Phytophthora ramorum Populations in Washington State

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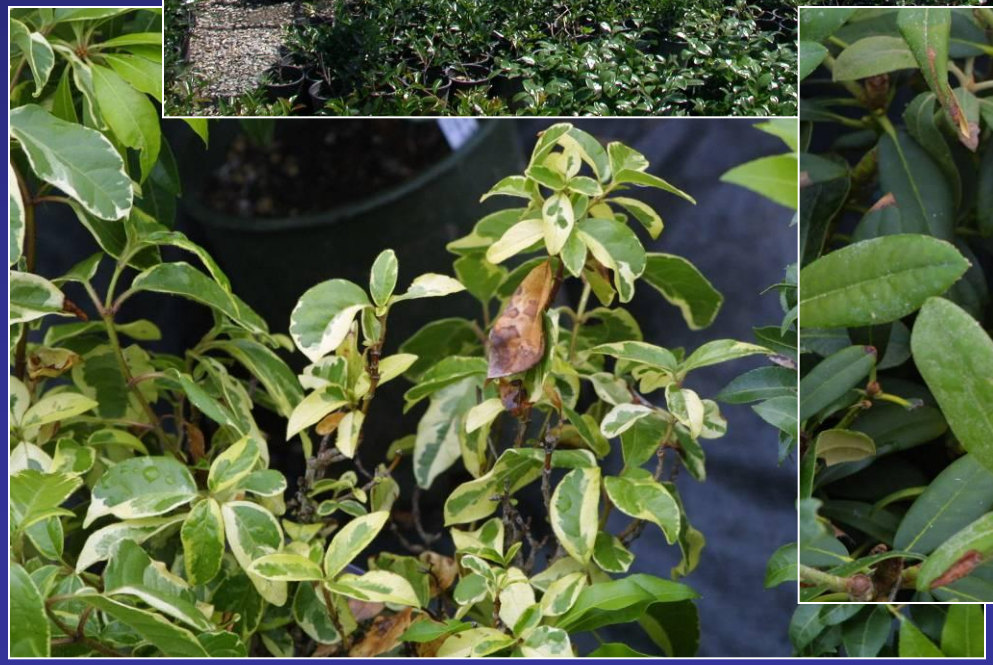
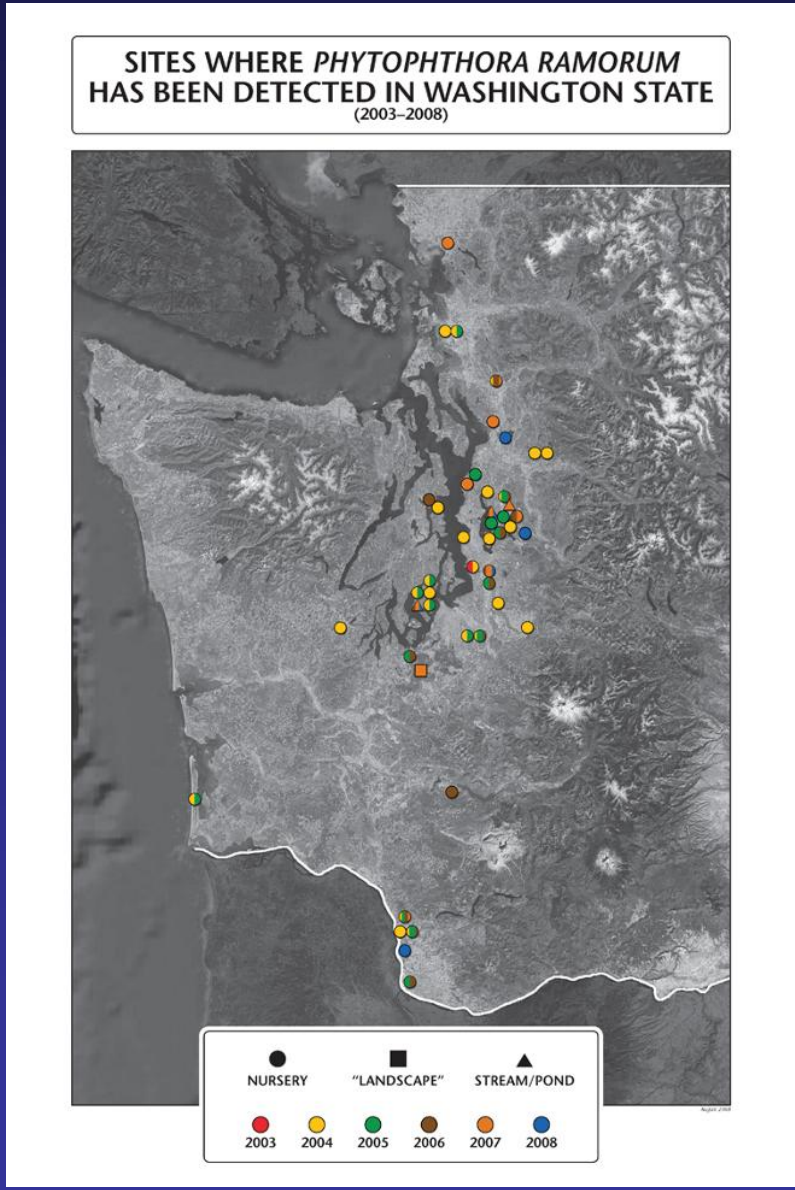
Spread of *P. ramorum* in WA will have a major economic impact on Washington's horticulture and forestry products industries

