West Nile Virus Surveillance in Washington State

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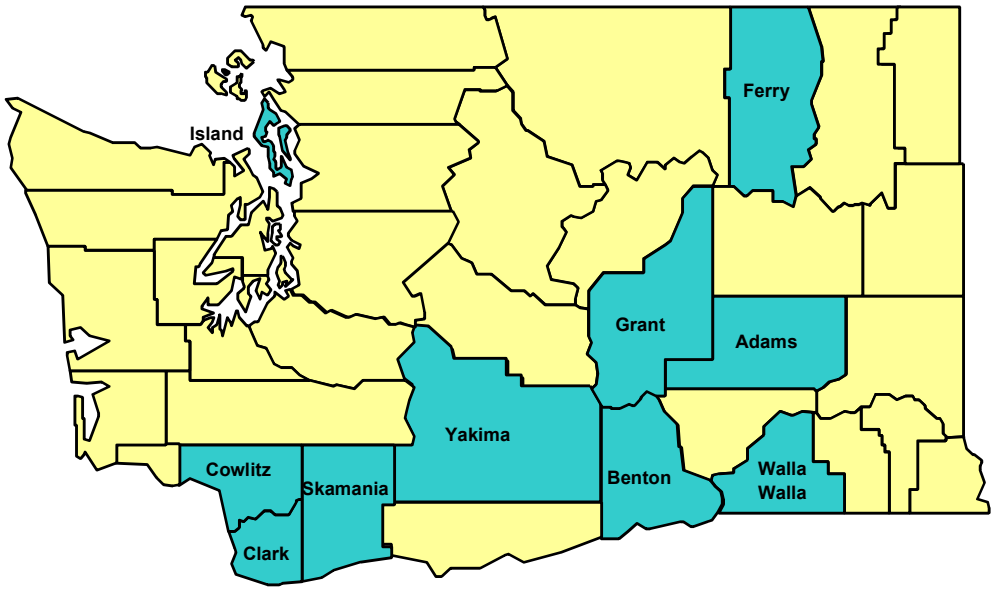
Introduction

The Department of Health (DOH) initiated surveillance activities for West Nile virus in 2000 under a grant from the Centers for Disease Control and Prevention. The first full season of activity was spring through fall of 2001. Components of the program include mosquito surveillance, dead bird surveillance, and enhanced passive surveillance for human and horse cases of encephalitis. Although the program is being established to provide early warning of the introduction of West Nile virus to Washington State, the procedures being implemented will also provide detection capability for other arboviruses, such as western equine encephalitis and St. Louis encephalitis.

Washington's history of mosquito-borne disease dates back to the 1930s. Several outbreaks of western equine encephalitis and St. Louis encephalitis in eastern Washington between 1939 and 1942 resulted in numerous human cases and several deaths. *Culex tarsalis* was shown to be the primary vector species with *Culex pipiens* and *Culiseta inornata* also implicated in the outbreaks. The last reported human case of mosquito-borne encephalitis occurred in the 1980s. The outbreaks were the driving force for establishment of mosquito control districts in the state. There are now 13 such districts operating in ten counties (Figure 1).

Figure 1. Mosquito Control Districts 2001



Mosquito Surveillance

Mosquito surveillance is an essential component of a comprehensive mosquito-borne disease control program. A good understanding of habitats that support mosquito populations, species distribution, and abundance of potential vector species present in the community are necessary to develop effective prevention and control programs. Diseases, such as West Nile virus encephalitis, emphasize the need to establish mosquito surveillance programs statewide.

DOH initiated mosquito surveillance in the spring of 2001. The goal of the surveillance program is to update species information statewide and establish a routine network throughout the state. The last comprehensive report on species distribution in Washington was done in the 1960s. Since that time, the only surveillance data available has been from the mosquito control districts in the state. Many of the most heavily populated counties do not have current information on mosquito habitat or species distribution.

Mosquito surveillance can serve a number of useful purposes. Species identification and determination of where vector species occur is valuable for disease prevention and control programs. Surveillance can also provide information on population densities of both larval and adult mosquitoes, which can be used to determine when control and public information messages are necessary. Adult females can be pooled and used for virus analysis to determine if specific disease agents are present in the population. Routine surveillance is also important in determining if new species, particularly those that can serve as vectors of disease, are present in the community.

Larval Mosquito Surveillance

The larvae of all mosquitoes live in water and have adapted to a wide variety of habitats including permanent ponds, marshes, tree holes, and artificial containers such as tires. Mosquito eggs are deposited either in permanent water sources or in the mud at the edges of temporary water sites to hatch when flooding occurs. Larvae are rarely found in lakes and ponds with deep water and clean shorelines or in flowing water such as streams or rivers. Larvae generally take four to ten days to complete their development and then pupate. The pupal stage lasts from one to ten days after which the adult mosquito emerges.

