CONTINENTAL DIALOGUE ON NON-NATIVE FOREST INSECTS & DISEASES
SIXTH DIALOGUE MEETING

ADDRESS *P. RAMORUM* INITIATIVE BREAKOUT SESSION

***Phytophthora ramorum*: What is the Threat to the East?**

Is presence of *P. ramorum* in streams a pathway for spread?
What is known about *P. ramorum* in the East?

Since 2004, the sudden oak death pathogen has been detected numerous times on plants shipped to Eastern U.S. states; most but likely not all of these plants have been tracked down and destroyed. The sudden oak death pathogen has also been found in 8 waterways in Mississippi, Alabama, Georgia, Florida and North Carolina. Run-off from nearby *P. ramorum* positive nurseries contaminated these 8 waterways. Several of the steams are in areas identified by the USDA Forest Service as "high risk" for infestation due to the presence of susceptible vegetation and suitable climate (Figure 1. Koch and Smith, *in press*). Water is not regulated as part of the federal *P. ramorum* quarantine.

This document provides key points relating to *P. ramorum* establishment in the East. Underlying these findings and hypotheses are uncertainties and risks. Over the next year, we would like to discuss, what level of precaution is called for given the resources at risk and the uncertainties?

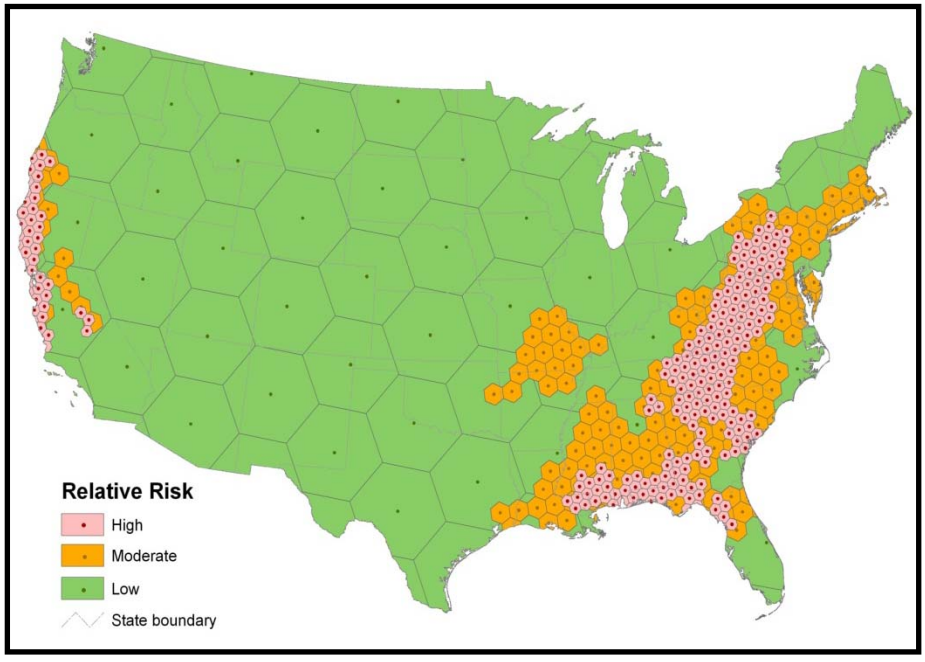
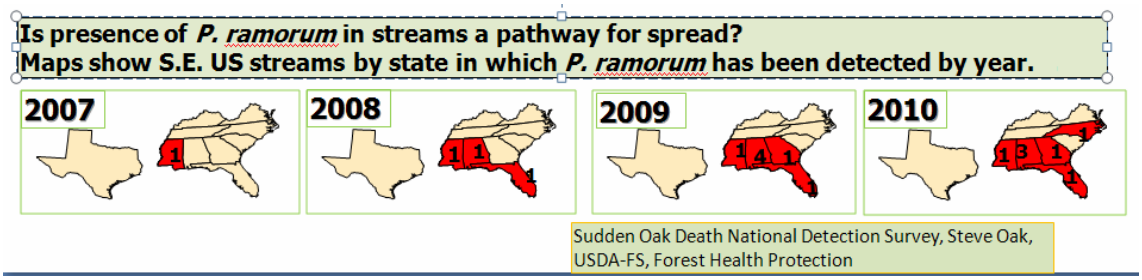