Spread of *P. ramorum* via Shipment of Infected Nursery Stock



WSDA Nursery Surveys

- First discovered in 2003
- A total of 46 nurseries



WSDA Nursery Surveys

Number "+"

2003 – 1

2004 – 25

2005 – 16

2006 – 11

2007 – 7

2008 – 5

2009 - 7

WSDA Nursery Surveys

Frequency of "+"nurseries

25 - "+" a single year

15 - "+" two consecutive years

2 - "+" three consecutive years

1 - "+" four consecutive years

3 - "+" for "multiple" years

Phytophthora ramorum

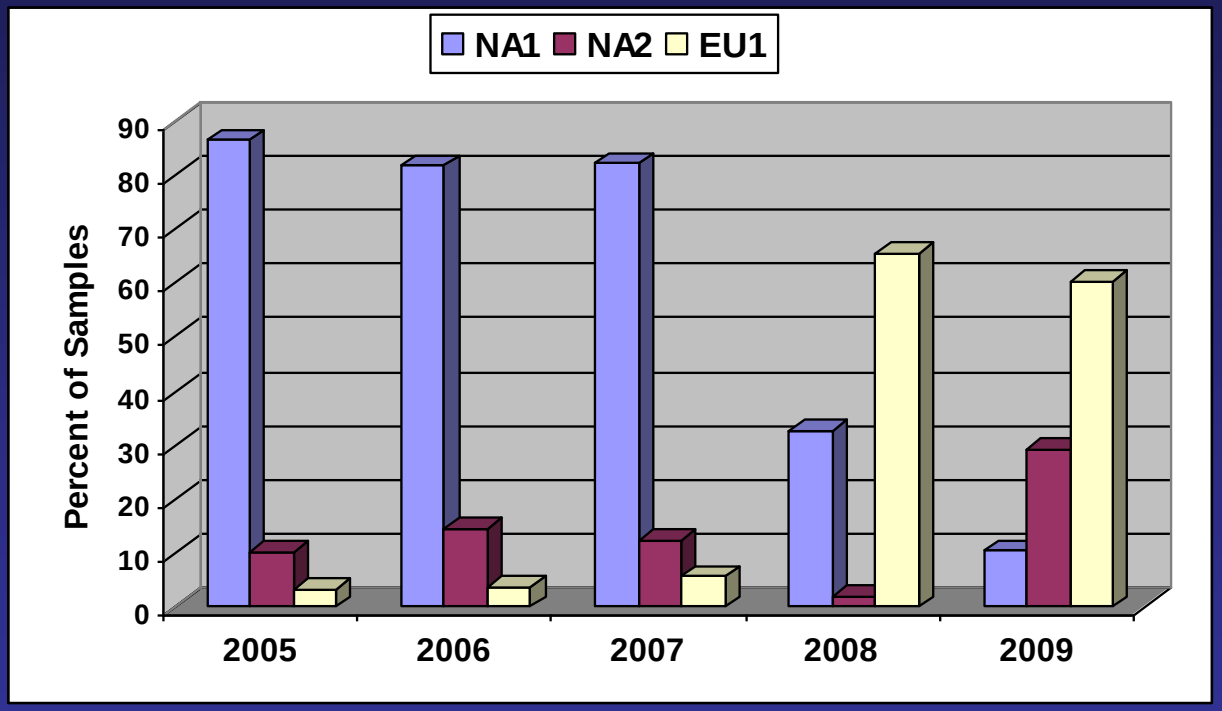
- **Three clades (lineages) known (Ivors et al., 2006)**
  - **EU1 – Europe (A1)**
  - **NA1 – Most common in N. America (A2)**
  - **NA2 – "Washington" clade (A2)**

