National *Phytophthora ramorum* Early Detection Survey of Forests

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AUSFNMC 2013 Contact Meeting
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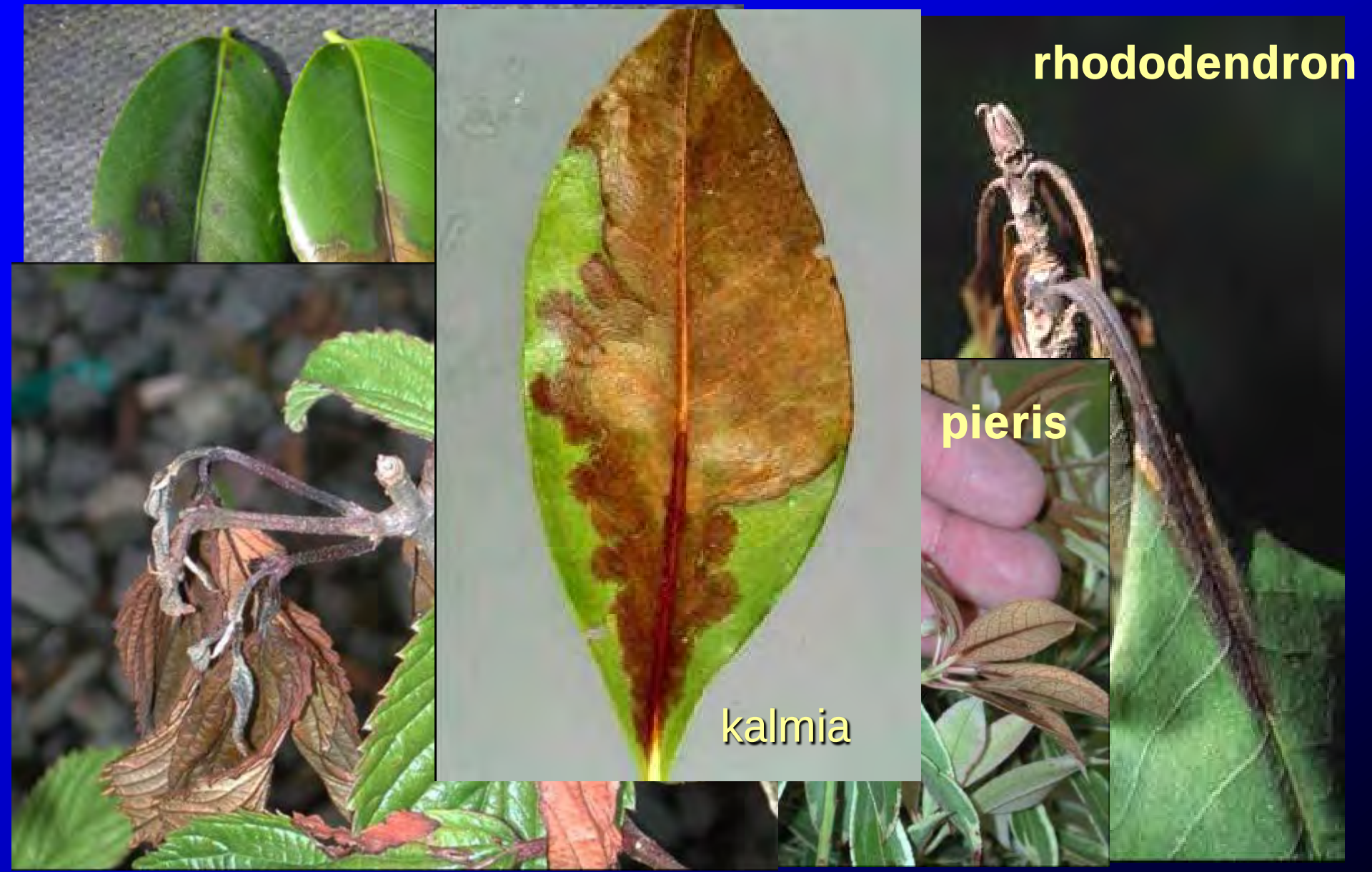
P. ramorum National Survey Outline

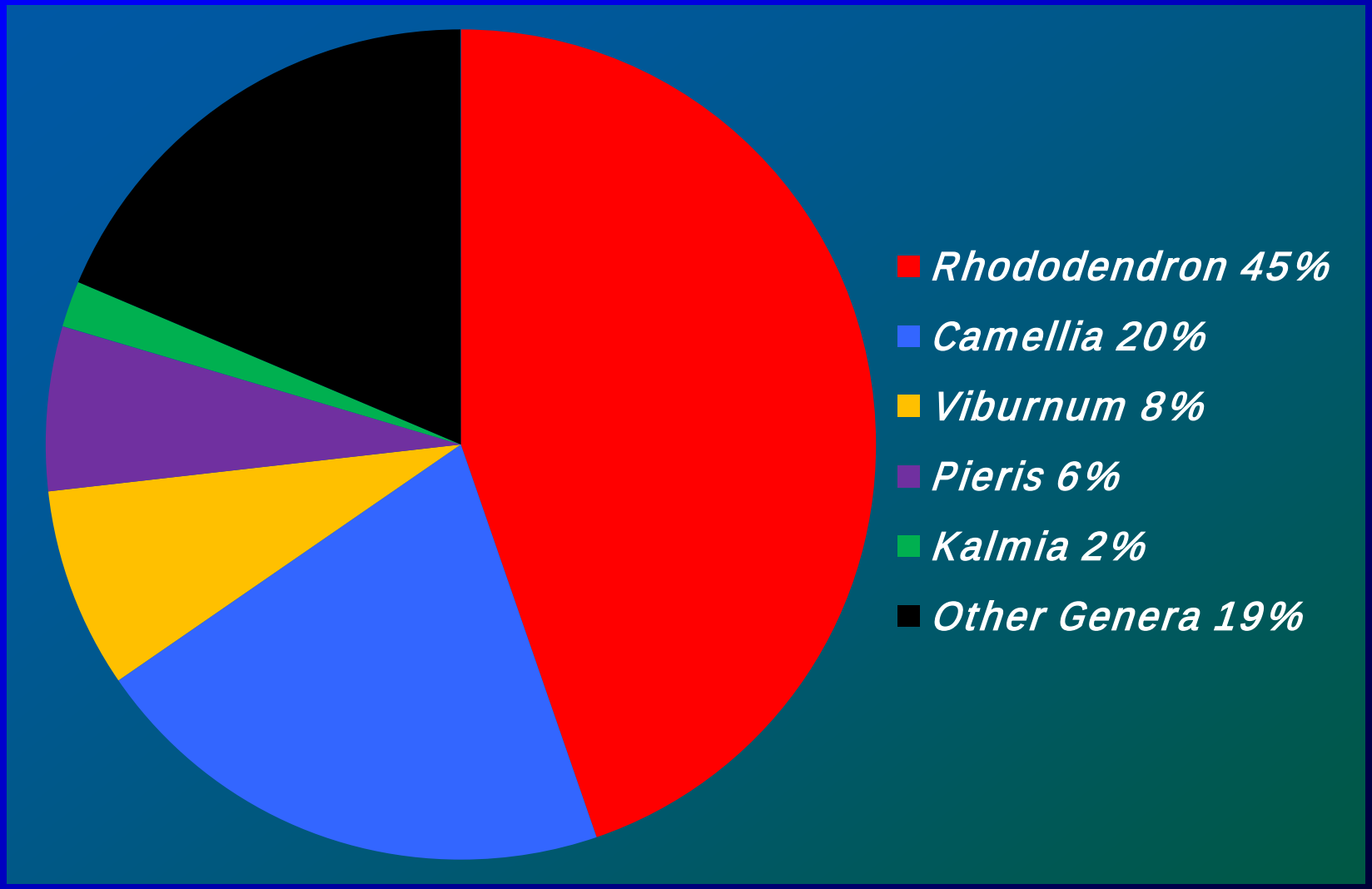
- **Why?**
  - Damage
  - Risk
- **How?**
  - Background
  - Protocol
- **Results!**