Larval surveillance involves sampling a wide range of aquatic habitats for the presence of immature mosquitoes. The sampling procedure is relatively simple and involves collection of larvae with a dipper or plastic pipette. Standardizing the procedure is only necessary if the goal is to determine population densities over time. Collected larvae and water are placed in a suitable container for transport such as plastic vials or jars.

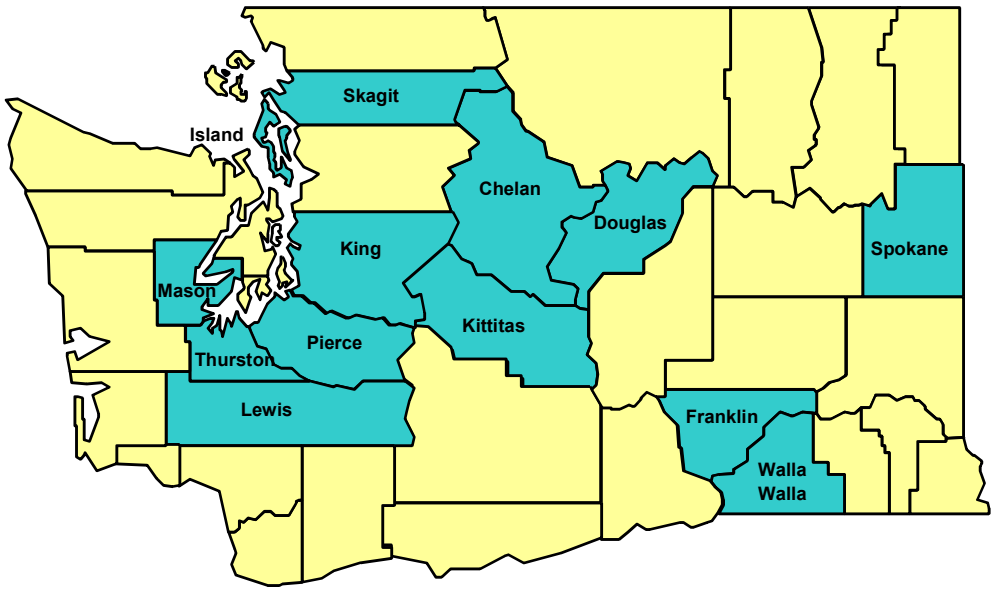
Larval mosquito samples were collected in King, Pierce, Thurston, and Chelan counties during the summer and fall of 2001. Samples were reared to adults by DOH staff and the Center for Health Promotion and Preventive Medicine (CHPPM) at Fort Lewis. Larvae were maintained in pond water in plastic trays covered with cheesecloth until the adults emerged. Collected adults were placed in plastic vials for shipment to CHPPM and identified by Frank Maloney, chief taxonomist. A total of 29 samples were submitted for identification. Table 1 contains information on the mosquito larvae collected in 2001.

Adult Mosquito Surveillance

Adult mosquito surveillance is undertaken to determine species distribution, relative population densities, or for collection of samples for arbovirus analysis. Adult surveillance takes advantage of the attraction of mosquitoes to light, carbon dioxide, and the need to find "resting" locations. Traps are located in areas where adult mosquitoes are suspected to occur and where the effects of wind and excessive temperature will not hamper trapping success. Different types of traps can be somewhat selective for certain species of mosquitoes. Certain traps may also select for females rather than males. Carbon dioxide baited traps, for instance, attract a disproportionate number of females, which is the segment of the population of most interest in arbovirus studies.

Adult surveillance was conducted in six eastside counties (Chelan, Douglas, Kittitas, Spokane, Walla Walla, and Franklin) and seven westside counties (Island, Skagit, King, Pierce, Thurston, Mason, and Lewis) (Figure 2). Surveillance began in June and ran through November. Seven local health jurisdictions, one mosquito control district, one private pest control operator, and personnel from CHPPM participated in providing surveillance information. Most surveillance activity employed the use of carbon dioxide traps with New Jersey light traps being used on a few occasions. The light trap collections, in most cases, contained large numbers of flying insects other than mosquitoes and were difficult to sort.

Figure 2. Mosquito Surveillance 2001



Carbon dioxide traps consist of a container loaded with approximately 4 lbs. of dry ice, a small battery operated fan, and a catch bag. Traps are generally operated from mid-afternoon until early morning. Mosquitoes are blown into the bag by the fan and captured alive. Captured mosquitoes are killed by placing the catch bags in a cooler containing dry ice. Insects caught in these traps were greater than 90 percent mosquitoes.