Population structure of *P. ramorum* in Washington State

- 2005 – 2009
- 31 nurseries
- 343 isolates
- 7 microsatellite loci (NA1)

Genotypes of *P. ramorum* in WA

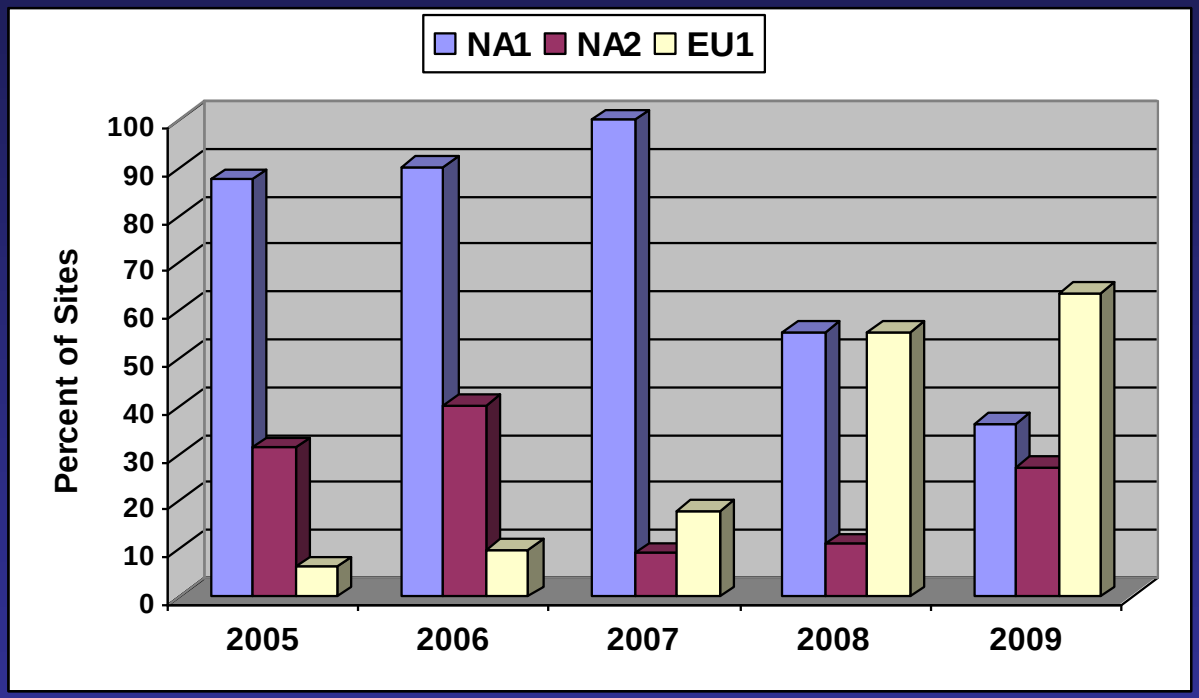
Detection of all 3 lineages (Samples)



(NA1 – 41 multilocus genotypes)

Genotypes of *P. ramorum* in WA

Detection of all 3 lineages (Sites)



