

**NAME OF SPECIES:** *Phytophthora ramorum* Sudden Oak Death pathogen

Synonyms:

Common Name: Sudden Oak Death pathogen

**A. CURRENT STATUS AND DISTRIBUTION**

**I. In Wisconsin?**

1. YES                      NO    X

2. Abundance:

3. Geographic Range:

4. Habitat Invaded:

5. Historical Status and Rate of Spread in Wisconsin:

6. Proportion of potential range occupied:

**II. Invasive in Similar Climate Zones**

YES                      NO    X

United States: In 14 coastal California Counties and in Curry County, Oregon. In nursery in Washington.

Canada: Nursery in British Columbia.

Europe: Germany, the Netherlands, the United Kingdom, Poland, Spain, France, Belgium, and Sweden.

**III. Invasive in Similar Habitat Types**

YES    X                      NO

**IV. Habitat Affected**

1. Habitat affected: this disease thrives in cool, wet climates including areas in coastal California within the fog belt or in low-lying forested areas along stream beds and other bodies of water. Oaks associated with understory species that are susceptible to foliar infections are at higher risk of becoming infected.

2. Host plants: Forty-five hosts are regulated for this disease. These hosts have been found naturally infected by *P. ramorum* and have had Koch's postulates completed, reviewed and accepted.

Approximately fifty-nine species are associated with *Phytophthora ramorum*. These species are found naturally infected; *P. ramorum* has been cultured or detected with PCR but Koch's postulates have not been completed or documented and reviewed.

Northern red oak (*Quercus rubra*) is considered an associated host. See end of document for complete list of plant hosts.

National Risk Model and Map shows susceptible forest types in the mid-Atlantic region of the United States. Wisconsin is considered moderate to low risk for significant mortality. Wisconsin has both understory foliar hosts and susceptible oak species; in some cases, these two hosts are growing together.

	<p>2. Conservation significance of threatened habitats: Extensive mortality of susceptible oak species is typically observed in three forest types: mixed evergreen, tanoak-Douglas fir and Coastal redwood. National Risk Model and Map shows susceptible forest types in the mid-Atlantic region of the United States. Wisconsin is considered moderate to low risk for significant mortality. Wisconsin has both understory foliar hosts and susceptible oak species; in some cases, these two hosts are growing together.</p>
<b>V. Native Habitat</b>	<p>1. Countries: Unknown origin. Thought to have been introduced separately to the USA and Europe, possibly from Asia.</p>
	<p>2. Hosts: See list below.</p>
<b>VI. Legal Classification</b>	<p>1. Quarantined species? YES    X                      NO</p>
	<p>2. By what states, countries? United States: California and Oregon.</p>
<b>B. ESTABLISHMENT POTENTIAL AND LIFE HISTORY TRAITS</b>	
<b>I. Life History</b>	<p>1. Type of organism: fungus-like; Oomycetes</p>
	<p>2. Life cycle: It is likely that infection of understory foliage occurs prior to infection of oak. Aerial plant parts, including leaves, green and woody stems are infected. Sporangia are most commonly produced at temperatures between 15 - 20 degree C. Sporangia and chlamydo spores can be produced on foliage and stems. Spores can be splashed by rain or irrigation and be blown in rain or land on the soil where they can move through soil water. Spores landing in streams may be transported a long distance.</p>
	<p>3. Methods of Spread: Can move in water and soil. Can also move on above-ground plant parts and is commonly moved on nursery stock. It is still unknown whether or not bark serves as an important source of infectious material. Green waste may serve as a source of spores. Christmas trees and wreaths may also serve as a source of infectious material. Infested soil may travel not only with nursery stock but also on shoes and in the tires of bikers.</p>
<b>II. Climate</b>	<p>1. Climate restrictions: Hot, dry climates are expected to limit the opportunities for infection of foliage and woody tissue. This pathogen is a cool temperature organism, with optimum growth at 20 degrees C. Zoospores and chlamydo spores do not survive drying but can survive in moist conditions for at least one month. Infection of foliar tissue requires cool temperatures and free water.</p>
	<p>2. Effects of potential climate change: Unknown</p>
<b>III. Dispersal Potential</b>	<p>1. Invasion pathways: Nursery stock trade, Christmas trees and wreaths, recreational user's movement, green waste.</p>
	<p>2. Distinguishing characteristics that aid in its survival and/or inhibit its control: The pathogen exists as two mating types (A1 and A2). Only the A2 type has been found in North American forests; the A1 type has been found on nursery plants in North America. If sexual reproduction occurs (between the two mating types), genetic variability would likely increase and long-lived oospores would be produced. Ability to survive and travel in soil makes this fungus very difficult to destroy. Chlamydo spores can also survive for long</p>

