	*Aedes nevadensis*	***Aedes nigromaculis****	*Aedes pionips* †	***Aedes provocans**** †	*Aedes pullatus*	*Aedes punctor* †	*Aedes sierrensis*	*Aedes s. idahoensis*	***Aedes sticticus****	*Aedes togoi*	***Aedes trivittatus**** †	*Aedes ventrovittis*	***Aedes vexans****	*Anopheles earlei*	***Anopheles freeborni****	*Anopheles occidentalis*
Western Washington																	
Clallam	X					X		X		X				X		X	
Clark								X	X	X				X		X	
Cowlitz			12					X	X	X				X		X	
Grays Harbor								X		X				X			
Island	X		5					X		X	X			X		X	
Jefferson						X		X		X	9			X		12	
King						X		X		X				X		X	
Kitsap								X					10	X			
Lewis								X						3			
Mason								X						X			
Pacific	X							X		X				X			
Pierce		X	X			X		X		X			X	X		X	X
San Juan								X			X						
Skagit		X				X		X		X	X			X			
Skamania					X	X		X		X				X		X	
Snohomish								X		X				X	X	X	X
Thurston	7							X		X				2		2	
Wahkiakum								X						3		X	
Whatcom								X		X	X			X		X	X

County	***Anopheles punctipennis****	***Coquillettidia perturbans****	***Culex apicalis****	*Culex boharti*	***Culex erythrothorax**** †	***Culex pipiens****	***Culex salinarius**** †	***Culex stigmatosoma****	***Culex tarsalis****	***Culex territans****	***Culiseta impatiens****	***Culiseta incidens****	***Culiseta inornata****	*Culiseta minnesotae*	***Culiseta morsitans****	***Culiseta particeps****	***Orthopodomyia signifera**** †
Western Washington																	
Clallam	X	X				X			X	X	X	X	X			14	
Clark	X	X				X			X	X	X	X	X	13	12	X	
Cowlitz	X	X	X	X		X		X	X	X	X	X	X	X		X	
Grays Harbor	X	X	X			X			X	X	X	X	3	X	X	X	
Island	X	X				X			X	X		X	X	X	X	X	
Jefferson	X	X		X		X	5		X	X	X	X	X	14	6	X	X
King	X	X	X	X		X	9	X	X	X	X	X	X	X	X	X	
Kitsap	X	X				X			X	X	X	X	X	2	X	X	
Lewis	X					X		X	X	X	X	X	X	2		1	
Mason	7	X				1			2	X	X	X			6		
Pacific		X				X			X	X	X	X	2	X	X	X	
Pierce	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
San Juan	X	X				X			X	X		X	X			X	
Skagit	2	X				X			X	X	X	X				14	
Skamania	X	X		X		X			X	X	X	X	X				
Snohomish	X	X	X	1		X			X	X	X	X	X	X	X	X	
Thurston	X	X				X	11		X	X	1	X	X	2	X	X	
Wahkiakum	X	X				X			X			X	X	X	3	X	
Whatcom	X	X		X		X			X	X	X	X	X	X	X	1	

Updated *Ochlerotatus* to a subgenus within *Aedes* in accordance with studies published by Reinert, Hardbach, and Kitching (2009).

Last Revised 10/31/2022

* CDC list of mosquito species in which West Nile virus has been detected, United States, 1999-2017

† Thirteen mosquito species reported for Washington are based upon one or two county records and in some cases one or few specimens. These species are *Aedes excrucians*, *Aedes intrudens*, *Aedes implicatus*, *Aedes pionips*, *Aedes provocans*, *Aedes punctor*, *Aedes togoi*, *Aedes trivittatus*, *Aedes ventrovittis*, *Anopheles occidentalis*, *Culex erythrothorax*, *Culex salinarius*, and *Othropodomyia signifera*.

New Findings for: 1-2006 | 2-2007 | 3-2008 | 4-2009 | 5-2010 | 6-2011 | 7-2012 | 8-2013 | 9-2014 | 10-2015 | 11-2016 | 12-2017 | 13-2018 | 14-2019 | 15-2020

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The matrix shows the known distribution of mosquito species by county for western Washington through 2015. Previous findings are based upon mosquito surveillance conducted by Washington State Department of Health in the 1960s and 1970s. In addition, previous findings were updated to reflect historical findings as presented in the revised *Distribution of Mosquitoes in Washington State,* William J. Sames et al. Journal of the American Mosquito Control Association, 23(4):442-448, 2007. New findings following the initiation of West Nile virus surveillance in 2001 are presented by surveillance year 2001 through 2015 based upon the earliest collection information for the species.