P. ramorum Damage

P. ramorum Diseases in Ornamental Plant Nurseries



Plant Genera Positive for *P. ramorum* in Ornamental Nurseries, 2010-12



Source: APHIS *P. ramorum* Quarterly Program Updates (on-line)
http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/updates.shtml

P. ramorum Is NOT A Mortal Threat To Most Ornamental Nursery Plants

P. ramorum Diseases In Ornamental Nurseries

APHIS Vision Statement

- **"The program will take a proactive approach to protect native biodiversity, wild lands, and managed landscapes from *Phytophthora ramorum* through a system of voluntary and mandatory (best management practices) approaches focused on critical control points."**

- ***Phytophthora ramorum* Program Review USDA-APHIS-PPQ Riverdale, MD 15-16 Dec 2009**

http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/review_2009/NationalReviewReport.pdf

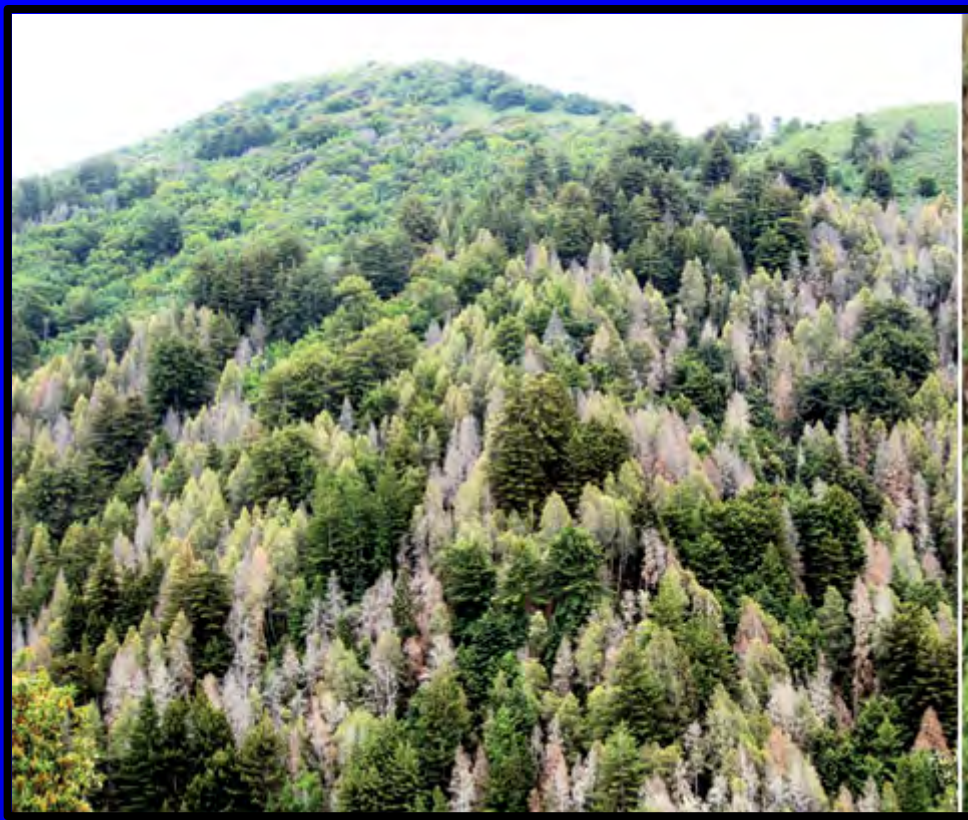
P. ramorum Diseases in North American Forests