New Jersey light traps consist of a 40-watt bulb in an aluminum hood with a fan that blows the insects into a kill jar. The trap requires an electrical outlet, which limits its use. The bottom of the kill jar has a strip of insecticide imbedded in plaster of paris. These traps also include a light sensor which turns the bulb on at dusk and off at dawn. They can be operated for several days in the same location or moved each day. They tend to collect a wide variety of insects in addition to mosquitoes. Table 2 contains information on adult mosquito surveillance for 2001.

Summary of Mosquito Surveillance Findings

A total of 105 larval and adult mosquito samples were submitted for identification. In addition, the Columbia Mosquito Control District identified species from 59 samples taken in Walla Walla and Franklin counties. Personnel from CHPPM also identified specimens from 182 samples collected at Fort Lewis. Table 4 shows the species found on the base.

There were eight counties in which mosquito species were identified for the first time based on available historical data. *Culiseta morsitans* was found in Chelan and Thurston counties, *Ochlerotatus togoi* in Mason County, *Anopheles freeborni* and *Culex territans* in Pierce County (Fort Lewis), *Culex territans* and *Culiseta impatiens* in Walla Walla County, *Culiseta incidens* in Spokane County, *Ochlerotatus increpitus* in Franklin County, and *Ochlerotatus japonicus* and *Anopheles freeborni* in King County. *Ochlerotatus togoi* and *Ochlerotatus japonicus* are vectors for Japanese encephalitis in Asia and *Ochlerotatus japonicus* has been identified as a potential vector for West Nile virus. Table 3 lists all species found in 2001.

Potential vector species for West Nile virus were found in four eastside counties (Spokane, Chelan, Franklin, and Walla Walla) and four westside counties (King, Pierce, Thurston, and Lewis) (Table 5). These are species from which West Nile virus has been isolated or West Nile viral RNA detected in other parts of the country. Vectors for western equine encephalitis and St. Louis encephalitis were identified in 9 of the 13 counties submitting samples. These species have been associated with human and horse cases of western equine encephalitis or St. Louis encephalitis in the past and include *Culex tarsalis*, *Culex pipiens,* and *Culiseta inornata.* They were found in the eight counties with potential West Nile virus vectors, and also in Kittitas County. Historical data (1960s) and information from mosquito control districts shows the presence of vector species for western equine encephalitis and St. Louis encephalitis in most Washington counties as well as potential vector species for West Nile virus.

The most significant finding was made in King County where *Ochlerotatus japonicus,* a species not previously identified in the western United States, was discovered. This mosquito has only been found in a few eastern states and has been identified as a carrier of West Nile virus in the United States. It is a container mosquito, depositing eggs in tires and discarded containers of various kinds, making it very difficult to control. It is also a daytime biter rather than an early morning or evening biter, making avoidance more difficult. The species was found in several locations in eastern King County and its distribution will be studied further next season.

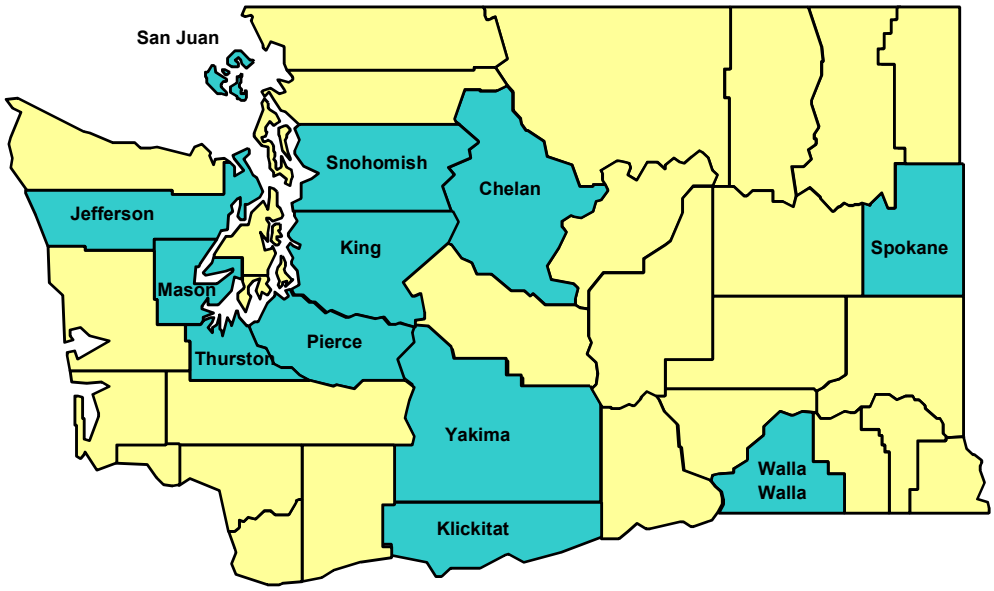
Dead Bird Surveillance

Certain species of birds serve as good sentinels for indicating the presence of West Nile virus in an area. Corvid birds (jays, crows, ravens, magpies) and raptors have been found to be particularly susceptible to the virus. They become infected when fed upon by mosquitoes carrying the virus. Laboratory analysis of dead birds is often the first indication of West Nile virus in a community.

