State of Oregon
West Nile Virus Summary Report
2009

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2009 Program Highlights

Some of the principal findings and accomplishments of Oregon's surveillance, education, and planning programs for West Nile virus (WNv) in 2009 include the following:

- A sharp increase in the number of WNv positive mosquito pools when compared to previous years.
- A decrease in human cases when compared to previous years.
- A decrease in the number of WNv positive dead birds, horses, and other mammals.

Table 1 summarizes WNv in Oregon, by year, 2004-2009.

Figure 1. Positive WNv tests by month of collection for Oregon, 2009.

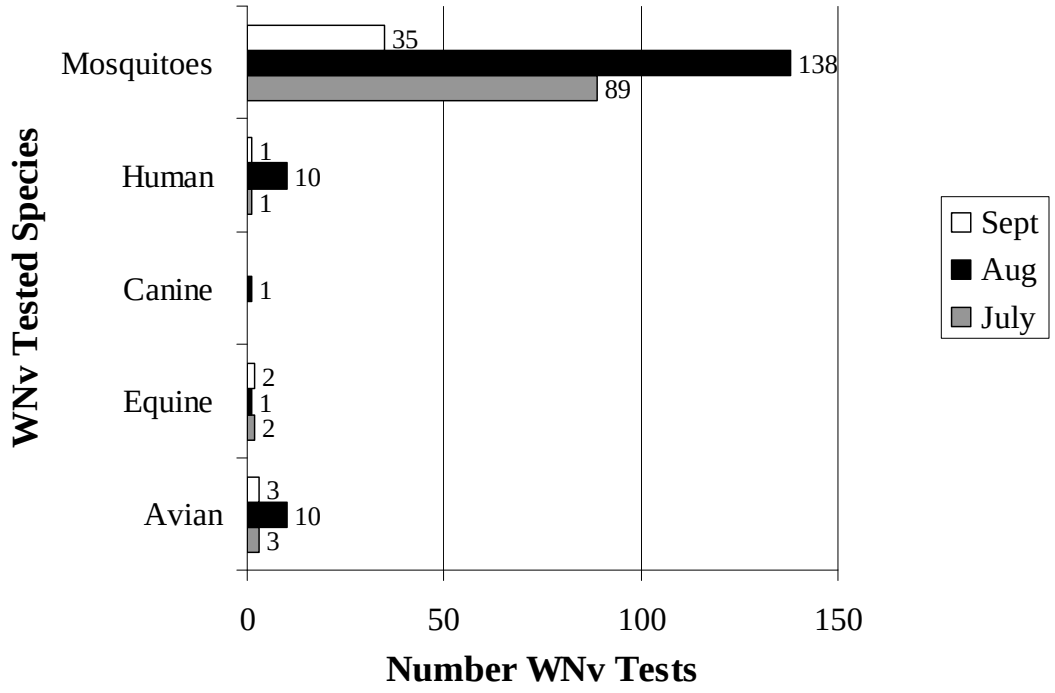


Table 1. Confirmed WNv infections in Oregon, 2004–2009.

Group	2004	2005	2006	2007	2008	2009
Human	5	8	73	27	16	12
Horses	32	46	35	16	0	5
Birds	23	15	25	52	2	16
Mosquito pools	0	11	22	28	16	262
Sentinel chickens	0	15	0	11	0	0