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Table 11. Distribution of Mosquito Species in Eastern Washington

Distribution of Mosquitoes in Washington State

Eastern Washington Mosquito Species by County

County	Aedes aboriginis	Aedes aloponotum	Aedes campestris	Aedes canadensis*	Aedes cataphylla	Aedes cinereus*	Aedes communis	Aedes dorsalis*	Aedes excrucians	Aedes fitchii*	Aedes flavescens	Aedes hexodontus	Aedes impiger	Aedes implicatus	Aedes increpitus	Aedes intrudens	Aedes j. japonicus*	Aedes melanimon*	Aedes nevadensis	Aedes nigromaculis*	Aedes pionips †	Aedes provocans* †	Aedes pullatus	Aedes punctor †	Aedes sierrensis	Aedes s. idahoensis
Eastern Washington																										
Adams								X										X		X						
Asotin																										
Benton			X		X		X	X		X					X			X		X					X	
Chelan	X	2			X	X	X	X	X	X	X	X	X	X	X	X		2	X				X	X	X	X
Columbia															X											
Douglas								X			2							X								
Ferry	X			X		X	X			X		X	X	X	X	X					X					
Franklin			X	1			13	X			X			12	X			X		X					X	
Garfield																										
Grant	12		X	X		X	X	X		X	X				X			X		X					X	X
Kittitas	X				X	X	X	X	X	X		X			X	7		5		X					4	X
Klickitat	X							2				X			X			2		2					X	
Lincoln							X	5	X	X	X				X										X	
Okanogan			X	X		X	X	X	X	X	X	X	X	X	X			X					X		X	X
Pend Oreille	4			X		X	X		X	X		X	X	X	X	X						X	X	X		X
Spokane	X		X	1		X		X	X	X	X				X			X				12	X		X	
Stevens	5		7	X	X	X	X	X		X	7				X			8	X	X		6			X	7
Walla Walla	X		3			X		X							X			X		X					X	
Whitman	X		X							X					X										X	
Yakima	X	X	1			X	X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X

County	Aedes sticticus*	Aedes togoi	Aedes trivittatus* †	Aedes ventrovittis	Aedes vexans*	Anopheles earlei	Anopheles freeborni*	Anopheles occidentalis	Anopheles punctipennis*	Coquilletidia perturbans*	Culex apicalis*	Culex boharti	Culex erythrothorax* †	Culex pipiens*	Culex salinarius* †	Culex stigmatasoma*	Culex tarsalis*	Culex territans*	Culiseta impatiens*	Culiseta incidens*	Culiseta inornata*	Culiseta minnesotae	Culiseta morsitans*	Culiseta particeps*	Orthopodomyia signifera* †
Eastern Washington																									
Adams					X		X			X				X			X				X				
Asotin							X							2			X								
Benton	X				X		X	X	X	X				X		X	X	X		X	X	X	5		
Chelan	X			X	X		X		X	1				X			X	X	X	X	X	X	X		
Columbia					X		X		X								X								
Douglas					X												X			X	X				
Ferry	X				X		X			X				X			X	X		X					
Franklin	X				X	10	X	X	X	X				X			X	10		X	X				
Garfield									X								X			X					
Grant					X		X		5	X				X			X	X	12	X	X				
Kittitas	X		8	X	X		X		X	X				X			X	X	X	X	X	X	X	4	
Klickitat	2				X		9		9	2				X		X	X			X	X	2			
Lincoln					X		X			14		X		X			X		5	X	X				
Okanogan	X				X	X	X	X	X	X				X			X	X		X	X				
Pend Oreille	X				X	X	X	X		4				X			X	X				X			
Spokane	X	12		X	X	X	X	7	X	X				X	X		X	7	12	X	X	X	X		
Stevens	5				X	X	X	X	5	5				X			X		X	X	X	5	5	5	
Walla Walla	X				X	7	X	7	X	X				X		X	X	X	X	X	X	7	1		
Whitman	X				X		X		X	X				X			X			X	X				
Yakima	X		X		X	6	X	6	X	X	X	6		X		X	X	X	X	X	X	X	X		

Updated *Ochlerotatus* to a subgenus within *Aedes* in accordance with studies published by Reinert, Hardbach, and Kitching (2009).

Last Revised 10/31/2022

*** CDC list of mosquito species in which West Nile virus has been detected, United States, 1999-2017**

† Eight mosquito species reported for Washington are based upon one or two county records and in some cases one or few specimens. These species are *Culex erythrothorax*, *Culex restuans*, *Culex salinarius*, *Aedes pionips*, *Aedes provocans*, *Aedes punctor*, *Aedes trivittatus*, and *Orthopodomyia signifera*.

New Findings for: 1-2006 | 2-2007 | 3-2008 | 4-2009 | 5-2010 | 6-2011 | 7-2012 | 8-2013 | 9-2014 | 10-2015 | 11-2016 | 12-2017 | 13-2018 | 14-2019 | 15-2020

The matrix shows the known distribution of mosquito species by county for western Washington through 2015. Previous findings are based upon mosquito surveillance conducted by Washington State Department of Health in the 1960s and 1970s. In addition, previous findings were updated to reflect historical findings as presented in the revised *Distribution of Mosquitoes in Washington State*, William J. Sames et al. Journal of the American Mosquito Control Association, 23(4):442-448, 2007. New findings following the initiation of West Nile virus surveillance in 2001 are presented by surveillance year 2001 through 2015 based upon the earliest collection information for the species.

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