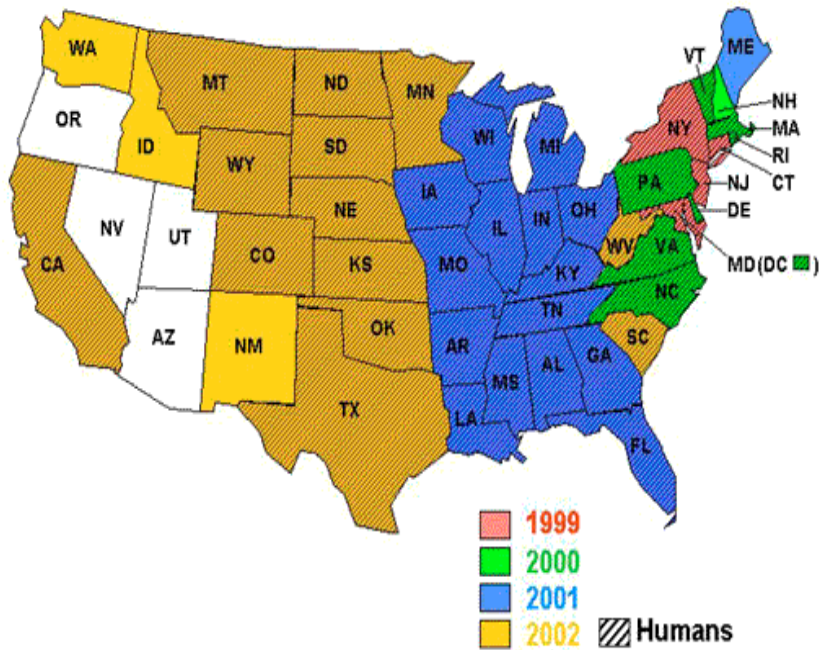


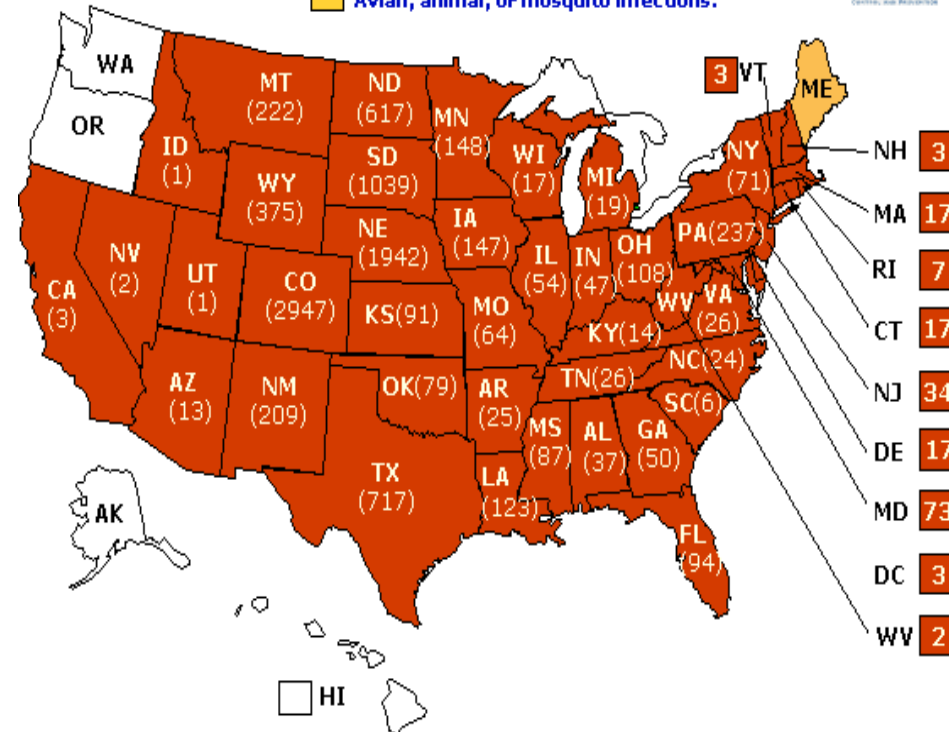
# Rapid Spread of WNV in US

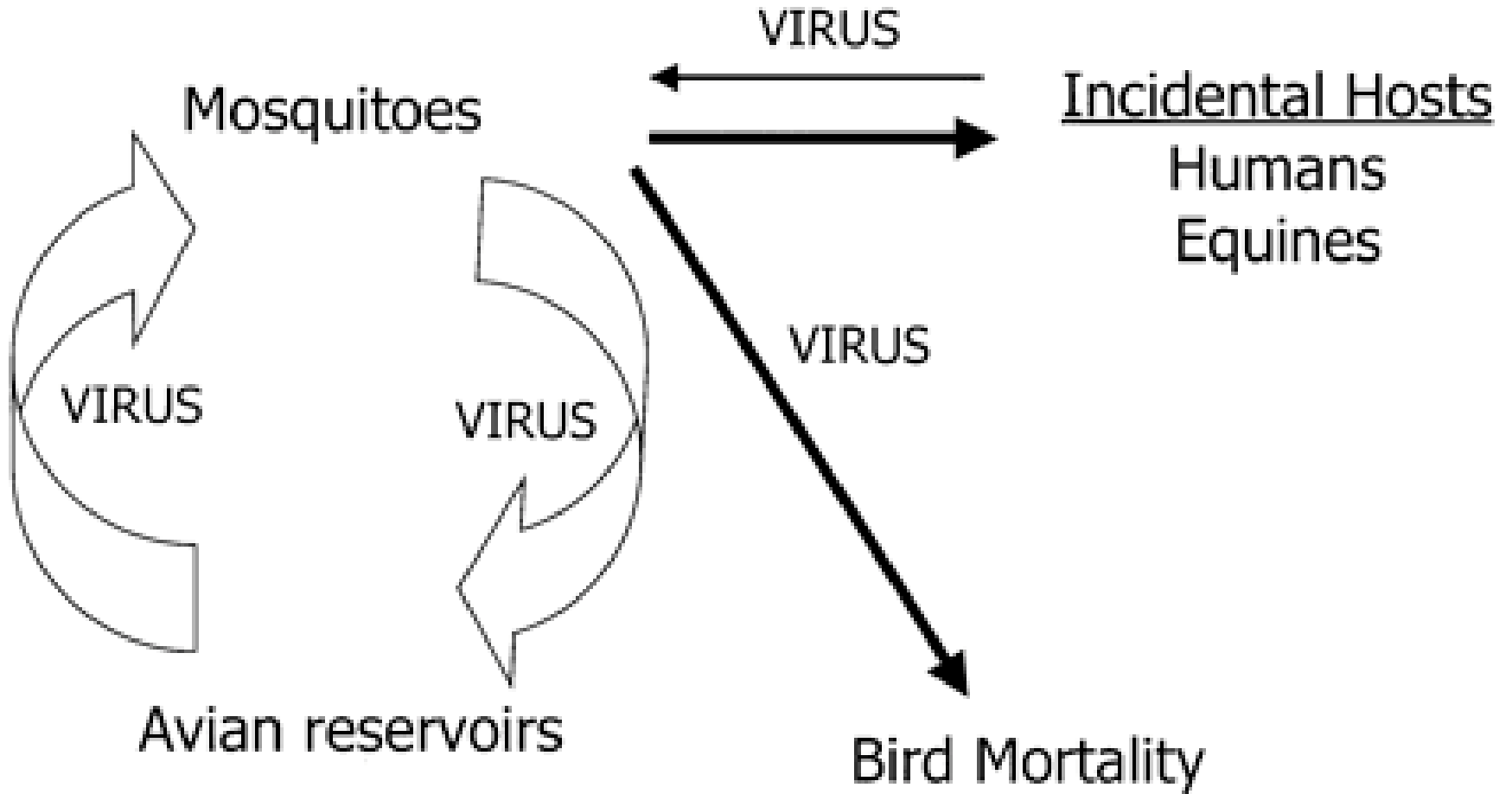
West Nile Virus in the United States, 1999 - 2002



# Indicates human disease case(s).

Yellow indicates Avian, animal, or mosquito infections.





Occurrence of vectors is fairly well known, but the role of particular birds as primary and secondary reservoir hosts versus incidental hosts is poorly known

# Keys to Understanding Ecology of WNV

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- Vectors
  - Environmental conditions suitable to breeding
    - Temperatures for transmission and overwintering (10 – 20°C)
    - Role of rainfall
  - Movement, biting, and hybridizing behaviors
- Hosts (>200 birds, reptiles, mammals)
  - Virus-amplifying, primary reservoirs
    - House Finch, American Robin, Ring-billed Gull, House Sparrow
  - Secondary or incidental
    - Incompetent species (Rock Pigeon, Starlings, Many Native Songbirds)
    - Species with high mortality (Corvids, Parids, Raptors)

Table 1. Mosquito vectors known to carry West Nile Virus in the range of the Northern Spotted Owl Range data from Darsie and Ward 1981 and Dr. Scott Meschke, University of Washington, personal communication. Vector activity from Dr. Scott Meschke, and [www.cdc.gov/ncidod/dvbid/westnile/mosquitoSpecies](http://www.cdc.gov/ncidod/dvbid/westnile/mosquitoSpecies). X indicates presence of the vector, - indicates absence of the vector, ? indicates unknown occurrence.