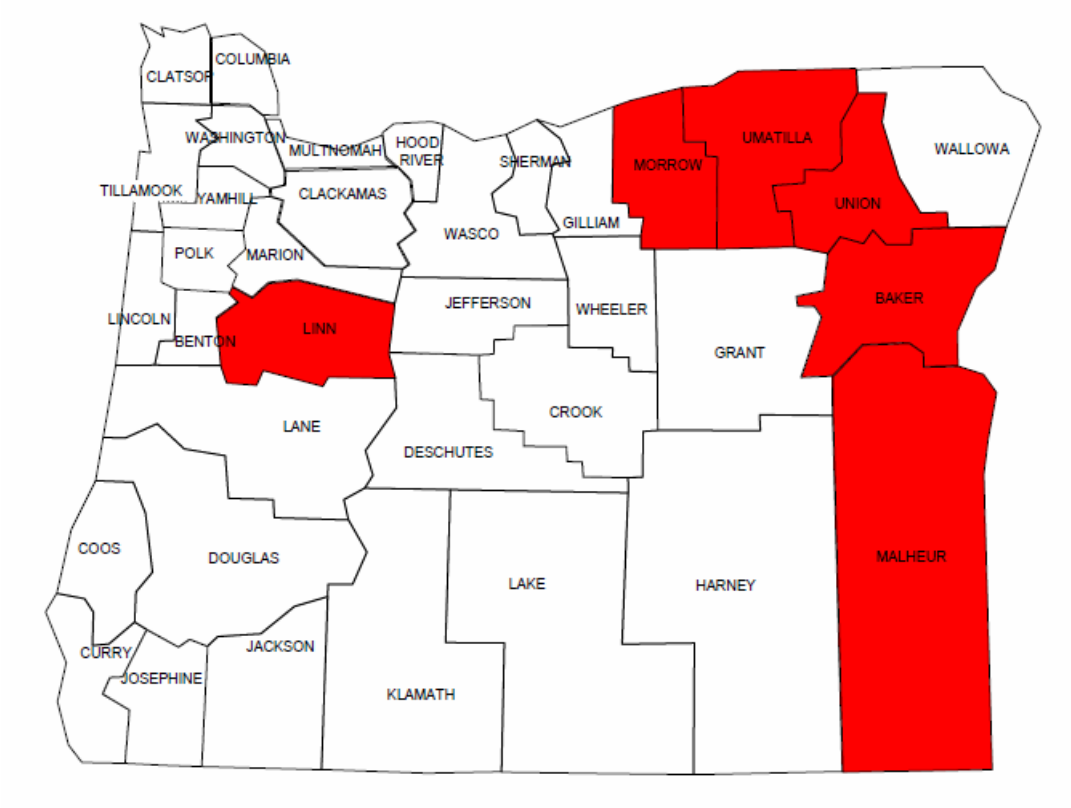
Introduction

West Nile Virus (WNv) first appeared in Oregon in 2004. Our first human, avian, and equine WNv cases were all diagnosed in August 2004. In 2009, a total of 12 humans, 16 birds, and 5 horses, and 1 domesticated canine were diagnosed with WNv infection.

Oregon's surveillance program for WNv was launched in 2001 and has since expanded to include 19 Vector Control Districts (VCDs) located throughout the state (see map of Oregon with participating VCDs highlighted in Figure 5). The VCDs collect mosquitoes and dead birds, identify them, and prepare them for testing. Some VCDs conduct initial WNv tests for mosquito pools and dead birds using RAMP (Rapid Analyte Measurement Platform). Because of financial constraints and reductions of labor resources, sentinel chicken surveillance was suspended by all VCDs in Oregon in 2009. In counties without VCDs, this work may be conducted by the local health department. Confirmatory testing of WNv for humans is performed by the Oregon State Public Health Laboratory (OSPHL). Oregon State University's (OSU's) Veterinary Diagnostic Laboratory performs WNv testing of mosquitoes, dead birds, horses, and other mammals.

The Oregon WNv surveillance findings for humans, horses, birds, and mosquitoes in 2009 are summarized in the sections that follow.

Figure 2. Map of Oregon with shaded counties reporting WNv, 2009.



WNv Surveillance and Related Activities

Human Surveillance

In 2009, twelve Oregon residents tested positive for WNv by IgM antibody, including 8 people who contracted WNv in Oregon and 4 whose location of contraction is unknown. Ten (83%) of the twelve Oregon cases were Malheur County residents. There were no fatalities related to WNv in 2009. Descriptive data for the 12 Oregon residents who contracted WNv are presented in Table 2.

