

# Host and Habitat Index for *Phytophthora* Species in Oregon<sup>1</sup>

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## Abstract

*Phytophthora* species are known as pathogens of agricultural crops or invasive pathogens destroying forests, and their prominent inclusion in various host-pathogen indices reflects this importance. It is increasingly evident, however, that *Phytophthora* species are abundant in streams in healthy forests and widespread in forest soils causing cryptic diseases, in addition to their more traditional roles as aggressive pathogens. While their ecology in non-agricultural ecosystems remains poorly understood, we now know that a numerous and diverse, nutritionally complex community of *Phytophthora* species is present in a variety of associations with forests and forest trees.

We compiled existing records from all available sources of reliably identified *Phytophthora* species from forests and forest trees in Oregon, United States. The results are summarized by host, habitat, and *Phytophthora* species in table 1. Details of specifically documented isolates, including locations, available cultures, and Genbank acquisitions (table 2), as well as citations, are included in the interactive paper available at the website ForestPhytophthoras.org. We have included isolations from soil and streams in forests that are often not associated with any specific disease symptoms. Our goal is to inventory forest *Phytophthora* species, not forest diseases. On the other hand, we have included records from forest trees growing outside the forest, as in Christmas tree plantations or in the urban landscape, for example. The result is, we hope, a more accurate representation of the ecological amplitude of *Phytophthora* and a more complete record of the sources from which they may be spread.

We have attempted to compile all reliable records for this report from all sources. Most records are from three large programs or projects: the Oregon State University Plant Disease Clinic database; the sudden oak death diagnostic program; and an ongoing survey of the *Phytophthora* species associated with declining alder trees along streams in western Oregon. In addition, there are many reports from systematic surveys of *Phytophthora* species in forest tree nurseries and Christmas tree plantations. All records are based on isolations in culture, and identifications of all problematic species were confirmed with molecular sequencing methods. Older records of species that lack distinctive morphology are not included unless they have been confirmed by recent sequencing.

Thirty-two *Phytophthora* species, including described but not formally named taxa, have been identified associated with 25 host species from Oregon forests or forest trees. This total includes 17 species recovered from streams and 18 from forest soils, generally in the absence of noticeable disease on associated vegetation (table 3). The sampling that produced these lists is not systematic, however, and is very uneven. Only in tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh) forests of Curry County have the full range of habitats been sampled. Two large studies have focused on forest stream sampling, so the list from that habitat is perhaps most complete, but this work still covers only a small portion of the state. In contrast, there are relatively few records of *Phytophthora* associated with root rot or bole cankers of trees in the forest apart from the invasive *P. ramorum* and *P. lateralis*. This reflects the relative health of Oregon forests despite the potential susceptibility of the trees evident from nurseries and Christmas tree plantations.

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**Table 1—Sample summaries sorted by host (A), habitat (B) or *Phytophthora* species (C)**

**(A) Host**

<b>Host</b>	<b><i>Phytophthora</i> species</b>	<b>Habitat</b>	<b>Plant part</b>
<i>Alnus rubra</i>	<i>alni</i> subsp. <i>uniformis</i> , <i>gonapodyides</i> , <i>gregata</i> , <i>pseudosyringae</i> , <i>siskiyouensis</i> , taxon Oaksoil, taxon <i>Pgchlamydo</i> , taxon Salixsoil, <i>gallica</i> , <i>siskiyouensis</i>	Forest	Bole, root
<i>Notholithocarpus densiflorus</i>	<i>cactorum</i> , <i>cambivora</i> , <i>cinnamomi</i> , <i>gonapodyides</i> , <i>nemorosa</i> , <i>pseudosyringae</i> , <i>psychrophila</i> , <i>ramorum</i> , <i>siskiyouensis</i> , taxon <i>Pluvialis</i> , taxon <i>Pgchlamydo</i>	Forest	Bole, leaf/twig
<i>Umbellularia californica</i>	<i>nemorosa</i> , <i>ramorum</i> , <i>siskiyouensis</i>	Forest	leaf/twig

**(B) Habitat**

<b>Habitat</b>	<b><i>Phytophthora</i> species</b>	<b>Host</b>
Christmas tree plantation	<i>cactorum</i>	<i>Abies procera</i>
	<i>cambivora</i>	<i>Abies procera</i>
	<i>cinnamomi</i>	<i>Abies procera</i>
	<i>megasperma</i>	<i>Abies procera</i>
	<i>pseudotsugae</i>	<i>Pseudotsuga menziesii</i>
	taxon <i>Pgchlamydo</i>	<i>Abies procera</i>
Landscape	<i>ilicis</i>	<i>Ilex aquifolium</i>
	<i>lateralis</i>	<i>Chamaecyparis lawsoniana</i> , <i>Thuja occidentalis</i>