Local health jurisdictions serve as the focal point for collection of dead birds. They have been provided with collection protocols and materials, shipping containers, and FedEx mailing envelopes. Samples are shipped directly to the National Wildlife Health Center Laboratory in Madison, Wisconsin for testing.

Dead birds were submitted for analysis from seven westside counties (San Juan, Snohomish, King, Pierce, Thurston, Mason, and Jefferson) and five eastside counties (Spokane, Walla Walla, Chelan, Yakima, and Klickitat). A total of 28 birds were analyzed in 2000-2001 including 19 American Crows, 4 Stellar's Jays, and 1 each of American Robin, Western Gull, Demoiselle Crane, Varied Thrush and European Starling. All birds submitted tested negative for the presence of West Nile virus.

Figure 3. Dead Bird Surveillance 2000-2001 by Submitting Counties



Sentinel Chicken Flock Surveillance

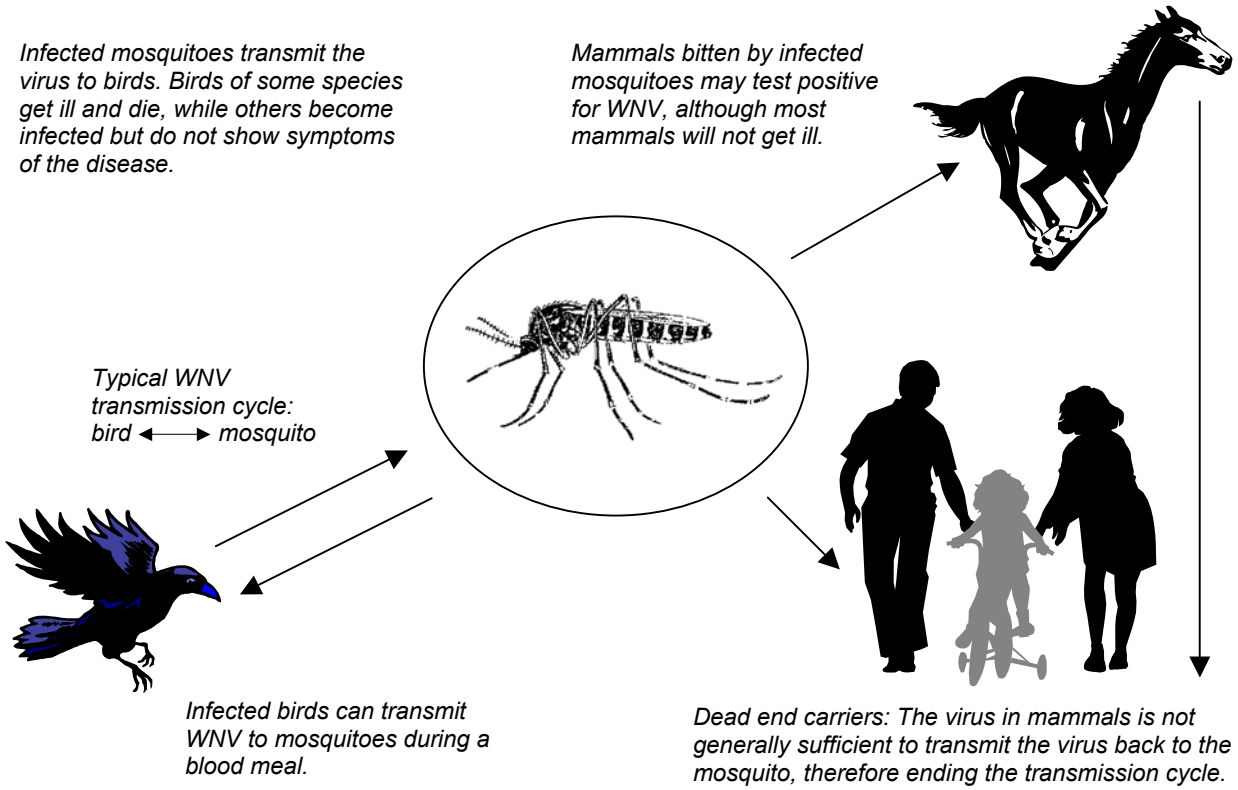
The Benton County Mosquito Control District operated a sentinel chicken flock program in 2000-2001. Five flocks with ten chickens per flock were placed in areas of suspected mosquito activity. The chickens were bled every other week through the summer and tested for western equine encephalitis, St. Louis encephalitis and West Nile virus. None of the samples were positive. Sentinel flocks have been shown to be effective in providing surveillance for western equine encephalitis and St. Louis encephalitis, but not as effective for West Nile virus. The district also had 47 adult mosquito pools tested for arboviruses, all of which were negative.