Table 2. Descriptive data for Oregon residents who contracted WNv, 2009.

		Number n=12	Percent
Sex	Male	3	25%
	Female	9	75%
Age	<19	0	0%
	19–29	2	16.6%
	30–39	2	16.6%
	40–49	2	16.6%
	50–59	3	25%
	60–69	2	16.6%
	70-79	0	0%
	>79	1	8.3%
County	Malheur	10	83.3%
	Morrow	1	8.3%
	Umatilla	1	8.3%
Source	In State	8	66.6%
	Out of State	0	0%
	Unknown	4	33.3%
Symptoms	Asymptomatic	1	8.3%
	Uncomplicated fever	8	66.6%
	Encephalitis+Meningitis	0	0%
	Meningitis	0	0%
	Other/Unknown	3	25%

Table 3. Trend data for Oregon residents who contracted WNv in Oregon, 2004–2009

Year	All Cases	Neuroinvasive	Deaths
2004	5	0	0
2005	8	1	0
2006	73	13	1
2007	27	7	1
2008	15	3	0
2009	8	0	0

Veterinary Surveillance

Surveillance for WNv in Oregon's equine population resulted in 5 positive tests. Sixty percent of the horses that tested positive for WNv were from Umitilla County. One domesticated canine from Linn County also tested positive for WNv. Positive test results for Oregon counties in 2009 are summarized in Tables 4 and 5.

Table 4. Positive Equine WNv test results, Oregon 2009.

County	Number of Positive Test Results
Malheur	1
Morrow	1
Umatilla	3
Total	**5**

Table 5. Other Positive WNv test results, Oregon 2009.

County	Number of Positive Test Results
Linn	1 Canine
Total	**1**

Avian Surveillance

Surveillance for WNv in Oregon's avian population resulted in 16 (18%) positive test results out of 90 birds tested by OSU's Veterinary Diagnostic Laboratory and the VCDs. Numbers of avian WNv tests and positive test results for Oregon counties in 2009 are summarized in Table 6. Thirteen birds (81%) that were collected and tested positive in Oregon in 2009 were of the family Corvidae (a.k.a. corvids) while the remaining three were American Robin *Turdus migratorius*. Trend data for avian WNv testing and positive test results for Oregon counties for the years 2004–2009 are presented in Table 7.

Table 6. Avian WNv tests and positive test results for Oregon Counties, 2009.

County*	Avian Specimens Tested	Positive Test Results	Percent Positive
Baker	**3**	**1**	**33%**
Benton	4	0	0
Clackamas	1	0	0
Columbia	0	0	0
Clatsop	0	0	0
Crook	0	0	0
Curry	0	0	0
Deschutes	6	0	0
Douglas	2	0	0
Harney	0	0	0
Jackson	2	0	0
Josephine	2	0	0
Lake	0	0	0
Lane	4	0	0
Lincoln	1	0	0
Linn	1	0	0
Malheur	0	0	0
Marion	2	0	0
Morrow	**7**	**4**	**57%**
Multnomah	14	0	0
Polk	0	0	0
Tillamook	0	0	0
Umatilla	**22**	**9**	**41%**
Union	**12**	**2**	**17%**
Wallowa	4	0	0
Wasco	0	0	0
Washington	3	0	0
Yamhill	0	0	0
Total	**90**	**16**	**18%**

*Counties with positive test results are indicated in **bold**.