Figure 1. USDA Forest Service *Phytophthora ramorum* U.S. Risk Map



How suitable are Eastern climatic conditions for *P. ramorum* survival and establishment?

Venette and Cohen (2006) show that the Gulf states (Louisiana, Mississippi, and Alabama) and the southern half of Arkansas, have the climate most suitable for *P. ramorum* establishment but most of the Eastern U.S. is classified as "favorable" or higher.

"Most of the eastern United States has actual and potential hosts growing in climates conducive to infection." - USDA APHIS Pest Risk Assessment for *P. ramorum*. Executive Summary. 2008

Phytophthora ramorum is considered a cool temperature organism, with optimal growth between 64°F (18 °C) and 72°F (22 °C) (Werres and others 2001).

"The results suggest that *P. ramorum* is capable of surviving some highly adverse temperature conditions for at least 7 days both as free chlamydospores in sand and within infected host tissue. Thus, *P. ramorum* present as free chlamydospores or within tissue of infected plants shipped to the eastern United States has the potential to survive some of the adverse conditions encountered in summer and winter in many eastern states." - Tooley, Browning and Berner 2008.

How susceptible are Eastern species? Do Eastern plants species support *P. ramorum* sporulation?

Information on Eastern plant species susceptibility comes from laboratory and greenhouse tests; or natural exposure in European wildlands, landscapes and gardens; exposure in nurseries or other environments.

"The results indicate that many common understory species in Eastern U.S. forests are susceptible to *P. ramorum* and capable of providing ample sources of inoculum (sporangia and chlamydospores) for forest epidemics should the pathogen be introduced and should temperature and moisture conditions exist that are conducive to disease development." - Tooley and Browning 2009

Kalmia latifolia (mountain laurel) is highly susceptible (Tooley and others 2004). Kalmia is the most susceptible of all eastern understory species tested. Under laboratory conditions, *Robinia pseudoacacia* (black locust) supports the most sporulation and *Rhus typhina* (staghorn sumac) produced the most chlamydospores (resistant spores). *Cornus florida* (flowering dogwood) and *Lonicera japonica* (Japanese honeysuckle) also support prolific sporulation (Tooley and Browning 2009).

" In October– November 2003, it [*P. ramorum*] was isolated from stem bleeding cankers on two American northern red oaks, *Quercus rubra*, in woodlands in The Netherlands" Brasier and others 2004a. It was isolated from a naturally infected mature (60 cm diameter) American southern red oak, *Quercus falcata* growing in southeast England (Brasier and others 2004b).

Tree species in the red oak/black oak group appear to be highly susceptible to *P. ramorum*. Two- to three-year old seedlings of *Q. alba*, an important white oak species of the eastern forest, as well as seedlings of *Q. rubra, Q. prinus*, and *Q. falcata* var. *pagodifolia* were found to be as susceptible to *P. ramorum* as the regulated host, *Q. agrifolia* (Tooley and Kyde, 2003).

One of the first isolations of *P. ramorum,* in 1995 was from *Rhododendron catawbiense* (Catawba rhododendron) in Germany (Werres and others 2001). *Rhododendron catawbiense* is native to the eastern United States, growing in the Appalachian Mountains from Virginia south to northern Alabama and naturalized north into Massachusetts (USDA NRCS Plants Profile 2010).

What ecological, economic and social impacts would an Eastern U.S. *P. ramorum* infestation have?