Human and Horse Case Surveillance

Local health jurisdictions, physicians involved with infectious diseases and diagnostic laboratories were requested to report encephalitis cases of unknown etiology to DOH. They were provided with clinical information on West Nile virus encephalitis and instructions for specimen submission. Specimens were submitted from six patients from August 2000 through November 2001. All were negative for West Nile virus antibodies.

Veterinarians were requested to submit samples from horses suspected of having encephalitis. Samples were analyzed from one horse and were negative.

Figure 4. Transmission Cycle of West Nile Virus (WNV)



Conclusions and Recommendations

The first two seasons of surveillance under the grant provided an opportunity to review the effectiveness of established procedures and make adjustments where necessary. Although a great deal of useful information was generated, changes in certain surveillance protocols and procedures will improve the overall effectiveness of the program. The program will also be expanded to additional counties and new partners will be sought to assist in field and case surveillance efforts. The goal is to develop surveillance expertise and capability at the county level on a long-term basis.

The mosquito surveillance program was highlighted by the finding of a new species in the state and species new to eight counties. This emphasizes the need to expand surveillance to counties not currently having active mosquito surveillance programs. Current species and habitat information is essential to developing effective prevention and control programs.

Adult trapping with carbon dioxide traps, although successful, required greater time expenditure than larval sampling. Also, there was difficulty in some cases in locating a convenient source of dry ice. Continued use of these traps is recommended however, as they do select for female mosquitoes which can also be used for arbovirus testing. The New Jersey light traps were not highly successful as they captured a disproportionate number of insects other than mosquitoes. Further experience in locating and operating these traps is needed to improve results.

Larval collection was shown to be an effective method to obtain samples for speciation. All larvae were reared to the adult stage for identification. The collection and rearing process are fairly simple and require minimal equipment. It is a particularly good method for identifying container mosquitoes, many of which are vector species. This effort should be expanded next year, especially in areas where surveillance has not been done for a number of years and resources are limited.

The dead bird surveillance network generally operated as planned. There is a need, however, to expand this activity substantially. Dead birds are an excellent indicator of the presence of West Nile virus. Health and natural resource agencies and organizations that may receive reports of dead birds will be encouraged to participate in the surveillance network.

Physicians and veterinarians will also be encouraged to report encephalitis cases for evaluation and possible West Nile virus or other arbovirus testing.

Table 1. Larval Mosquito Surveillance 2001

Chelan County		
Date	**Location**	**Species**
08/21	Wenatchee, Residence (5)	*Culex pipiens*
King County		
08/23	Seattle, Pea Patch	*Culex pipiens*
08/30	Carnation, Residence (1)	*Ochlerotatus japonicus japonicus*
10/12	Carnation, Residence (1)	*Ochlerotatus japonicus japonicus*
10/12	Carnation, Residence (1)	*Ochlerotatus japonicus japonicus*
10/15	Seattle, Residence (1)	*Culiseta incidens*
10/15	Bellevue, Residence	*Culiseta incidens*
10/17	Seattle, Canoe Club	*Culex pipiens* *Culiseta incidens*
10/18	Fall City	Negative
10/18	Fall City	*Culex pipiens* *Culiseta incidens*
10/19	Black Diamond	*Ochlerotatus japonicus japonicus* *Ochlerotatus sierrensis* *Culiseta incidens*
10/19	Kent, Farm	*Culiseta incidens* *Ochlerotatus japonicus japonicus*
10/23	Carnation, Residence (1)	*Culiseta incidens* *Ochlerotatus japonicus japonicus* *Ochlerotatus sierrensis*
10/23	Carnation, Residence (2)	*Culiseta incidens* *Ochlerotatus japonicus japonicus*
10/24	Fall City, Farm/Dairy	*Culiseta incidens* *Culex pipiens*
10/26	Seattle, Houseboat	*Anopheles freeborni*
10/26	Seattle, Pea Patch	*Culex pipiens*
10/28	Seattle, Lotus Avenue	Negative
10/28	Seattle, Harbor Avenue SW	*Culiseta incidens*
11/02	Issaquah, Highpoint	*Ochlerotatus japonicus japonicus*
Pierce County		
07/30	Lakewood	*Culex pipiens* *Culiseta incidens*
07/30	Spanaway, Auto Parts Store	*Culex pipiens* *Culiseta incidens*
07/30	Tacoma, 27th Street NE, #1	*Culex pipiens* *Culiseta incidens*
07/30	Tacoma, 27th Street NE, #2	*Culiseta incidens*
07/30	Spanaway, Tire Store	*Culex pipiens* *Culiseta incidens*
07/30	Tacoma, Tire Service Store	*Culex pipiens* *Culiseta incidens*
08/19	Mt. Rainier, Silver Falls	*Culiseta incidens*
Thurston County		
06/09	Nisqually Wildlife Refuge	*Culiseta incidens*