bleeding stem canker

shoot dieback

leaf blight

P. ramorum Is A Potential Mortal Threat To Forest Health



Oak & Tanoak Mortality- CA, OR

Japanese Larch Mortality- UK

Photo credits: Brasier, DEFRA

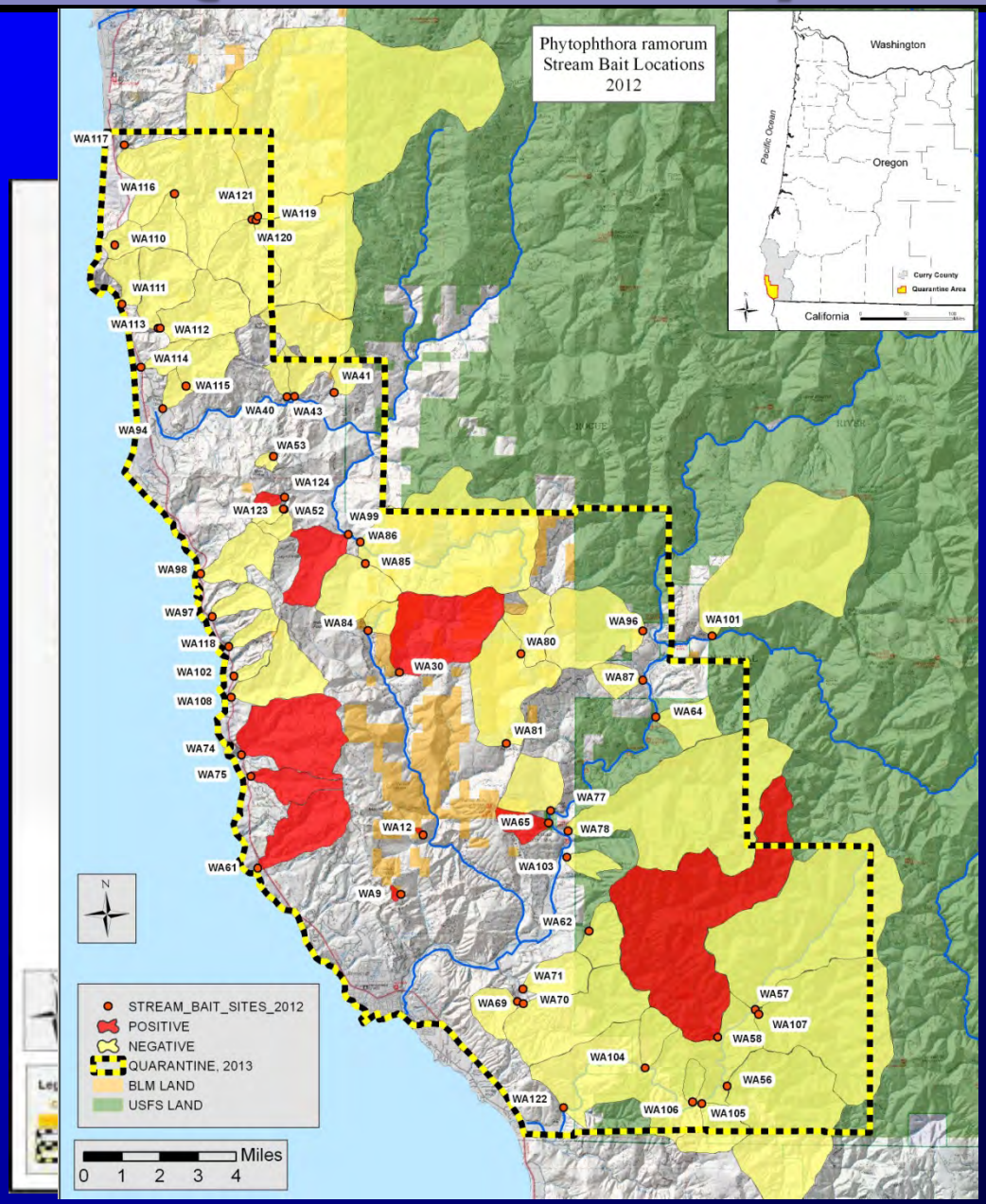
Sudden Oak Death Distribution- North America
July, 2013

Tree-killing disease in 14 Central Coastal CA Counties

&

Curry County, OR

P. ramorum Quarantine- Curry County, OR



Emergency Response- Curry County, OR

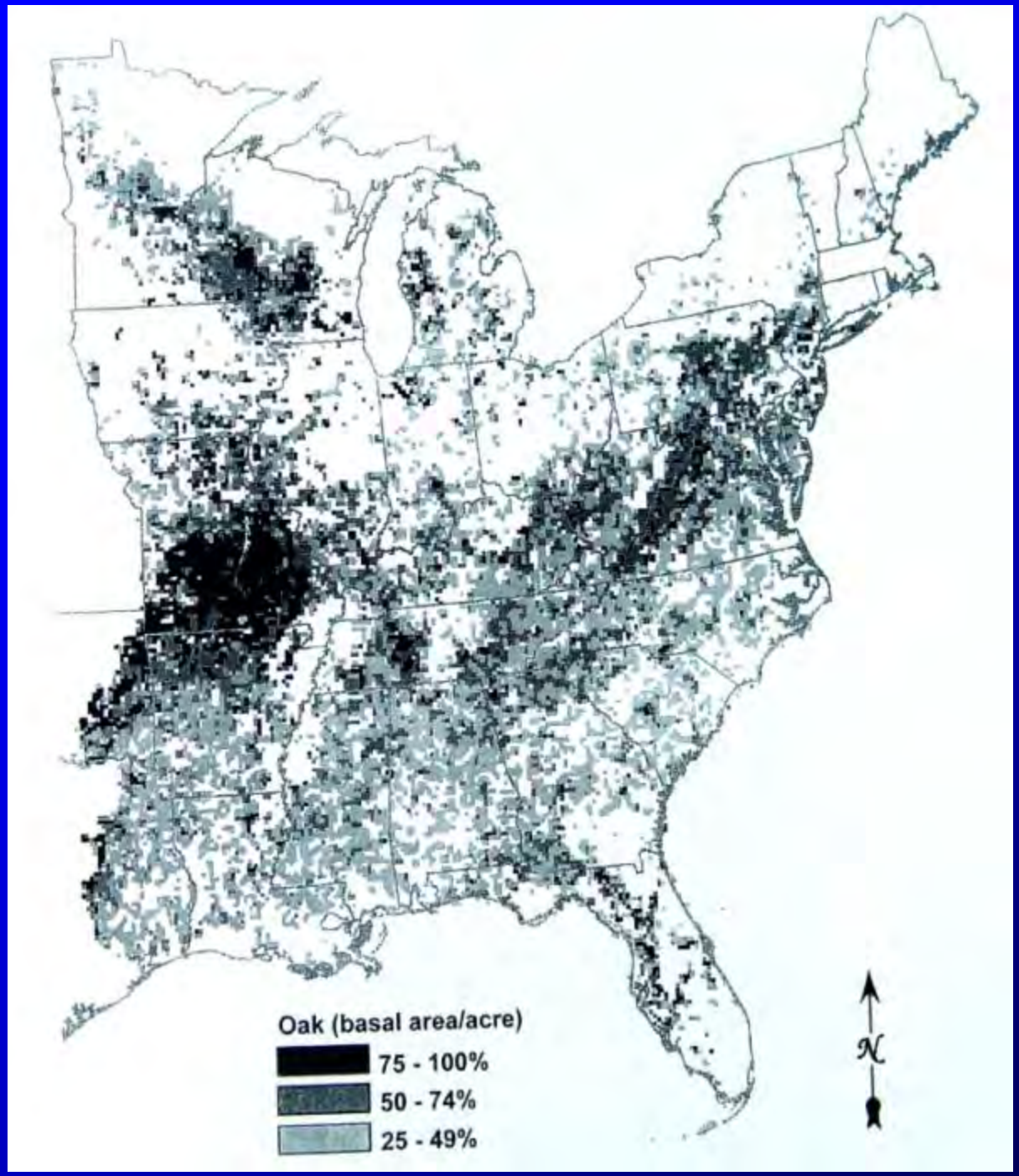
Photo: Everett Hansen, Oregon State University

P. ramorum Risk

If *P. ramorum* is confined to the west coast, why should easterners worry?