Oaks are highly valued by many Americans. "By any standard, oak merits the distinction of being named the people's choice for America's National Tree" (John Rosenow, Chief Executive Arbor Day Foundation). "America has the grandest trees on earth--the largest, the oldest, and some of the most magnificent. Now, with Congressional passage and presidential signing of a historic bill, America has an official National Tree–the oak (Arbor Day Foundation 2004)."

We do not know how eastern oak populations would react to exposure to *P. ramorum* but if thousands of trees died, we can predict adverse ecological impacts. "Heavy loss of oaks, or of related susceptible genera, due to P. *ramorum* infection could result in significant ecological effects, including changes in forest composition, loss of wildlife food and habitat, increased soil erosion and a significant increase in fuel loads in heavily populated urban-forest interfaces. *Quercus* spp. are considered the most important and widespread of the hardwood trees in the North Temperate Zone, with about 300 species." - Kliejunas, J. 2003. A Pest Risk Assessment for *Phytophthora ramorum* in North America.

Many oaks in the red (or black) oak group are susceptible to *P. ramorum*. Northern red oak (*Quercus rubra*) is a common dominant tree in the East. Oaks have ecological, economic and social value. "Northern red oak occurs as a dominant in many communities, including mixed mesophytic forests, pine-oak communities, and southern bottomland forests. "Northern red oak is an important source of hardwood lumber. Its wood is heavy, hard, strong, coarse-grained, and at least moderately durable. The wood of northern red oak has been used to make railroad ties, fenceposts, veneer, furniture, cabinets, paneling, flooring, caskets, and pulpwood." "The acorns of many species of oak (*Quercus* spp.) were traditionally an important food source for Native American peoples." (USDA FS, FEIS)

What pathways are most likely for establishment of *P. ramorum* in the East?

The pathogen could spread directly from infected plants to other plants (plants from nurseries, internet sales, or farmers' markets outplanted). Pathogen spread could also result from plant exposure to contaminated waterways or infested soil.

In the East U.S., how likely to initiate new *P. ramorum* infestations are the infested waterways?

No one knows the likelihood of a stream infestation leading to pathogen establishment. However, in 2009 an infested stream adjacent to a retail nursery in Washington State served as the pathway for infection of riparian salal plants. (The salal and nursery infestations are under eradication by Washington State Department of Agriculture in cooperation with APHIS.) Conversely there are infested streams that have not triggered pathogen establishment on riparian plants.

We can hypothesize several methods for the pathogen to move from the water to plants. For infection, the pathogen needs to contact the plant. This could occur by the following ways: leaves or other plant parts grow down into the water; trees or plants fall over so the crown is partly in and partly above the water; flood events; inadvertent application of the infested water when used for irrigation, road dust abatement, fire fighting or other uses; and perhaps other means. *P. ramorum* can move aerially, so once it is on a plant, it could spread to other plants if the conditions are suitable.

If a plant is exposed to the pathogen will it become infected?

When susceptible host plant populations are exposed to pathogens, every plant does not typically develop symptoms. Disease development depends on the growth stage and condition of the plant, microenvironment, genetic resistance and other factors. The likelihood of disease development depends on the pathogen inoculum level, which depends on the environmental conditions. *P. ramorum* has infected millions of trees and plants in California and Oregon. The pathogen has infected over 0.5 million Japanese larch, *Larix kaempferi*, in the UK. Common Eastern understory plants such as *Kalmia*, have been detected as infected in nurseries and natural infection of eastern U.S. species growing in Europe, most notably northern red oak, *Quercus rubra,* has occurred.

Sudden larch death, or something like it, should I be concerned?

Brasier and Webber (2010) characterized the current *P. ramorum* situation in the UK as, "An aggressive and unpredictable fungal pathogen is devastating larch plantations in Britain. Its remarkably broad host range, and the possibility of further geographical spread, give heightened cause for concern." Nature. News and Views. August 11, 2010.

For more information

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