Table 2. Adult Mosquito Surveillance 2001

Chelan County		
Date	**Location**	**Species**
07/26	Entiat, Land Trust	*Aedes vexans* *Culex tarsalis* *Ochlerotatus increpitus*
07/26	Pond above Dryden	*Culex tarsalis*
08/01	Entiat River Rd., Ponderosa	*Aedes vexans* *Ochlerotatus increpitus*
08/01	Wenatchee, Residence (3)	Negative
08/01	Wenatchee, Residence (4)	Negative
08/02	Wenatchee, Residence (4)	Negative
08/07	Entiat River Rd., Ponderosa	*Aedes vexans* *Ochlerotatus increpitus* *Culiseta morsitans*
08/15	Dryden, Pond	*Culex pipiens* *Culex tarsalis* *Ochlerotatus fitchii*
08/21	Entiat, Residence (1)	*Ochlerotatus fitchii*
08/21	Wenatchee, Residence (1)	Negative
08/29	Dryden, Pond	*Culex pipiens*
08/29	Leavenworth, Residence (1)	*Culex tarsalis*
09/05	Entiat, Land Trust	Negative
09/05	Entiat, Residence (1)	Negative
09/13	Entiat, Land Trust	Negative
09/13	Wenatchee, Residence (3)	Negative
09/17	Wenatchee, Residence (5)	*Culex pipiens*
09/19	Dryden, Pond	Negative
09/19	Entiat, Land Trust	Negative
09/19	Entiat, Residence (1)	Negative
Douglas County		
08/01	East Wenatchee, Residence (1)	Negative
08/05	East Wenatchee, Residence (1)	*Culex tarsalis*
Franklin County		
06/07	Pasco, Dairy	*Culex pipiens*
06/07	Pasco, Sacajawea Park	*Culex tarsalis*
06/07	Pasco, Sacajawea Park PD #600	*Culex tarsalis* *Ochlerotatus increpitus*
Island County		
08/29	Camano Island, Elger Bay	*Ochlerotatus dorsalis*

Table 2. Adult Mosquito Surveillance 2001 (continued)

King County		
Date	**Location**	**Species**
07/10	Redmond, Residence	*Ochlerotatus sierrensis*
08/03	Kenmore, Residence (1)	*Culex pipiens* *Culiseta incidens*
08/10	Seattle, Florist (1)	Negative
08/21	Seattle, Armory Parking Lot	Negative
08/22	Auburn, Residence (1)	*Culiseta incidens*
08/22	Seattle, Residence (3)	*Culiseta incidens*
09/01	Bellevue, Residence (1)	*Culex pipiens* *Culiseta incidens*
09/01	Kenmore, Residence (1)	*Culex pipiens* *Culiseta incidens*
09/06	Seattle, Japanese Gardens	*Culex pipiens*
09/06	Seattle, Residence (1)	*Culiseta incidens*
09/13	Duvall, Residence (1)	Negative
09/18	Bellevue, Mercer Slough (1)	Negative
09/18	Bellevue, Mercer Slough (3)	Negative
09/18	Bellevue, Mercer Slough (4)	*Culex tarsalis*
09/22	Bellevue, Mercer Slough (1)	*Culex territans* *Coquillettidia perturbans*
09/24	Bellevue, Mercer Slough (2)	Negative
10/05	Seattle, Pump Station	*Culiseta incidens*
10/05	Seattle, Residence (1)	*Culiseta incidens*
10/05	Seattle, Residence (3)	*Culiseta incidens*
10/10	Seattle, Residence (2)	*Culiseta incidens*
Kittitas County		
08/06	Brickmill Road	*Culex tarsalis*
08/06	Brickmill Road	*Ochlerotatus aboriginis*
Lewis County		
09/14	Rochester, Residence	*Culiseta incidens* *Culex pipiens*
09/19	Napavine, Tire Pile (1)	Negative
09/19	Napavine, Tire Pile (2)	Negative
09/19	Napavine, Tire Pile (3)	Negative
09/19	Napavine, Tire Pile (4)	Negative
09/19	Toledo, Tire Pile (1)	Negative
09/19	Toledo, Tire Pile (2)	*Culex pipiens*
09/19	Toledo, Tire Pile (3)	*Culex tarsalis*
09/19	Toledo, Tire Pile (4)	*Culex pipiens* *Culiseta incidens*
Mason County		
07/13	Aldrich Lake	*Ochlerotatus togoi*

Table 2. Adult Mosquito Surveillance 2001 (continued)