**(C) Species**

<b><i>Phytophthora</i> species</b>	<b>Hosts</b>	<b>Habitats</b>	<b>Plant parts</b>	<b>Counties</b>
<i>alni</i> subsp. <i>uniformis</i>	<i>Alnus rubra</i>	Forest	Root	1
<i>cambivora</i>	<i>Abies procera</i> , <i>Alnus</i> sp., <i>Chrysolepis chrysophylla</i> , <i>Fagus grandifolia</i> , <i>Notholithocarpus densiflorus</i>	Christmas tree plantation, forest, forest soil, forest stream, urban	Bole	9
<i>lateralis</i>	<i>Chamaecyparis lawsoniana</i> , <i>Taxus brevifolia</i> , <i>Thuja occidentalis</i>	Forest, forest research nursery, forest tree nursery, landscape	Root	12

**Table 2—Sample entries from the searchable index**

<i>Phytophthora</i> species	Notes	Isolate	Host	Habitat	Plant part	County	Year Isolated	Culture collection	GenBank	Citation
<i>alni</i> spp.		118-R-1J3	<i>Alnus rubra</i>	Forest	Root	Lane	2011			Sims
<i>uniformis</i>	A1	143	<i>Abies procera</i>	Christmas tree plantation	Root	Benton	1987			Saaverdra, Chastagner
<i>cambivora</i>	A1	150	<i>Abies procera</i>	Christmas tree plantation	Bole	Marion	1987			Saavedra
<i>cambivora</i>	A2	P592	<i>Abies procera</i>	Christmas tree plantation		Oregon		ATCC46719 MYA-4076 CB114087	HQ261516	Gallegly ME, Hong C. 2006; Robideau
<i>lateralis</i>		T4P3	<i>Chamaecyparis lawsoniana</i>	Forest	Root	Josephine	2000		HQ643176 AY369361	Martin and Tooley, Oh
<i>lateralis</i>		43-3	<i>Chamaecyparis lawsoniana</i>			Oregon	1974	ATCC28511		Trione, Phytopath. 64: 1531-1533, 1974

**Table 3—Thirty-two species of *Phytophthora* associated with forests in Oregon**

<i>Phytophthora</i> species	Forest plants <sup>a</sup>	Forest soil	Forest streams	Cultivated and urban <sup>b</sup>
<i>alni</i> subsp. <i>uniformis</i>	Green	Brown		Grey
<i>cactorum</i>		Brown	Blue	Grey
<i>cambivora</i>	Green		Blue	
<i>cinnamomi</i>	Green			Grey
<i>cryptogea</i>		Brown		Grey
<i>europaea</i>			Blue	
<i>gallica</i>	Green	Brown	Blue	
<i>gonapodyides</i>	Green	Brown	Blue	Grey
<i>gregata</i>	Green			
<i>hydropathica</i>	Green	Brown	Blue	
<i>ilicis</i>				Grey
<i>lateralis</i>	Green			Grey
<i>megasperma</i>			Blue	Grey
<i>multivora</i>		Brown		
<i>nemorosa</i>	Green	Brown	Blue	Grey
<i>nicotianae</i>			Blue	
<i>pini</i>			Blue	Grey
<i>plurivora</i>		Brown		
<i>pseudosyringae</i>	Green	Brown	Blue	
<i>pseudotsugae</i>		Brown		Grey
<i>psychrophila</i>	Green			
<i>ramorum</i>	Green	Brown	Blue	
<i>riparia</i>			Blue	
<i>sansomeana</i>				Grey
<i>siskiyouensis</i>	Green	Brown	Blue	
<i>syringae</i>		Brown	Blue	
taxon <i>Ceanothus</i>				Grey
taxon <i>Morella</i>	Green			
taxon <i>Oaksoil</i>	Green	Brown	Blue	
taxon <i>Pgchlamydo</i>				Grey
taxon <i>Pluvialis</i>				Grey
taxon <i>Salixsoil</i>	Green	Brown	Blue	

<sup>a</sup> Includes canopy drip from baited raintraps.

<sup>b</sup> Includes Christmas tree plantations, seed orchards, landscape plantings, forest tree and native plant restoration nurseries, and urban forests.