

National *Phytophthora ramorum* Early Detection Surveys for Forests 2003-2005

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ABSTRACT

Diseases caused by *Phytophthora ramorum* in North American forest landscapes were first detected in central coastal CA in the mid-1990's. The vulnerability of other ecosystems is suggested by brisk trade in susceptible woody ornamental hosts; greenhouse inoculation trials of other nursery and forest plants; and the discovery in Europe of disease in hosts which are abundant in oak-dominated forests of eastern North America. Federal and state forest management agencies in seven eastern US states outside the known distribution of *P. ramorum* joined in pilot tests of early detection survey methods for forests in 2003. Climatic variables, putative host abundance and distribution, and potential pathways of *P. ramorum* introduction were combined in a risk map used to guide sampling intensity in the 77.8 million HA area. The survey was greatly expanded to more than 30 states after it was learned that *P. ramorum* had been accidentally introduced throughout the US on infected ornamental nursery stock. The first and largest introduction of potentially infected plants was discovered in spring of 2004, originating from a southern CA nursery. Smaller introductions were repeated in 2004-05 from CA, OR, and WA nurseries. As a result, 21 states have confirmed *P. ramorum* in nursery stock. This poster presents results of forest surveys for the period 2003 through 2005.



Worldwide, *P. ramorum* causes 3 distinct diseases on host genera common to eastern hardwood forests; ramorum leaf blight, ramorum dieback, and ramorum canker shown here on *Rhododendron*, *Kalmia*, *Viburnum*, and *Quercus*. Climatic parameters similar to ramorum-endemic areas on the west coast were combined with host type and potential introduction pathways (i.e., ornamental nurseries) for a risk rating used to guide sampling in forest surveys.

Preliminary SOD Risk/Hazard Map



- *Surveys were conducted by state forestry agency cooperators after regional training.
- *General forest (GF) and nursery perimeter (NP) sites were surveyed with 4-100 meter transects.
- *Priority was given to high-risk areas (including probability of importing infected nursery stock).
- *Samples of symptomatic tissues from 11 host genera were tested with replication for *P. ramorum* presence using molecular methods at one of more than 20 cooperating local or regional laboratories.

2003 Results

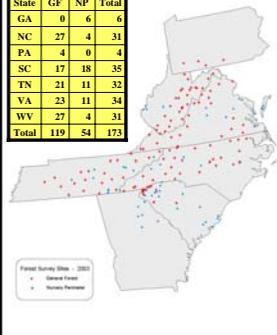
*Methods were pilot tested in 7 states comprising most of the high and moderate risk area outside of ramorum-endemic areas on the west coast.

*69 percent of the surveyed sites were general forest.

**P. ramorum* was not detected.

2003 Locations

State	GF	NP	Total
GA	0	6	6
NC	27	4	31
PA	4	0	4
SC	17	18	35
TN	21	11	32
VA	23	11	34
WV	27	4	31
Total	119	54	173



2004 Results

*Nursery stock infected with *P. ramorum* was found to have been shipped around the US.

*21 states (shaded) have confirmed the pathogen in nurseries and/or ornamental landscapes.

*Survey expanded to 36 states.

*72.5 percent of the surveyed sites were nursery perimeters.

*Surveys detected *P. ramorum* only in San Francisco, CA, consolidating the 14 central coastal counties already infested.

▲ Survey location coordinates not provided for WA, OR, and CA



2004 Locations

Region/State	GF	NP	Total
South			
AL	0	35	35
AR	0	35	35
FL	0	6	6
GA	0	38	38
LA	0	5	5
MS	1	8	9
NC	5	63	68
SC	44	47	91
TN	14	29	43
TX	0	106	106
VA	28	36	64
Northeast			
CT	1	3	4
DE	2	3	5
MA	2	6	8
MD	0	55	55
ME	0	6	6
NH	2	3	5
NJ	3	7	10
NY	8	15	23
OH	0	11	11
PA	14	18	32
RI	0	4	4
VT	0	12	12
WV	1	138	139
North Central			
IA	12	1	13
IL	7	4	11
IN	6	9	15
MI	23	7	30
MN	6	24	30
MO	22	8	30
WI	24	7	31
Interior West			
NV	19	0	19
UT	15	30	45
West Coast			
CA	47	0	47
OR	0	6	6
WA	7	42	49
Total	313	827	1140

2005 Locations

Region/State	GF	NP	Total
South			
AL	7	23	30
AR	23	7	30
FL	0	8	8
GA	11	15	26
KY	24	6	30
LA	5	6	11
MS	5	28	33
NC	10	20	30
OK	6	4	10
SC	40	26	66
TN	10	20	30
TX	0	64	64
VA	0	38	38
Northeast			
CT	1	6	7
DE	5	10	15
MA	0	12	12
MD	11	31	42
ME	3	7	10
NH	5	5	10
NJ	6	4	10
NY	17	13	30
OH	10	20	30
PA	14	26	40
RI	1	5	6
VT	10	10	20
WV	43	17	60
North Central			
IA	10	20	30
IL	12	17	29
IN	10	12	22
MI	22	8	30
MN	7	26	33
MO	8	22	30
WI	8	22	30
Interior West			
KS	9	5	14
NV	54	0	54
West Coast			
CA	41	0	41
OR	39	26	65
WA	29	1	30
Total	516	590	1106

2005 Results

*More accidental introductions occur originating in CA, OR, and WA.

*No change in the states confirming *P. ramorum*.

*Survey expanded to 38 states.

*53 percent of the surveyed sites were general forest areas.

**P. ramorum* not detected.



Ramorum Forest Survey Diagnostic Statistics by Year

Year	Location Type	Location #	Sample #	Ramorum+
2003	General Forest	119	837	0
	Nursery Perimeter	54	279	0
	Subtotal	173	1116	0
2004	General Forest	313	1310	2
	Nursery Perimeter	812	3207	0
	Subtotal	1140	4517	2
2005	General Forest	516	908	0
	Nursery Perimeter	590	1130	0
	Subtotal	1106	2038	0
Grand Total	2419	7671	2	

Cumulative *P. ramorum* Forest Survey Locations, 2003-2005

(▲ 2004 location coordinates lacking for WA, OR, and CA)



Conclusions

P. ramorum is likely not native to US forests. It has been widely introduced to nurseries.

P. ramorum is not yet widely established outside regulated area, even in proximity to nurseries receiving infected stock in high risk areas.

It has been detected in planted woody ornamentals (OR, GA, and SC).

Present in forest environs of CA & OR only.

Early detection and aggressive eradication measures offer hope for limiting spread into North American forest ecosystems where *P. ramorum* does not yet occur.