Pierce County		
Date	**Location**	**Species**
06/25	Tacoma, South Hill	*Ochlerotatus sierrensis*
07/30	Tacoma, 27th Street NE	*Culiseta incidens* *Ochlerotatus sierrensis*
Skagit County		
09/04	Mount Vernon, Residence (1)	Negative
09/15	Concrete, River Lane System	*Ochlerotatus sp.*
Spokane County		
08/15	Spokane Neighborhood (1)	*Culex pipiens*
08/18	Spokane Neighborhood (2)	*Culex pipiens*
08/20	Spokane Neighborhood (3)	*Culex pipiens* *Culiseta incidens*
Thurston County		
08/27	Olympia, Residence (1)	Negative
08/31	Olympia, Residence (1)	*Ochlerotatus fitchii*
08/31	Tumwater, Millersylvania (1)	*Culiseta inornata*
08/31	Tumwater, Millersylvania (2)	*Coquillettidia perturbans* *Culex pipiens* *Culiseta incidens* *Culiseta inornata* *Culiseta morsitans*
08/31	Tumwater, McLane Creek (1)	Negative
09/03	Olympia, Residence (2)	Negative
09/12	Olympia, Residence (3)	Negative
09/13	Olympia, Residence (2)	Negative
09/14	Tumwater, McLane Creek (2)	*Culiseta incidens*
09/14	Olympia, Residence (3)	Negative
09/20	Olympia, Residence (2)	*Culiseta incidens* *Culiseta inornata*
09/20	Olympia, Residence (3)	*Culiseta inornata*

Table 2. Adult Mosquito Surveillance 2001 (continued)

Walla Walla County		
Date	**Location**	**Species**
05/30	Burbank, Pond #9992	*Aedes vexans* *Culex tarsalis* *Culiseta inornata*
05/30	Burbank, Residence (9)	Negative
05/30	Burbank, Residence (11)	*Culex tarsalis* *Culiseta inornata*
05/31	Burbank, Firestation	*Culex tarsalis*
05/31	Burbank, McNary HQ	*Culex pipiens*
05/31	Burbank, Slough PD #9409	*Culex pipiens* *Culex tarsalis* *Culiseta inornata*
05/31	Burbank, Slough PD #9416	*Culex tarsalis* *Culiseta inornata*
05/31	Burbank, Residence (10)	Negative
06/06	Burbank, Hood Park PD #522	*Culex pipiens* *Culex tarsalis*
06/06	Burbank, Residence (12)	*Culex tarsalis*
06/06	Burbank, Residence (13)	*Anopheles freeborni*
06/06	Burbank, Residence (14)	*Culiseta inornata*
06/18	Wallula, Junction PD #9565	*Culex tarsalis*
06/18	Wallula, S. Quary Pond #9546	*Aedes vexans* *Culex tarsalis*
06/18	Wallula, S. Quary Pond #9557	*Culex tarsalis* *Ochlerotatus increpitus*
06/18	Wallula, Simplot PD #369	*Culex pipiens* *Culex tarsalis*
06/18	Wallula, Terminal Pond #9358	*Culex pipiens*
06/19	Burbank, McNary PD #9941	*Anopheles freeborni* *Culex pipiens* *Culex tarsalis*
06/19	Burbank, Residence (1)	Negative
06/19	Burbank, Residence (15)	*Anopheles freeborni* *Culex tarsalis*
06/19	Burbank, Residence (17)	*Culex pipiens* *Culex tarsalis*
06/21	Burbank, McNary HQ	*Culex tarsalis*
06/21	Burbank, Residence (16)	*Culex tarsalis*
06/21	Burbank, Residence (18)	Negative
06/25	Burbank, Columbia Basin	*Anopheles punctipennis* *Culex tarsalis*
06/25	Burbank, McNary PD #9929	*Anopheles punctipennis* *Culex tarsalis*
06/25	Burbank, Pond #9921	*Anopheles punctipennis*
06/25	Burbank, PD #9990	*Anopheles punctipennis*
06/28	Burbank, McNary HQ	Negative
07/02	Burbank, CMCD Shop	*Anopheles punctipennis*

Table 2. Adult Mosquito Surveillance 2001 (continued)