Table 7. Avian WNv tests and trend of positive test results for Oregon counties, 2004–2009

Year	Number Tested	Number Positive	% Positive
2004	448	23	5%
2005	298	15	5%
2006	212	25	12%
2007	246	55	22%
2008	117	2	2%
2009	90	16	18%

Mosquito Surveillance

In 2009, the VCDs conducted surveillance for WNv in Oregon's mosquito population. Figure 3 shows the counties with participating VCDs and their activities. Statewide, 262 mosquito pools (154,555 individual female mosquitoes) were collected for testing. The mosquitoes submitted represent 12 mosquito species. PCR testing for WNv was conducted by OSPHL and RAMP was performed by some VCDs. Table 8 displays the mosquito species and the number of individual female mosquitoes that VCDs collected for testing in Oregon in 2009. Table 9 displays the number of mosquito pools per species that tested positive for WNv in Oregon in 2009 only. Table 10 displays the mosquito species in Oregon between 2004 through 2009 found positive for WNv. Figure 3 indicates the efficiency of vector transmission for various mosquito species (information obtained from the Centers for Disease Control and Prevention).

Table 8. Female mosquitoes collected for testing by Oregon VCDs, 2009.

Vector Control District	***Aedes dorsalis***	***Aedes nigromaticus***	***Aedes vexans***	***Anopheles freeborni***	***Anopheles punctipennis***	***Coquilletidia perturbans***	***Culex erythrothorax***	***Culex pipiens***	***Culex tarsalis***	***Culex sp.***	***Culiseta incidens***	***Culiseta inornata***
Baker			1318						4402			10
Benton								21				
Clackamas								522	33			
Columbia			6720	159					330			
Deschutes (Four Rivers)	219		140					15	180			400
Jackson			877			1985	13424	270	2586			
Klamath	54	50	3880	611					967			332
Lane			54979					1301	1867			
Malheur										2018		
Morrow	25		1315	282		11		4403	10722			
Multnomah			3159		70			1986	4087		30	
Umatilla	40		1070	25		43		4518	16877	409		
Union								298	2004			
Washington			368		476		161	1182	1324			
Total	**338**	**50**	**73826**	**1077**	**546**	**2039**	**13585**	**14516**	**45379**	**2427**	**30**	**742**

Table 9. WNv Positive Mosquito Pools, Oregon 2009

VCD	Mosquito Species	Number of Positive Mosquito Pools	Collection Date
Baker	*Culex tarsalis*	12	7/22 – 8/6
Malheur	*Culex sp.*	48	8/11 – 9/9
Malheur	*Culex tarsalis*	1	8/6
Morrow	*Aedes vexans*	1	7/15
Morrow	*Coquillettidia perturbans*	1	8/3
Morrow	*Culex pipiens*	33	7/15 – 8/18
Morrow	*Culex tarsalis*	72	7/1 – 8/18
Umatilla	*Aedes vexans*	1	8/19
Umatilla	*Anopheles punctipennis*	1	8/25
Umatilla	*Culex sp.*	4	8/18 – 9/15
Umatilla	*Culex pipiens*	42	7/24 – 9/11
Umatilla	*Culex tarsalis*	46	7/24 – 9/15

Table 10. Trend data, WNv Positive Mosquito Pools, Oregon 2004–2009

Year	Mosquito Species	Number of Positives
2004	-	-
2005	*Culex tarsalis* *Culex stigmatosoma* *Culex pipiens*	(11 pools)*
2006	*Culex tarsalis*	(22 pools)
2007	*Aedes Vexans* *Culex pipiens* *Culex tarsalis*	(8 pools) (2 pools) (23 pools)
2008	*Aedes vexans* *Culex pipiens* *Culex tarsalis*	(5 pools) (3 pools) (8 pools)
2009	*Aedes vexans* *Anopheles freeborni* *Anopheles punctipennis* *Coquillettidia perturbans* *Culex pipiens* *Culex tarsalis* *Culex sp.*	(1 pool) (1 pool) (1 pool) (1 pool) (75 pools) (131 pools) (52 pools)

*1 pool ≈ 50 mosquitoes

Figure 3. Potential Oregon vectors of WNV based on laboratory vector competence studies (2). ***Posted with permission.***

Table 3. Potential for selected North American mosquitoes to transmit WNV based on bionomics, vector competence, virus isolations, and involvement with other arboviruses