	periods of time.
<b>IV. Ability to go Undetected</b>	HIGH X      MEDIUM      LOW
	<p>Signs and symptoms:  Foliage:  Disease symptoms vary widely on foliage. Lesions may be light tan to dark brown. Necrosis may be concentrated along the midvein or scattered anywhere on the leaf. A yellow halo may also be present on some foliar hosts. There are many fungi that cause similar lesions.</p> <p>Twigs:  Infection in twigs can cause shoot tip dieback, necrosis of leaves or Shepard's crook.</p> <p>Woody stem cankers:  Cankers on the stems of oaks have red-brown to black discoloration and seep dark black to red or amber sap.</p>
<b>C. DAMAGE POTENTIAL</b>	
<b>I. Competitive Ability</b>	1. Presence of Natural Enemies: Unknown 2. Presence of Competitors: Unknown 3. Rate of Spread: Unknown
<b>II. Environmental Effects</b>	1. Alteration of ecosystem/community composition? YES    X            NO Notes: Effects of loss of oak from an ecosystem would vary, depending on species available for replacement. Some sites could transition to jack pine, aspen and white pine or to shrub species.
	2. Alteration of ecosystem/community structure? YES    X            NO Notes: Community structure would be altered but effects would depend on species that replace oak. In addition, the opening of the canopy from death of individual trees increases the amount of available light, nutrients, and moisture on the forest floor, and thereby increases the populations of both herb and shrub species.
	3. Alteration of ecosystem/community functions and processes? YES    X            NO Notes: Oaks are a critical producer of mast for wildlife and are excellent den trees. Loss of overstory could increase runoff – affecting area streams and increase loss of soil from the site.
<b>III. Socio-economic</b>	1. Effects of Restricting Entry: Restricting the movement of nursery stock could have a significant effect on the nursery industry.
	2. Effects on Human Health: None known
<b>D. PREVENTION AND CONTROL</b>	
<b>I. Detection Capability:</b>	Notes: Phytophthora ramorum is very difficult to detect based on visual symptoms alone. Many organisms can cause foliar symptoms that are similar to P. ramorum-caused infections. Isolation and/or PCR are required; laboratory analysis may be expensive. False positives may occur.
<b>II. Costs of Prevention :</b>	Notes: Unknown.
<b>III. Responsiveness to prevention efforts:</b>	Notes: Quarantines, if enforced, could have a significant effect on limiting the long-range movement of this pathogen.

<b>IV. Control tactics:</b>	1. Cultural: None known. Eradication has been attempted in Oregon. Effectiveness is still being evaluated. 2. Biological: None known 3. Chemical: Several fungicides are registered for preventative use for foliage infections. 4. Regulatory: Quarantines focusing on limiting movement of potentially infectious material are in place and could be very effective.
<b>V. Minimum Effort:</b>	Notes: Quarantines limiting the movement of nursery stock from infected areas.
<b>VI. Most Effective Control:</b>	Notes: Quarantines that limit or prohibit the movement of infected material. Eradication is still being evaluated.
<b>VII. Cost of prevention or control vs. Cost of allowing invasion to occur:</b>	Notes: Unknown
<b>VIII. Non-Target Effects of Control:</b>	Notes: Eradication could alter a forest ecosystem, change the structure and function of the forest.
<b>IX. Efficacy of monitoring:</b>	Notes: Monitoring has shown to be most effective in climatic regions where <i>Phytophthora ramorum</i> thrives.
<b>X. Legal and landowner issues:</b>	Notes: Eradication requires the destruction of all infected material, which typically includes both overstory oak and understory herbaceous material. This practice is unpopular.

#### F. REFERENCES USED:

Dart, N.L., and Chastagner, G.A. 2007. High recovery rate of *Phytophthora* from containerized nursery stock pots at a retail nursery highlights potential for spreading exotic oomycetes. *Plant Health Progress*: 2007 - 0816-01-BR.

Davidson, J.M., and Shaw, T. G. 2003. Pathways of movement for *Phytophthora ramorum*, the causal agent of Sudden Oak Death. Sudden oak death online symposium. doi:10.1094/SOD-2003-TS.

Davidson, J. M., Werres, S., Garbelotto, M., Hansen, E. M., and Rizzo, D. M. 2003. Sudden oak death and associated diseases caused by *Phytophthora ramorum*. Online. *Plant Health Progress* doi:10.1094/PHP-2003-0707-01-DG.

Kanaskie, Alan, McWilliams, M., Mair, J., Goheen, E., Hansen, E., Sutton, W., Osterbauer. 2003. Monitoring Sudden Oak Death in Oregon. Poster. National Forest Health Monitoring Meeting.

Kluza, D. A., Vieglais, D. A., Andreasen, J. K., Peterson A.T. 2007. Sudden oak death: geographic risk estimates and predictions of origins doi:10.1111/j.1365-3059.2007.01602.x *Plant Pathology* 56 (4), 580-587.