Worldwide *P. ramorum* Host & Associated Genera in Eastern Forests

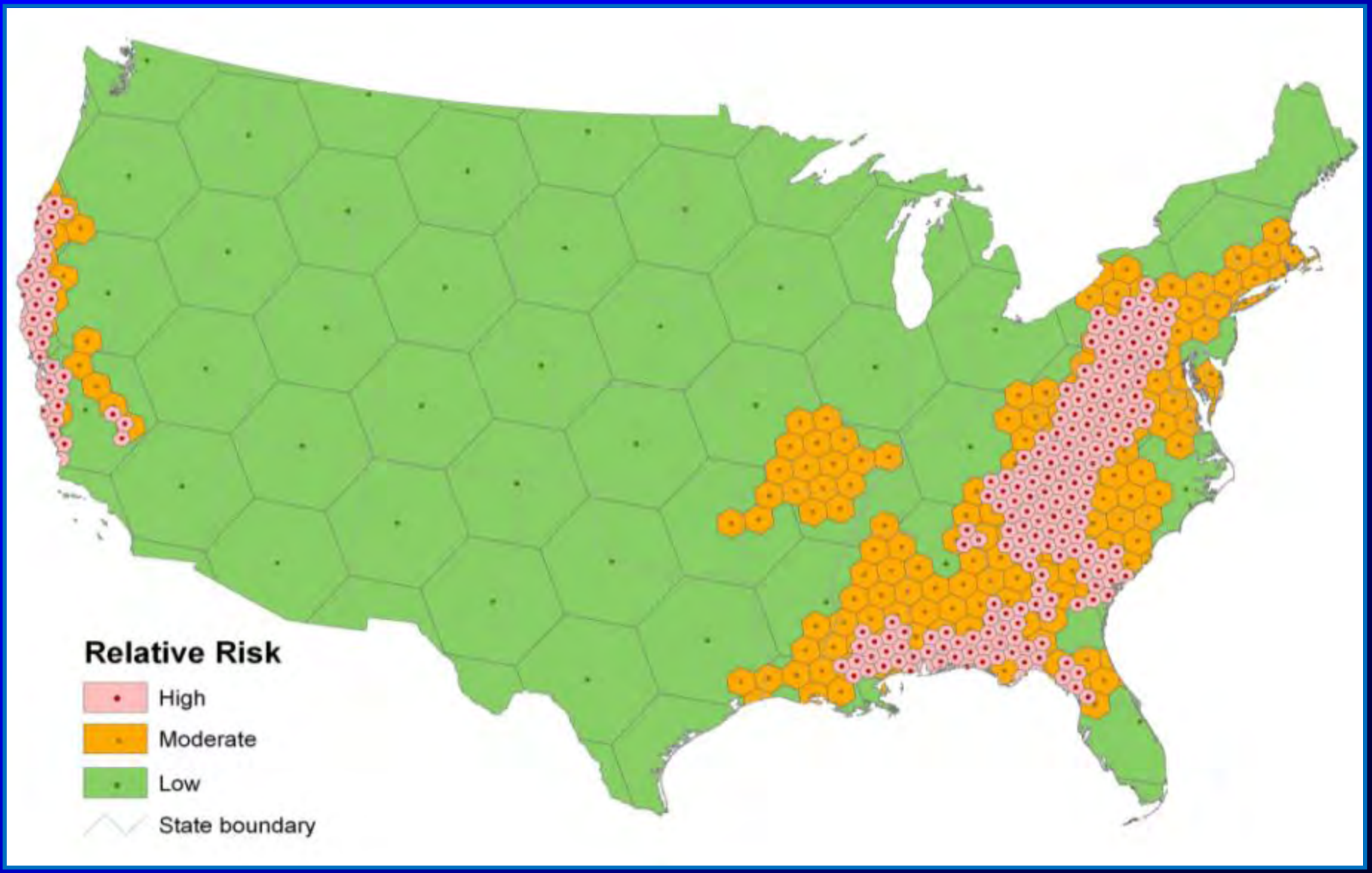
- *Abies* (fir)
- *Acer* (maple)
- *Aesculus* (buckeye)
- *Arctostaphylos* (kinnikinick)
- *Calycanthus* (sweet bush)
- *Castanea* (chestnut)
- *Corylus* (hazelnut)
- *Euonymus*
- *Fagus* (beech)
- *Fraxinus* (ash)
- *Gaultheria* (teaberry)
- *Kalmia* (mountain laurel)
- *Hamamelis* (witch hazel)
- *Leucothoe* (doghobble)
- *Lonicera* (honeysuckle)
- *Magnolia*
- *Maianthemum* (false Solomon's seal)
- *Pieris* (fetterbush)
- *Prunus* (cherry)
- *Quercus* (oak)
- *Rhamnus* (buckthorn)
- *Rhododendron*
- *Rubus* (salmonberry, blackberry)
- *Salix* (willow)
- *Toxicodendron* (poison oak, ivy)
- *Vaccinium* (huckleberry, blueberry)
- *Viburnum* (arrowwood)



