

SUDDEN OAK DEATH

Pathogen:

Phytophthora ramorum, a fungus-like red alga, was first identified in 2000 as the cause of widespread death of oaks and tanoaks in the western United States. Sporangia (top) and chlamydospores (bottom) are the most frequent propagules.



1 LEAF INFECTION

P. ramorum reproduces on the leaf surfaces of numerous plant species, causing leaf spot, wilt, or trunk girdling, but not necessarily plant death. These **foliar host** plants serve as reservoirs of the pathogen, and oak mortality is highest in areas where foliar host species are also present.

Foliar Hosts:

- (a) California rhododendron (*Rhododendron macrophyllum*)
- (b) Douglas fir (*Pseudotsuga menziesii*)
- (c) Madrone (*Arbutus menziesii*)
- (d) California bay laurel (*Umbellularia californica*)
- (e) Big-leaf maple (*Acer macrophyllum*)

More than 30 foliar hosts have been discovered.

2 PATHOGEN DISPERSAL

Wind-blown rain is the primary natural means of dispersal, but humans spread *P. ramorum* by moving infected plant material (especially nursery stock) and tracking propagule-laden mud in shoes.

Bark Canker Hosts:

- (f) Black oak (*Quercus kelloggii*)
- (g) Canyon oak (*Quercus chrysolepis*)
- (h) Tanoak (*Lithocarpus densiflorus*)
- (i) Coast live oak (*Quercus agrifolia*)

not shown:

Shreve oak (*Quercus parvula* var. *shrevei*)

3 BARK CANKER FORMATION

Once the pathogen spreads to a **bark canker host** species, cankers form on the base of the trunk, bleeding a dark-red, viscous sap. As the cankers expand, they cause girdling and restriction of essential physiological functions.

4 TREE DEATH

As infection progresses, the leaves of the tree turn brown and die. Weakened infected trees often fall prey to bark beetles and fungi that decay sapwood. In some areas dead oaks are so numerous that fire risk threatens the entire remaining forest ecosystem.