Tooley, Paul W., Kyde, K.L., 2007. Susceptibility of some eastern forest species to *Phytophthora ramorum*.doi: 10.1094/PDIS-91-4-0435. *Plant Disease*: 91(4), 435-438.

<http://nature.berkeley.edu/comtf/>  
<http://na.fs.fed.us/SOD/>

[http://aphis.usda.gov/plant\\_health/plant\\_pest\\_info/pram/](http://aphis.usda.gov/plant_health/plant_pest_info/pram/)

**Regulated Hosts** (updated 2/27/07)

These plants are naturally infected by *P. ramorum*, and have had [Koch's postulates](#) completed, documented, reviewed, and accepted. Further details on regulated plants and plant parts can be found at [http://www.aphis.usda.gov/plant\\_health/plant\\_pest\\_info/pram/index.shtml](http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/index.shtml)

**Scientific Name**

[Acer macrophyllum](#)

*Acer pseudoplatanus*

[Adiantum aleuticum](#)

[Adiantum jordanii](#)

[Aesculus californica](#)

*Aesculus hippocastanum*

[Arbutus menziesii](#)

[Arctostaphylos manzanita](#)

[Calluna vulgaris](#)

[Camellia spp.](#)

[Castanea sativa](#)

*Fagus sylvatica*

[Frangula californica](#) (= *Rhamnus californica*)

[Frangula pushiana](#) (= *Rhamnus purshiana*)

*Fraxinus excelsior*

[Griselinia littoralis](#)

[Hamamelis virginiana](#)

[Heteromeles arbutifolia](#)

[Kalmia latifolia](#)

[Laurus nobilis](#)

[Lithocarpus densiflorus](#)

[Lonicera hispidula](#)

[Maianthemum racemosum](#) (= *Smilacina racemosa*)

[Michelia doltsopa](#)

*Parrotia persica*

[Photinia fraseri](#)

*Pieris* spp

[Pieris japonica](#) & all hybrids of *P. japonica*

[Pseudotsuga menziesii](#) & all nursery grown *P. menziesii*

[Quercus agrifolia](#)

[Quercus chrysolepis](#)

*Quercus cerris*

**Common Name**

[Bigleaf maple](#)

Planetree maple

[Western maidenhair fern](#)

[California maidenhair fern](#)

[California buckeye](#)

Horse chestnut

[Madrone](#)

[Manzanita](#)

[Scotch heather](#)

[Camellia - all species, hybrids, and cultivars](#)

[Sweet chestnut](#)

European Beech

[California coffeeberry](#)

[Cascara](#)

European ash

[Griselinia](#)

[Witch hazel](#)

[Toyon](#)

[Mountain Laurel](#) - all species, hybrids and cultivars

[Bay laurel](#)

[Tanoak](#)

[California honeysuckle](#)

[False Solomon's seal](#)

[Michelia](#)

Persian ironwood

[Red tip photinia](#)

Andromeda, Pieris - all species, hybrids and cultivars

[Japanese pieris](#)

[Douglas fir](#)

[Coast live oak](#)

[Canyon live oak](#)

European turkey oak

<a href="#"><u>Quercus falcata</u></a>	<a href="#"><u>Southern red oak</u></a>
<a href="#"><u>Quercus ilex</u></a>	<a href="#"><u>Holm oak</u></a>
<i>Quercus kelloggii</i>	California black oak
<i>Quercus parvula</i> var. <i>shrevei</i> & all nursery grown <i>Q. parvula</i>	Shreve's oak
<a href="#"><u>Rhododendron spp</u></a>	<a href="#"><u>Rhododendron (including azaleas) - all species, hybrids, and cultivars</u></a>
<a href="#"><u>Rosa gymnocarpa</u></a>	<a href="#"><u>Wood rose</u></a>
<a href="#"><u>Salix caprea</u></a>	<a href="#"><u>Goat willow</u></a>
<a href="#"><u>Sequoia sempervirens</u></a>	<a href="#"><u>Coast redwood</u></a>
<a href="#"><u>Syringa vulgaris</u></a>	<a href="#"><u>Lilac</u></a>
<a href="#"><u>Taxus baccata</u></a>	<a href="#"><u>European yew</u></a>
<a href="#"><u>Trientalis latifolia</u></a>	<a href="#"><u>Western starflower</u></a>
<a href="#"><u>Umbellularia californica</u></a>	<a href="#"><u>California bay laurel/Oregon myrtle/pepperwood</u></a>
<a href="#"><u>Vaccinium ovatum</u></a>	<a href="#"><u>Evergreen huckleberry</u></a>
<a href="#"><u>Viburnum spp.</u></a>	All species, hybrids, and cultivars of <a href="#"><u>Viburnum</u></a>

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### Associated Plant Species

These plants are found naturally infected, and *P. ramorum* has been cultured and/or detected using PCR, but Koch's postulates have not been completed or documented and reviewed.