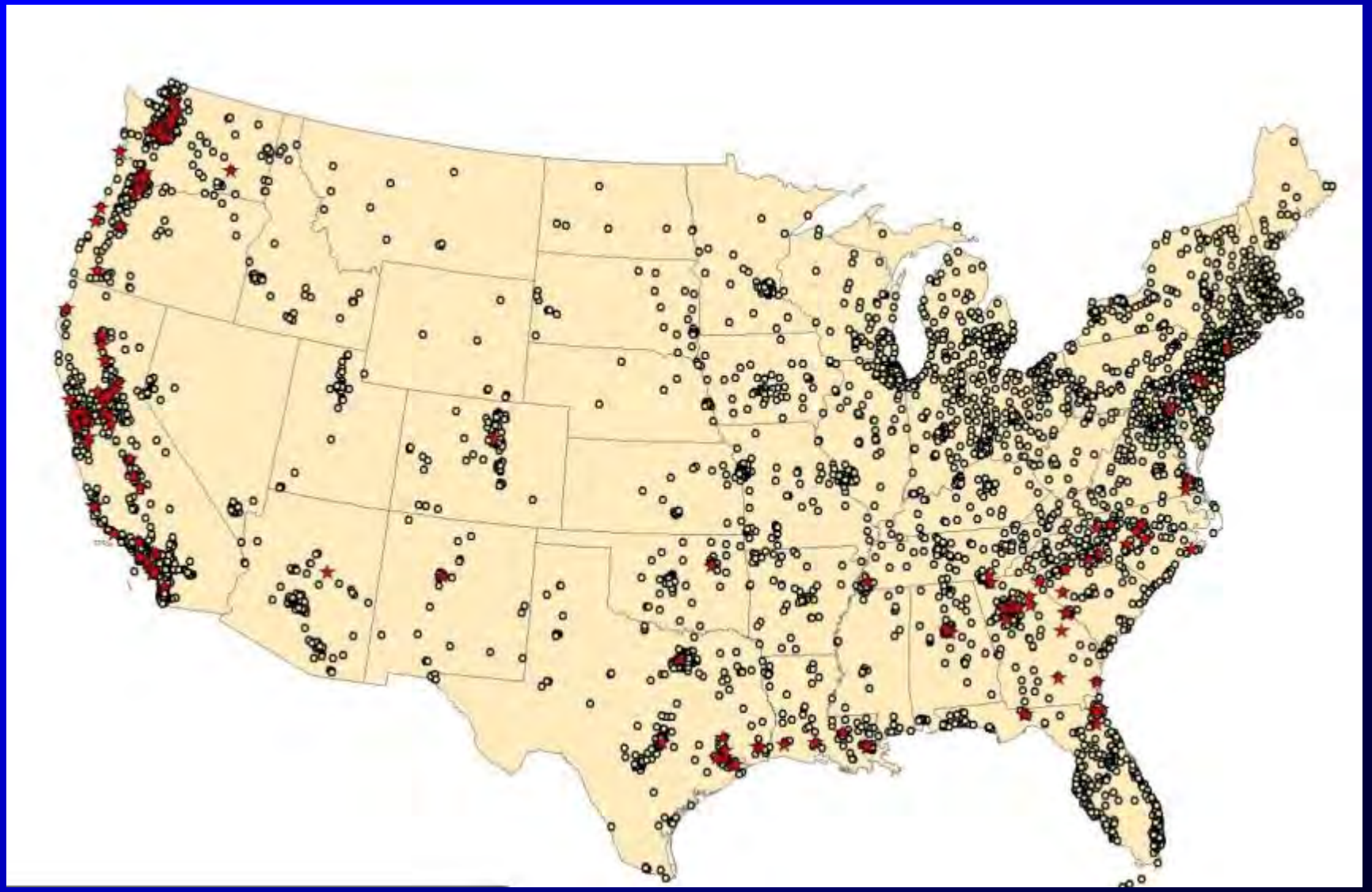
Eastern Oak Density

Timberland with ≥ 25 % oak basal area

FIA Eastwide Forest Inventory Database (adapted from McWilliams, et al.)


Relative Risk
High
Moderate
Low
State boundary

2003-4 *P. ramorum* Nursery Stock Introductions
Trace Forward Zip Codes



P. ramorum
Early Detection
(in forests!)

2003-2006
Symptomatic Terrestrial Host Plant Survey

National *P. ramorum* Forest Survey Statistics for the US 2003-2006

	Overall
Cooperating States	39
Total Locations	3570
Nursery Perimeter	2214
General Forest	1356
Samples Diagnosed	12699
P. ramorum +	2

**P. ramorum* + from San Francisco County, CA

Streamside *Rhododendron* & *Kalmia* plants with Typical Symptoms of *Phytophthora* spp. Infection

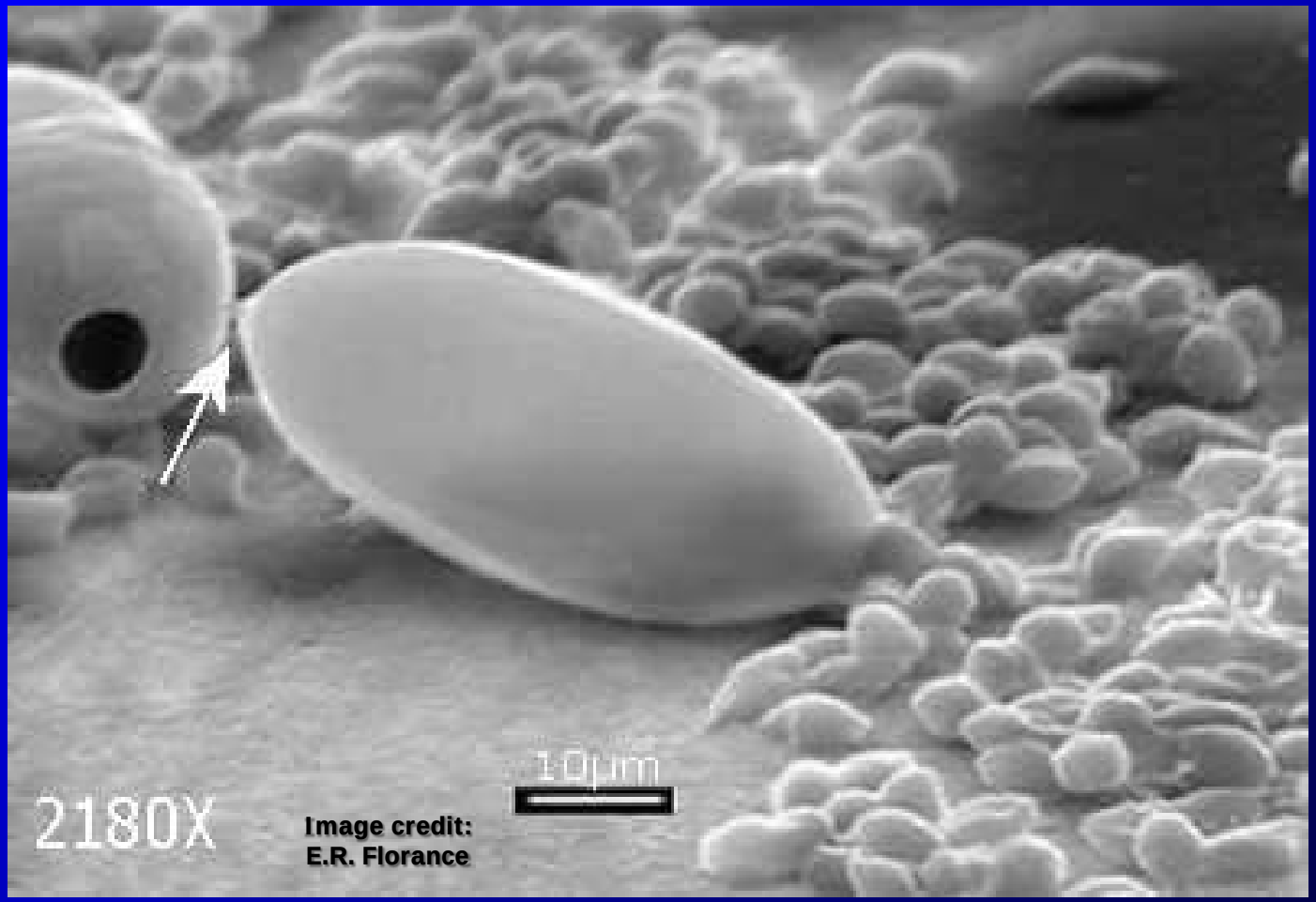
(*P. citricola, P. heveae*)