Mosquito Species	Occurrence Confirmed in:		
	Washington	Oregon	California
<i>Culex pipiens</i>	X	X	X
<i>Culex tarsalis</i>	X	X	X
<i>Culex restuans</i>	X	?	?
<i>Culex territans</i>	X	X	X
<i>Ochlerotatus japonicus</i>	X	?	?
<i>Ochlerotatus canadensis</i>	X	?	?
<i>Orchlerotatus sticticus</i>	X	?	?
<i>Orchlerotatus dorsalis</i>	X	X	X
<i>Orchlerotatus fitchii</i>	X	X	?
<i>Aedes vexans</i>	X	X	X
<i>Aedes cinereus</i>	X	?	-
<i>Culiseta inornata</i>	X	X	X
<i>Coquillettidia perturbans</i>	X	X	?
<i>Anopheles punctipennis</i>	X	X	X
<i>Orthopodomyia signifera</i>	-	?	?

TABLE 1. . Mortality at The Owl Foundation during the West Nile outbreak period <sup>a</sup> and results of real-time RT-PCR testing on tissues from dead birds.

Species <sup>b</sup>	At	Died	Tested <sup>c</sup>	Positive		Crude MR <sup>d</sup>	WNV-related	WNV-rela
	Risk <sup>c</sup>			Number	%	%	MR <sup>d</sup> %	Deaths
Snowy Owl	20	20	11	11	100.0	100.0	100.0 <sup>e</sup>	20 <sup>e</sup>
Northern Hawk Owl	26	26	17	17	100.0	100.0	100.0 <sup>e</sup>	26 <sup>e</sup>
Great Gray Owl	27	27	23	21	91.3	100.0	91.3 <sup>e</sup>	25 <sup>e</sup>
Boreal Owl	11	11	11	10	90.9	100.0	90.9	10
Northern Saw-whet Owl	13	12	12	12	100.0	92.3	92.3	12
Northern Pygmy Owl	6	1	1	1	100.0	16.7	16.7	1
Short-eared Owl	16	2	2	2	100.0	12.5	12.5	2
Flammulated Owl	9	1	1	1	100.0	11.1	11.1	1
Barred Owl	8	1	1	0	0.0	12.5	0.0	0
Burrowing Owl	10	0	0	-	-	0.0	0.0	0
Eastern Screech Owl	36	0	0	-	-	0.0	0.0	0
Elf Owl	1	0	0	-	-	-	-	0
Spotted Owl	1	1	1	1	100.0	-	-	1
Tawny Owl	2	1	1	1	100.0	-	-	1
American Kestrel	2	0	0	-	-	-	-	0
Peregrine Falcon	2	0	0	-	-	-	-	0
<b>Total:</b>	235	108	85	79	92.9	46.0	43.0	101

# Certainties

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- WNV is a new source of mortality for NSO
- WNV is in WA and southern CA
- Vectors are present in NSO range
- Amplifying hosts are present in range, but details of relative importance are not well known
- Many owls are susceptible to WNV

# Uncertainties

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- Heightened mortality may only last a few years after outbreak
- Adults may develop immunity after initial exposure to WNV
- Barred Owls may suffer less than NSO
- Northern Goshawks may suffer as much as NSO
- Small mammal prey may indirectly pass WNV to NSO

# Scenarios

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- 1. Localized centers of increased owl mortality for 1 – 2 years after outbreak; juvenile mortality increased where virus exists; increase in Barred Owls is offset by reduction in NSO predators
  - range-wide population viability remains intact
    - Shown by common raptors in east and midwest
- 2. Localized centers of increased owl mortality for 1 – 2 years after outbreak; continued high mortality of juveniles without resistance; increased competition from less affected Barred Owls is greater than reduction in predators
  - Range-wide population viability erodes
    - Long-lived species with low reproductive output are sensitive to increased mortality
    - Rare species may already be in an “extinction vortex” and each additional reduction of viability is disproportionately severe.