Species	Association with other viruses[a]	Host preference	Activity time	Flight range	Vector competence for WNV[b]	Field isolations of WNV[c]	Potential to serve as a	
							Enzootic vector[d]	Bridge vector[e]
Ae. aegypti		Mammals	Crepuscular/day	200 m	+++, 3	+	0	+
Ae. albopictus	EEE	Opportunistic	Crepuscular/day	200 m	++++, 3, 6	+	+	++++
Ae. vexans	EEE, WEE, SLE	Mammals	Crepuscular/night	>25 km	++ 1, 5, 8	+++	0	++
Cq. perturbans	EEE	Opportunistic	Crepuscular/night	5 km	+, 4	+	+	+
Cs. melanura	EEE	Birds	Crepuscular/night	9 km	+, 8	++	++	0
Cs. inornata	WEE	Mammals	Crepuscular/night	2 km	+++, 5	+	+	++
Cx. stigmatosoma	SLE	Birds	Night	1 km	+++, 5	0	+++	+
Cx. erythrothorax	WEE	Opportunistic	Crepuscular/day	<2 km	++++, 5	0	++	+++
Cx. nigripalpus	EEE, SLE	Opportunistic[f]	Crepuscular	5 km	++, 4	+++	+++	++
Cx. pipiens	SLE	Birds	Crepuscular/night	2 km	+++, 1, 3, 5	++++	+++++	++
Cx quinquefasciatus	SLE	Birds	Crepuscular/night	2 km	+++, 4, 5	0	++++	++
Cx. restuans	SLE	Birds	Crepuscular/night	2 km	++++, 4	+++	+++++	++
Cx. salinarius	EEE, SLE	Opportunistic	Crepuscular/night	10 km	++++, 4	+++	+++	++++
Cx. tarsalis	WEE, SLE	Opportunistic[f]	Crepuscular/night	>6 km	++++, 5, 7	++++	++++	+++
Oc. atropalpus		Mammals	Day and night	1 km	++++, 3	+	+	++
Oc. canadensis	EEE	Mammals	Day	2 km	++, 8	+	0	++
Oc. cantator	EEE	Mammals	Day	>10 km	++, 8	+	0	++
Oc. dorsalis	WEE	Mammals	Day and night	5 km	+++, 5	+	0	++
Oc. japonicus	JE?	Mammals	Crepuscular/day	unk	++++, 2, 3	+++	+	++++
Oc. melanimon	WEE	Mammals	Day and night	>10 km	+++, 5	0	0	++
Oc. sierrensis		Mammals	Crepuscular/day	1 km	+, 5	0	0	+
Oc. sollicitans	EEE	Mammals	Crepuscular/night	>25 km	++, 1, 3	+	0	+
Oc. taeniorhynchus	EEE	Mammals	Day and night	>25 km	+, 1, 3	+	0	+
Oc. triseriatus		Mammals	Day	200 m	+++, 8	++	0	+++
Ps. ferox	SLE	Mammals	Day	2 km	0, 8	+	0	0

Distribution and bionomics based on and generalized from information in Carpenter and LaCasse (1955), Darsie and Ward (1981), and Moore et al. (1993).

[a] Known association with other viruses with a similar transmission cycle. EEE, eastern equine encephalomyelitis virus; JE; Japanese encephalitis virus; SLE; St. Louis encephalitis virus; WEE; western equine encephalomyelitis virus. Based on Karabatsos (1985).

[b] Efficiency with which this species is able to transmit WNV in the laboratory. 0, incompetent; +, inefficient; ++++, extremely efficient vector. Based on 1 (Turell et al. 2000), 2 (Sardelis and Turell 2001), 3 (Turell et al. 2001), 4 (Sardelis et al. 2001), 5 (Goddard et al. 2002), 6 (Sardelis et al. 2002), 7 (Turell et al. 2003), or 8 (present study).