Phytophthora spp. Diversity
Recovered by Filtration in 5 Western NC Forest Streams
April-Nov 2005

Species	Location				
	Davidson River	So. Mills River	Big Creek	Fletcher Creek	Bent Creek
P. cambivora		+			
P. cinnamomi		+			
P. citricola	+	+	+	+	+
P. citrophthora	+	+		+	+
P. gonapodyides	+	+	+	+	+
P. heveae		+			
P. pseudosyringae	+	+		+	+
Group A			+		
Group B					+
Group C	+	+			+
Group F	+	+		+	+
Group I					+
Group J		+			
Group L			+		

Phytophthora ramorum

sporangia & zoospores



The swimming zoospore
is the life stage baited in water

Symptoms of Infection by *Phytophthora* spp. on Rhododendron Leaf Baits

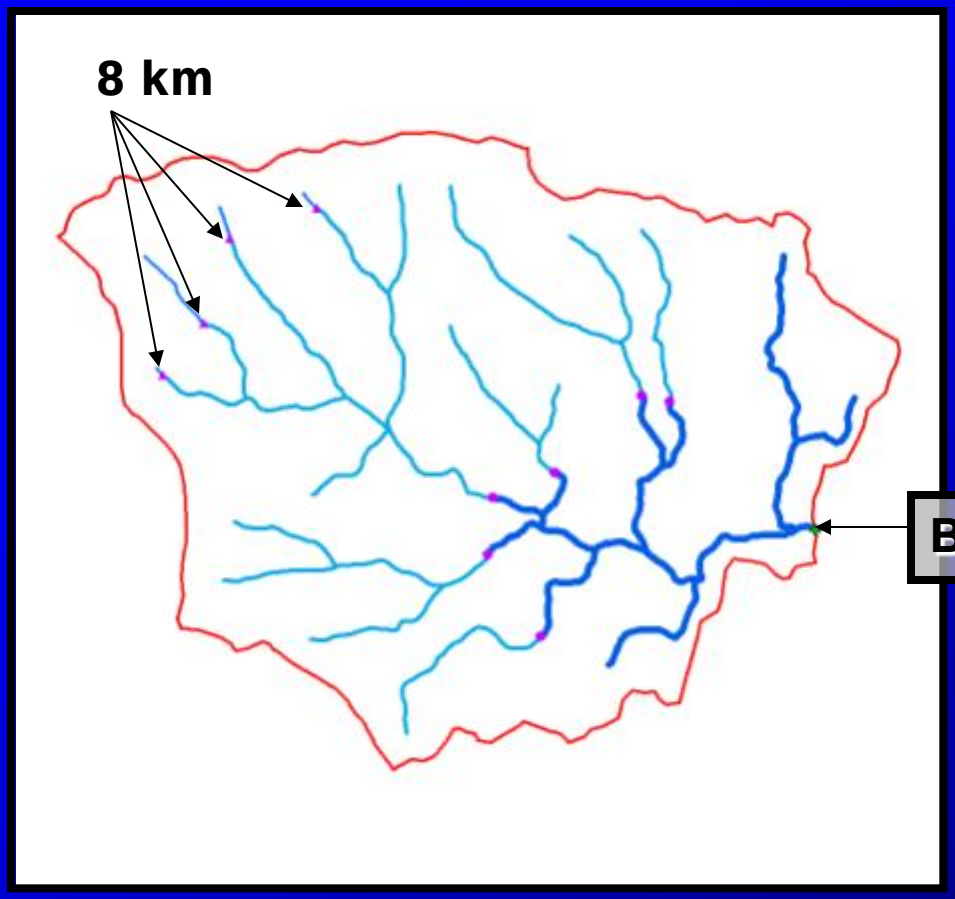
In Situ Assay- Bait Bags

Photo credit- Dan Omdal

In Vitro Assay (Bottle O' Bait- BOB)