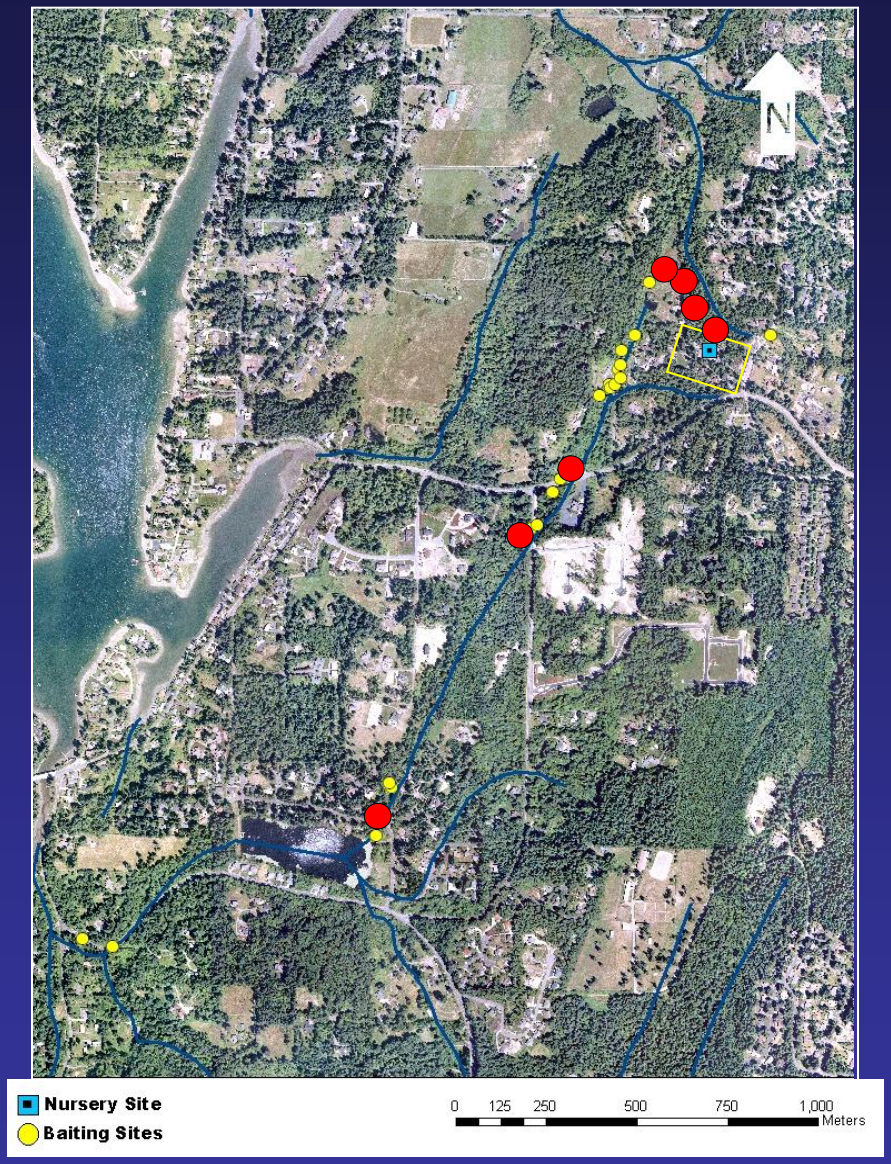
P. ramorum Detection in Water (2006-2010)

Spread via Water

Persistence in WA Nurseries & Waterways

		Year					
		2004	2005	2006	2007	2008	2009
Pierce Co.	Nursery	****	****	------	------	------	------
	Stream			****	****	****	****
King Co.	Nursery "B"			****	****	------	------
	H. pond				****	------	****
	River				****	****	****
Clark Co.	Nursery					****	****
	Pond/ditch					****	****
Pierce Co.	Nursery	****					****
	Pond/ditch						****
	Salal plants						****

Rosedale Stream and Nursery Site in Pierce Co., WA



Chronology

Plants at nursery

“+” 2004 (Rh), genotypes: NA1 (unk)

“+” 2005 (Rh), genotypes: NA1 (8)

“-” 2006-2009

Soil at nursery

“+” 2005, genotypes: NA1 (8, 25, 46, 47)

“-” 2009 (not tested 2006-2008)

Rosedale Stream (seasonal)

“+” 2006, genotypes: NA1 (8, 25)