[c] Relative number of WNV-positive pools detected. 0, none; +, few; ++++, many.

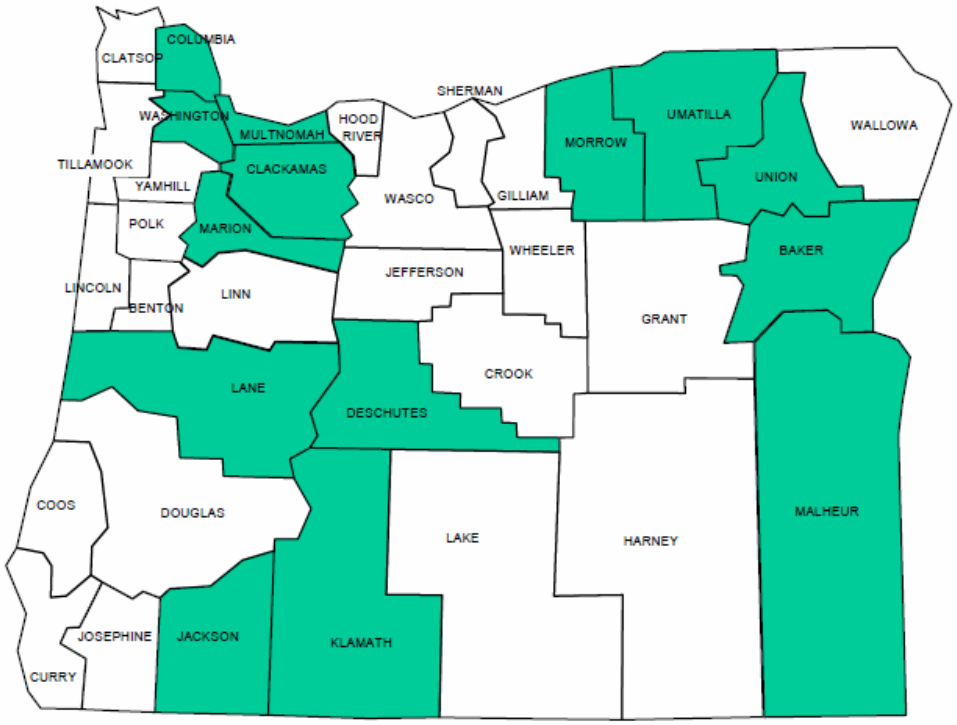
[d] Potential for this species to be an enzootic or maintenance vector based on virus isolations from the field, vector competence, feeding behavior, etc. 0, little to no risk; +++++, this species may play a major role.

[e] Potential for this species to be an epizootic or bridge vector based on virus isolations from the field, vector competence, feeding behavior, etc. 0, little to no risk; +++++, this species may play a major role.

[f] Feeds primarily on avian hosts in spring and early summer and mixed between avian and mammalian hosts in late summer and fall.

Vector Control Districts

Figure 4. Oregon counties with participating vector control districts (VCDs) and their activities.



District/county	Mosquito collection	Mosquito fish	Sentinel Chickens	Bird collection	Larvaciding	Adulticiding
Columbia	*			*	*	*
Deschutes	*			*	*	*
Jackson	*			*	*	*
Klamath	*	*		*		*
Lane	*			*		
Malheur				*		
Marion	*			*	*	*
Morrow	*			*	*	*
Multnomah	*	*		*	*	*
Umatilla	*	*		*	*	*
Union	*	*		*	*	*
Washington	*	*		*	*	*

References

1. Kilpatrick AM, Kramer LD, Jones MJ, Marra PP, Daszak P (2006) West Nile virus epidemics in North America are driven by shifts in mosquito feeding behavior. PLoS Biol 4(4): e82.
2. Turell, MD, et al. "An Update on the Potential of North American Mosquitoes (*Diptera: Culicidae*) to Transmit West Nile Virus. J. Med. Entomol. 42(1): 57-62 (2005).

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