Walla Walla County		
Date	**Location**	**Species**
07/02	Burbank, PD #9543	*Aedes vexans* *Anopheles freeborni* *Anopheles punctipennis* *Culex tarsalis* *Culiseta inornata*
07/02	Burbank, Peninsula PD #425	*Culex tarsalis*
07/02	Burbank, Peninsula PD #9531	*Aedes vexans* *Anopheles freeborni* *Anopheles punctipennis* *Culiseta inornata* *Culex pipiens* *Culex tarsalis*
07/10	Burbank, Residence (2)	*Anopheles freeborni*
07/10	Burbank, Residence (3)	*Anopheles freeborni* *Culex tarsalis*
07/10	Burbank, Residence (5)	*Anopheles freeborni* *Anopheles punctipennis* *Culex tarsalis*
07/10	Burbank, White Drive	*Culex tarsalis*
07/12	Burbank, McNary Pond #9941	*Anopheles freeborni* *Anopheles punctipennis* *Culex pipiens* *Culex tarsalis* *Ochlerotatus dorsalis* *Ochlerotatus increpitus*
07/12	Burbank, McNary Pond #9929	*Aedes peus* *Aedes vexans* *Anopheles freeborni* *Culex pipiens* *Culex tarsalis* *Culiseta inornata* *Ochlerotatus increpitus*
07/12	Burbank, Residence (4)	*Culex tarsalis* *Culiseta inornata* *Ochlerotatus dorsalis*
07/18	Burbank, Pond	*Culex tarsalis*
07/18	Burbank, Residence (6)	*Culex pipiens* *Culex tarsalis* *Culiseta inornata*
07/18	Burbank, Residence (8)	*Ochlerotatus dorsalis*
07/23	Burbank, Residence (1)	*Culex tarsalis*
07/23	Wallula, Cemetery	*Culex tarsalis* *Ochlerotatus dorsalis*
07/23	Wallula, Madam Dorian Park	*Aedes vexans* *Culex tarsalis* *Ochlerotatus dorsalis*

Table 2. Adult Mosquito Surveillance 2001 (continued)

Walla Walla County		
Date	**Location**	**Species**
07/23	Wallula, Pond #9356	*Aedes vexans* *Culex pipiens* *Culex tarsalis* *Ochlerotatus dorsalis*
07/24	Burbank, Charbonneau Park	*Culex tarsalis* *Culex territans* *Culiseta impatiens*
07/24	Burbank, Residence (7)	*Culex pipiens* *Culex tarsalis*
08/01	Touchet, Residence (1)	*Culex pipiens*
08/01	Touchet, Residence (2)	*Anopheles freeborni* *Culex tarsalis*
08/01	Wallula, RV Park	*Culex tarsalis*
08/01	Wallula, Residence (2)	*Culex tarsalis*
08/07	Wallula, Pond #9571	*Aedes vexans* *Culex pipiens* *Culex tarsalis* *Culiseta inornata* *Culiseta impatiens* *Ochlerotatus dorsalis* *Ochlerotatus increpitus*
08/07	Wallula, S. Quary Pond #9546	*Aedes vexans* *Culex pipiens* *Culex tarsalis* *Ochlerotatus increpitus* *Ochlerotatus nigromaculis*
08/07	Wallula, S. Quary Pond #9549	*Aedes vexans* *Culex tarsalis* *Ochlerotatus increpitus* *Ochlerotatus nigromaculis*

Table 3. Mosquito Species Found in Washington 2001

Species Identified	
Aedes peus	*Culiseta impatiens*
Aedes vexans	*Culiseta incidens*
	Culiseta inornata
Anopheles freeborni	*Culiseta morsitans*
Anopheles occidentalis	
Anopheles punctipennis	*Ochlerotatus aborigines*
	Ochlerotatus dorsalis
Coquillettidia perturbans	*Ochlerotatus fitchii*
	Ochlerotatus increpitus
Culex pipiens	*Ochlerotatus japonicus japonicus*
Culex tarsalis	*Ochlerotatus nigromaculis*
Culex territans	*Ochlerotatus sierrensis*
	Ochlerotatus togoi

Table 4. Mosquito Species Found at Fort Lewis 2001

Species Identified	
Anopheles punctipennis	*Culiseta incidens*
Anopheles occidentalis	*Culiseta inornata*
Anopheles freeborni	*Culiseta morsitans*
Coquillettidia perturbans	*Ochlerotatus aboriginis*
	Ochlerotatus fitchii
Culex pipiens	*Ochlerotatus sierrensis*
Culex tarsalis	
Culex territans	

Table 5. West Nile Virus Species Found Nationwide*

Species Identified	
Aedes albopictus	*Culiseta melanura*
Aedes cinereus	
Aedes vexans	*Ochlerotatus atlanticus/tormentor*
	Ochlerotatus canadensis canadensis
Anopheles barberi	*Ochlerotatus cantator*
Anopheles punctipennis	*Ochlerotatus japonicus japonicus*
Anopheles quadrimaculatus	*Ochlerotatus sollicitans*
	Ochlerotatus taeniorhynchus
Coquillettidia perturbans	*Ochlerotatus triseriatus*
	Ochlerotatus trivittatus
Culex nigripalpus	
Culex pipiens	*Orthopodomyia signifera*
Culex quinquefasciatus	
Culex restuans	*Psorophora columbiae*
Culex salinarius	
	Uranotaenia sapphirina

*Species from which West Nile virus has been isolated and/or WN viral RNA detected, not necessarily a competent vector