“+” 2007, genotypes: NA1 (8, 46, 60)

“+” 2008, genotypes: NA1 (5, 8)

“+” 2009, genotypes: NA1 (8)

Streamside vegetation surveys

“ .” to date

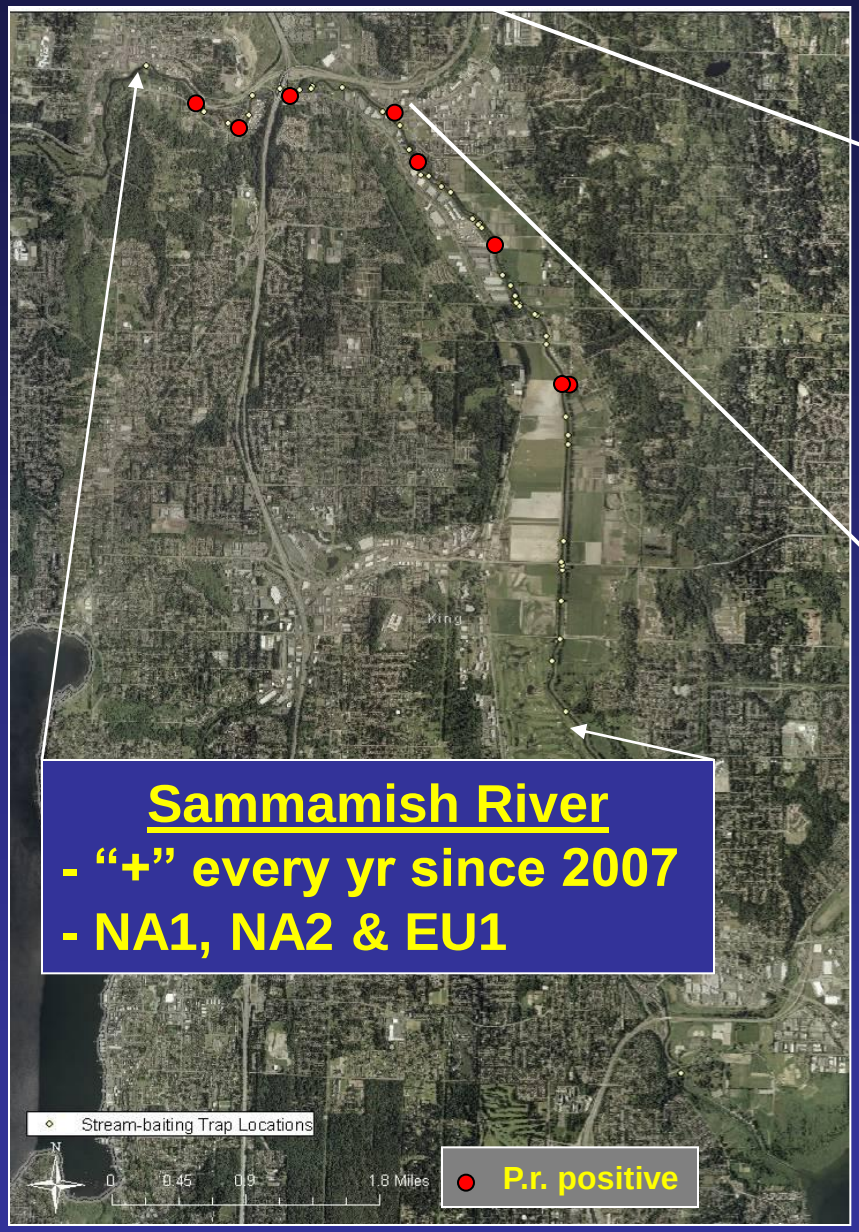
Gil Dermott - WSU

Sammamish River in King Co., WA

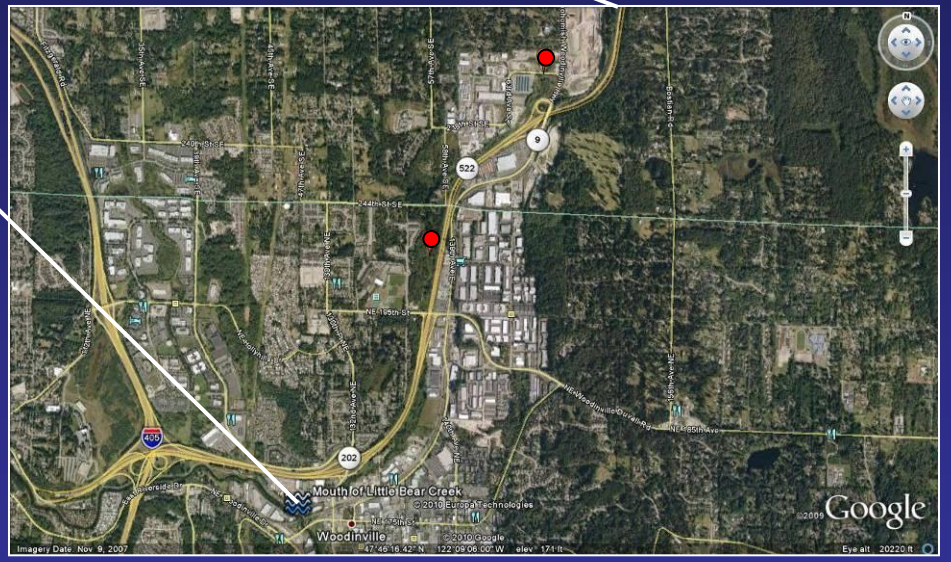
Suspected Initial Sammamish River "+" Nursery

Dan Omdal and Amy Ramsey-Kroll – WA DNR

Sammamish River and Little Bear Creek



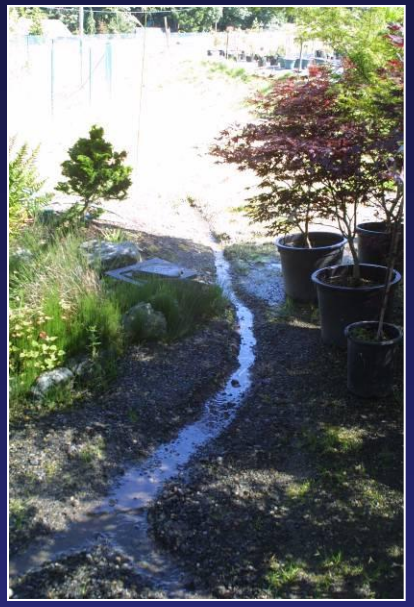
Sammamish River
- "+" every yr since 2007
- NA1, NA2 & EU1



Little Bear Creek – "+" sites in 2010 (NA2)

Amy Ramsey-Kroll and Dan Omdal – WA DNR

Nursery Site in Pierce County, WA with Spread to Salal Plants



Nursery Site in Pierce County, WA with Positive Salal

Chronology

Plants at nursery

"+" 2004 (Rh & C), genotypes: NA1 (unk)

