A GUIDE FOR HOMEOWNERS • SMALL WOODLAND OWNERS RESOURCE MANAGERS • CONSERVATION GROUPS

SUDDEN OAK DEATH

Prevention, Recognition, Restoration

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Figure 1: Sudden Oak Death causes mortality of tanoak in Curry County, Oregon.

What is Sudden Oak Death?

Sudden Oak Death (SOD) is a disease caused by the water mold *Phytophthora ramorum*, an internationally quarantined plant pathogen that is killing tanoaks and infecting a wide array of other native plants in Oregon's southern Curry County (Figure 1). *Phytophthora ramorum*, which also causes Ramorum leaf blight and shoot dieback, is a serious threat to Oregon's forest and nursery industries.

This guide is for homeowners, small woodland owners, resource managers, conservation groups, and others interested in SOD and related diseases. It covers disease recognition, prevention, and management and planting strategies in SOD risk areas (Figure 3, page 3).

Phytophthora ramorum is a nonnative plant pathogen that causes these plant diseases:

• **Sudden Oak Death**

• **Ramorum leaf blight and shoot dieback**

Which species are affected?

In Oregon, the primary host for *Phytophthora ramorum* is tanoak (*Notholithocarpus densiflorus*), which is not a true oak (true oaks are those in the genus *Quercus*). Oregon true oaks susceptible to *Phytophthora ramorum* are California black oak (*Quercus keloggii*) and canyon live oak (*Quercus chrysolepis*). California black oak and canyon live oak infested with *Phytophthora ramorum* can develop cankers and die. The canker symptoms are similar to that in tanoak, with reddish
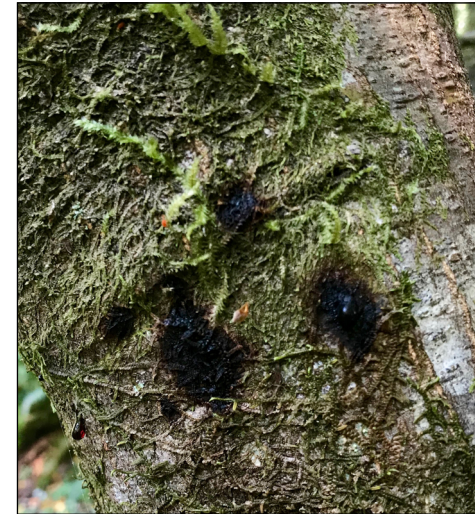

Photo: Christine Buhl, Oregon Department of Forestry

Figure 2. A bleeding trunk is a sign of infection on tanoak, *Notholithocarpus densiflorus*.

discoloration below the bark and bleeding sap on the surface of the bark (Figure 2). Oregon white oak (*Quercus garryana*) has not been found to be susceptible to *Phytophthora ramorum*.

California black oak and canyon live oak are considered bole hosts (trees in which *Phytophthora ramorum* causes cankers on the trunk) and are not known to spread the disease through foliar sporulation (where foliage becomes infested and spreads the pathogen to other hosts through leaf splash, wind, and rain). California black oak and canyon live oak are widely distributed in southwestern Oregon (from Lane County south and west of the Cascades), particularly in warmer, drier locations. To date, there have been no *Phytophthora ramorum* infestations of these two species in Oregon.

Douglas-fir, grand fir, coast redwood, Pacific madrone, Pacific rhododendron, evergreen huckleberry, and many other tree and shrub species common in Oregon and Washington forests are also susceptible to *Phytophthora ramorum*.