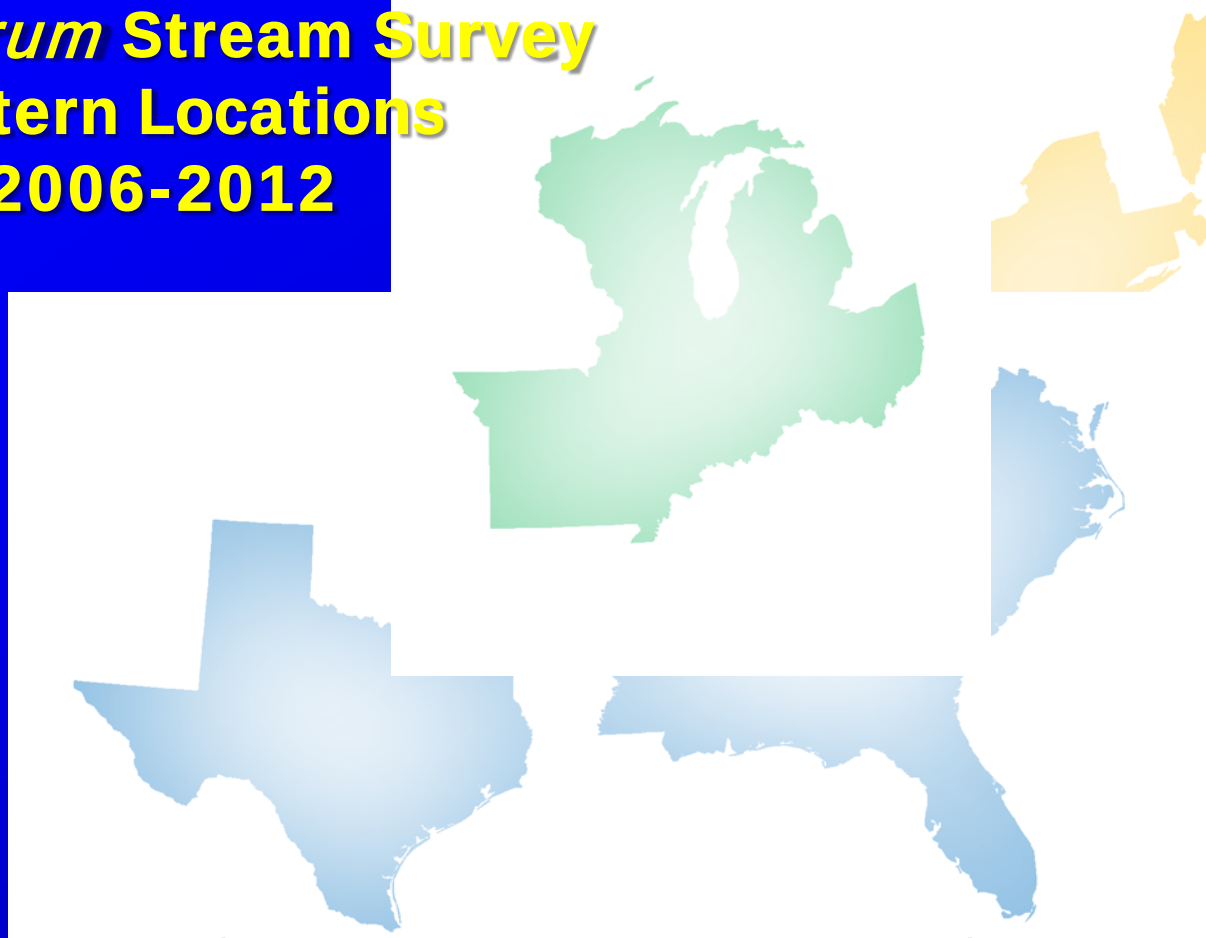
Stream Baiting Survey Area

Example: Davidson River, NC



P. ramorum detection limit at least 6 km downstream from inoculum source

P. ramorum Stream Survey
Eastern Locations
2006-2012



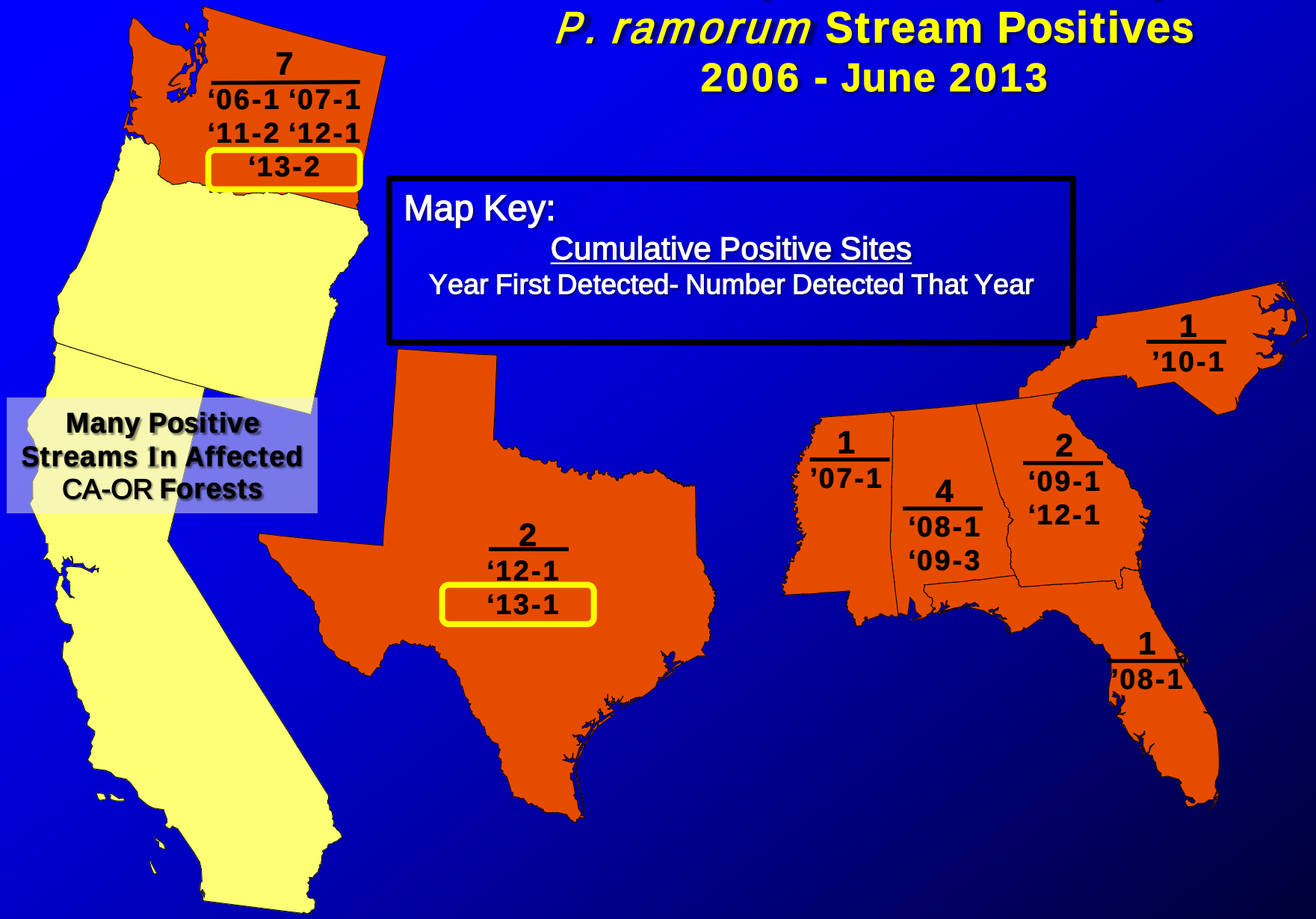
	Year							Streams Surveyed	
Region	2006	2007	2008	2009	2010	2011	2012	Total	Unique
Northeast (9)	24	37	29	15	15	15	11	146	91
North Central (7)	0	20	15	0	2	2	4	43	34
South (10)	33	64	71	78	73	76	68	403	224
Eastern Total (26)	57	121	115	93	90	93	83	652	349