"-" 2005-2008

"+" 2009 (Rh), genotypes: NA2 & EU1

"+" 2010 (C), genotypes: NA2

Soil at nursery

"-" 2009

Drainage ditch and retention pond

"+" 2009, genotypes: NA2

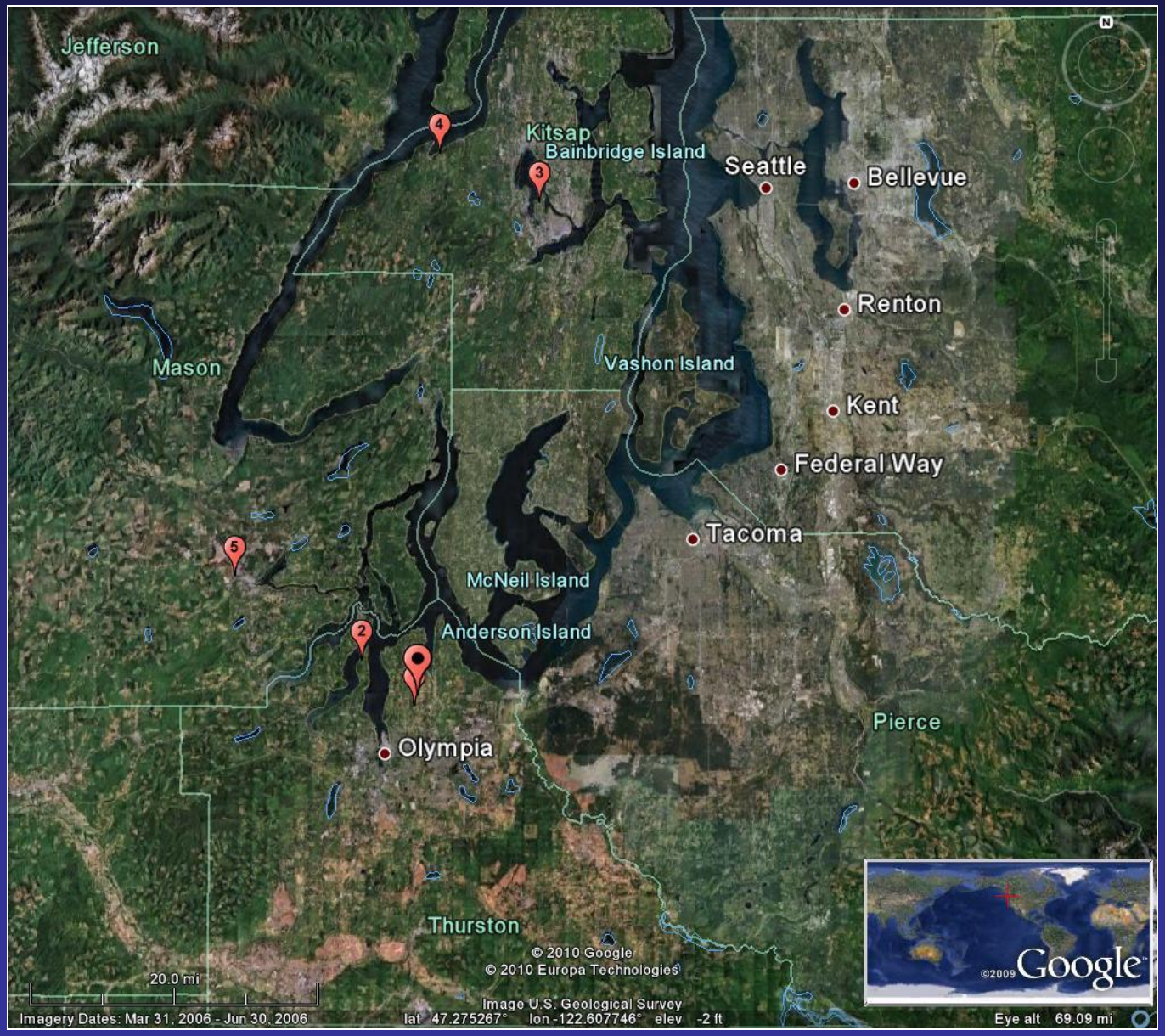
"+" 2010, genotypes: NA2, NA1 (6)

Perimeter vegetation surveys

"+" 2009 (S), genotype: NA2

W = "+" water S = "+" salal C = "+" Camellia

Spread via movement of infected plants from a nursery in Olympia, WA to the landscape



EU1 Lineage

Genotype and Spread Summary

- All three lineages of *P. ramorum* have been detected in WA nurseries and waterways.
- Genotype data suggest that the *P. ramorum* has been reintroduced following completion of the CNP in some nurseries and that it is persisting from year to year in other nurseries.
- There has been a shift in the population structure of *P. ramorum* in WA nurseries – decrease in NA1 and a increase in NA2 and EU1 lineages.
- Potential increased risk of genetic recombination and spread of NA2 and EU1 lineages to the landscape.
- The EU1 lineage has been detected on trace forward "landscape" plants at several sites.
- The spread of the NA2 lineage onto salal plants at the Pierce County site illustrates the importance of water pathways for the spread of *P. ramorum* from nurseries to plants in the landscape.

Population structure of *P. ramorum* in Washington State

- Increased sampling in nurseries, waterways, and landscapes
- Genotypes within EU1 and NA2 lineages
- Reason for shift – fitness?

Acknowledgements

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WSU SOD Research & Education Program
http://www.puyallup.wsu.edu/ppo/sod.html

Thank You - Questions and Comments?