Scientific Name	Common Name
<a href="#"><u>Abies concolor</u></a>	<a href="#"><u>White fir</u></a>
<a href="#"><u>Abies grandis</u></a>	<a href="#"><u>Grand fir</u></a>
<i>Abies magnifica</i>	Red fir
<a href="#"><u>Acer circinatum</u></a>	<a href="#"><u>Vine maple</u></a>
<i>Acer davidii</i>	Striped bark maple
<a href="#"><u>Acer laevigatum</u></a>	<a href="#"><u>Evergreen maple</u></a>
<a href="#"><u>Arbutus unedo</u></a>	<a href="#"><u>Strawberry tree</u></a>
<a href="#"><u>Arctostaphylos columbiana</u></a>	<a href="#"><u>Manzanita</u></a>
<a href="#"><u>Ardisia japonica</u></a>	<a href="#"><u>Ardisia</u></a>
<a href="#"><u>Calycanthus occidentalis</u></a>	<a href="#"><u>Spicebush</u></a>
<i>Castanopsis orthacantha</i>	Castanopsis
<i>Ceanothus thyrsiflorus</i>	Blueblossm
<i>Cinnamomum camphora</i>	Camphor tree
<a href="#"><u>Clintonia andrewsiana</u></a>	<a href="#"><u>Andrew's clintonia bead lily</u></a>
<i>Cornus kousa</i> x <i>Cornus capitata</i>	Cornus Normal Haddon
<a href="#"><u>Corylus cornuta</u></a>	<a href="#"><u>California hazelnut</u></a>
<i>Distylium myricoides</i>	Myrtle-leafed Distylium

[\*Drimys winteri\*](#)

*Dryopteris arguta*

*Eucalyptus haemastoma*

[\*Euonymus kiautschovicus\*](#)

[\*Fraxinus latifolia\*](#)

*Gaultheria shallon*

*Hamamelis x intermedia*  
(*H. mollis* & *H. japonica*)

*Hamamelis mollis*

*Ilex purpurea*

*Kalmia angustifolia*

[\*Leucothoe axillaris\*](#)

[\*Leucothoe fontanesiana\*](#)

[\*Loropetalum chinense\*](#)

[\*Magnolia grandiflora\*](#)

[\*Magnolia stellata\*](#)

[\*Magnolia x loebneri\*](#)

*Magnolia x soulangeana*

*Manglietia insignis*

*Michelia maudiae*

*Michelia wilsonii*

*Nerium oleander*

*Nothofagus obliqua*

*Osmorhiza berteroi*

*Osmanthus decorus* (= *Phillyrea decora*; = *P. vilmoriniana*)

[\*Osmanthus delavayi\*](#)

*Osmanthus fragrans*

*Osmanthus heterophyllus*

*Parakmeria lotungensis*

*Pittosporum undulatum*

*Prunus laurocerasus*

*Prunus lusitanica*

[\*Pyracantha koidzumii\*](#)

*Quercus acuta*

[\*Quercus petraea\*](#)

[\*Quercus rubra\*](#)

*Rosa* (specific cultivars)

Royal Bonica (tagged: "MEI modac")

Pink Meidiland (tagged: "MEI poque")

Pink Sevillana (tagged: "MEI geroka")

[Winter's bark](#)

California wood fern

Scribbly gum

[Spreading euonymus](#)

[Oregon ash](#)

Salal, Oregon wintergreen

Hybrid witchhazel

Chinese witchhazel

Oriental holly

Sheep laurel

[Fetterbush, dog hobble](#)

[Drooping leucothoe](#)

[Loropetalum](#)

[Southern magnolia](#)

[Star magnolia](#)

[Loebner magnolia](#)

Saucer magnolia

Red lotus tree

Michelia

Michelia

Oleander

Roble beech

Sweet Cicely

Osmanthus

[Delavay osmanthus, Delavay tea olive](#)

Sweet olive

Holly olive

Eastern joy lotus tree

Victorian box

English laurel, cherry laurel

Portuguese laurel cherry

[Formosa firethorn](#)

Japanese evergreen oak

[Sessile oak](#)

[Northern red oak](#)

Hybrid roses

*Rosa rugosa*

[\*Rubus spectabilis\*](#)

*Schima wallichii*

[\*Taxus brevifolia\*](#)

[\*Taxus x media\*](#)

[\*Torreya californica\*](#)

[\*Toxicodendron diversilobum\*](#)

[\*Vancouveria planipetala\*](#)

Rugosa rose

[Salmonberry](#)

Chinese guger tree, needlewood

[Pacific yew](#)

[Yew](#)

[California nutmeg](#)

[Poison oak](#)

[Redwood ivy](#)

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