Many streams surveyed in more than one year

USFS National Early Detection Survey of Forests

P. ramorum Stream Positives

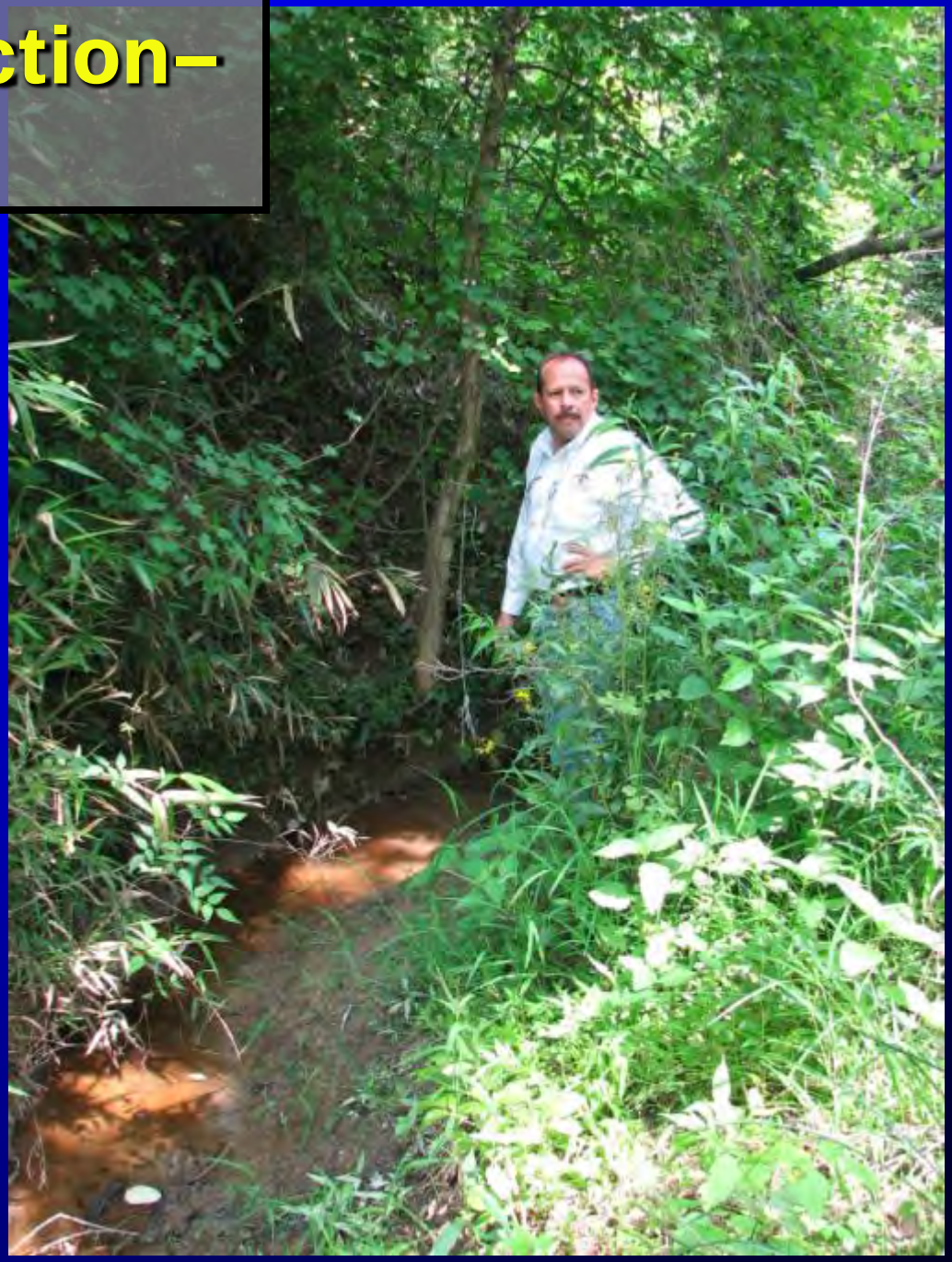
2006 - June 2013



USFS National Early Detection Survey of Forests
P. ramorum Stream Positive Summary
2006 - June 2013
Number of Positive Sites By Year Of First Detection

State	Total	Year of First Detection							
		'06	'07	'08	'09	'10	'11	'12	To 6/'13
OR	Many positive waterways in infested forest areas								
CA									
WA	7	1	1				2	1	2
AL	4			1	3				
FL	1			1					
GA	2				1			1	
MS	1		1						
NC	1					1			
TX	2							1	1
Total	18	1	2	2	4	1	2	3	3

First Eastern Detection– MS, 2007




Urban-Wildland Interface


Forested “Wild Land”

“Urban” Forest Setting
Multiple Suspect Waterways

Location A (top)
First Detection- 2008

Location B (bottom)
First Detection- 2009

P. ramorum Risks to Eastern Forests

What we know…

- The quarantine is “leaky”.
- The pathogen persists in infested nurseries despite eradication measures.
- Inoculum is leaving infested nurseries in water.
- There is a plausible pathway from water to terrestrial ecosystems.
- Natural and artificial inoculation shows eastern woody plants are susceptible.
- Climate is at least seasonally suitable for infection.

P. ramorum Risks to Eastern Forests

What we don't know…

- Eastern epidemiology.
  - Sufficient sporulation to initiate/sustain epidemics?
  - Suitable climate at the right time for infection?
- Coincidence of sporulating hosts in infested streamside zones?
- Lag time from infection to establishment to epidemic?
- Ecosystem effects?

PROBLEMS

No Matter how Great and Destructive your Problems May Seem Now,
Remember, You've Probably only Seen the Tip of Them.

www.despair.com