Map: Sarah Navarro, Oregon Department of Forestry
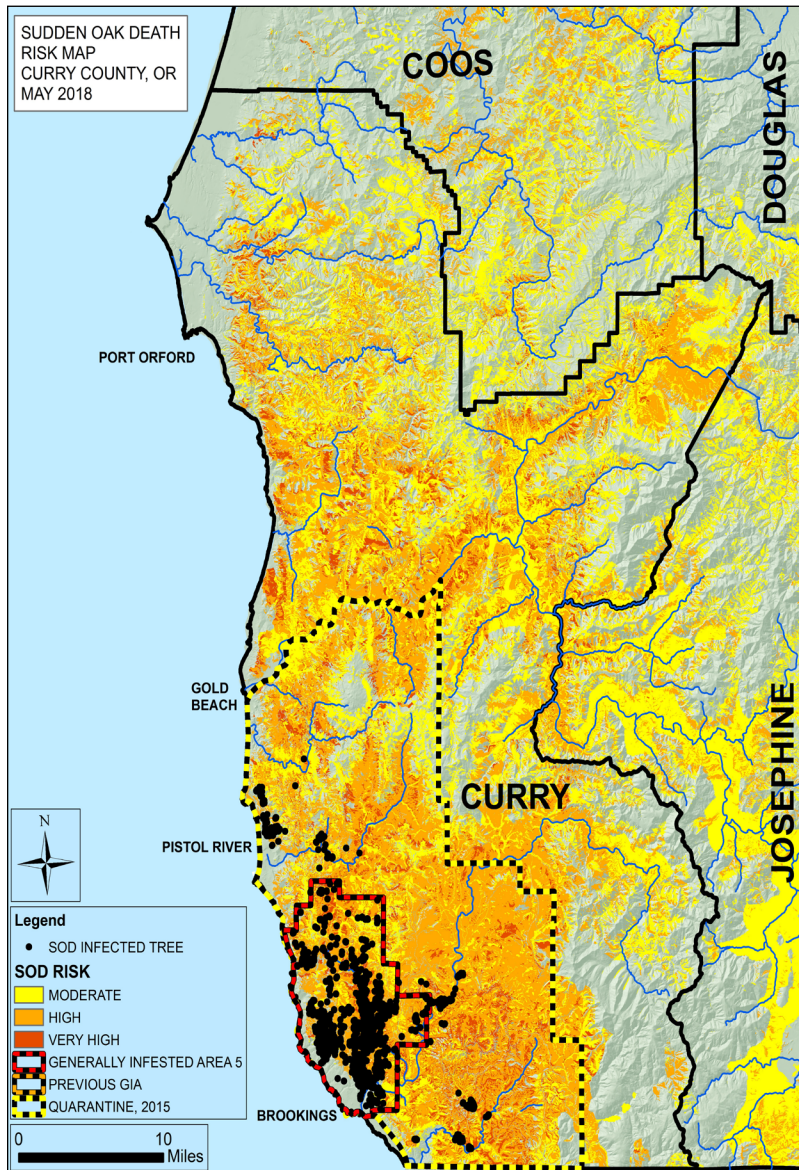
Figure 3. Map of Sudden Oak Death risk areas. Risk of spread is highest in areas with moderate temperatures, lots of moisture, and susceptible hosts. Tanoak is the primary host in Oregon. Data from *Predicting potential and actual distribution of Sudden Oak Death in Oregon: Prioritizing landscape contexts for early detection and eradication of disease outbreaks*, Vaclavik, Hansen, Ohmann, Meentemeyer. Forest Ecology and Management 260 (2010) 2026-1035.
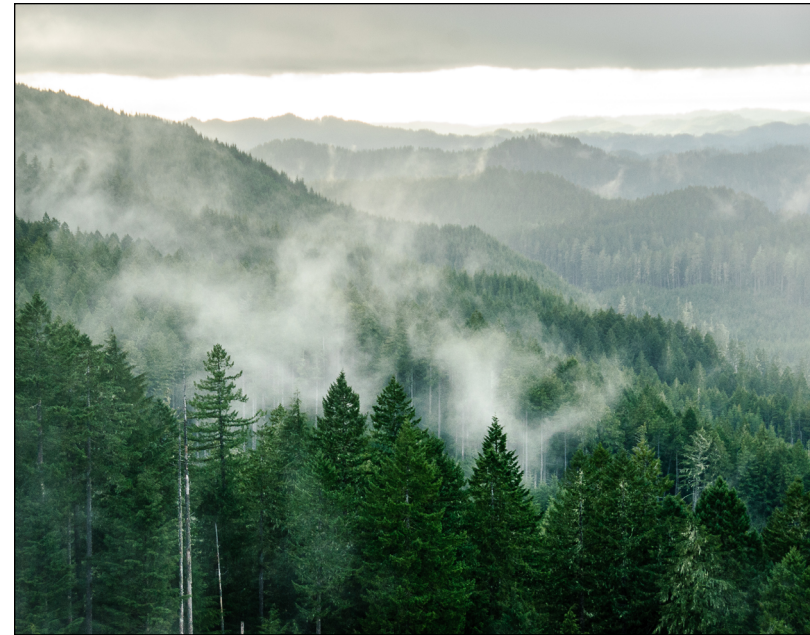

Photo: Loren Kerns/CC BY-NC-SA 2.0

Figure 4. Rain and wind move *Phytophthora ramorum* spores.

How does *Phytophthora ramorum* spread?

Sudden Oak Death was discovered in Oregon in 2001; it was first described in California in the mid-1990s and has spread to 15 coastal counties in California. *Phytophthora ramorum*, the pathogen that causes SOD, thrives in Oregon's cool, wet coastal climate (Figure 4). The pathogen survives in infested plant material, litter, soil, and water.

Phytophthora ramorum can spread in several ways:

- Rain and fog wash spores from treetops onto tree trunks, shrubs, and other vegetation near the forest floor.

- Wind and rain carry spores from treetop to treetop across landscapes.

- People can inadvertently transport spores by moving infected plants, infected plant parts, or infested soil.

The exact origin of *Phytophthora ramorum* is unknown. Two strains of *Phytophthora ramorum* are present in Oregon's forests, the North American strain (NA1) discovered in 2001 and the European strain (EU1) discovered in 2015.

How can I prevent the spread of SOD?

First, find your location in relation to the *Phytophthora ramorum* quarantine area boundary (Figure 3, page 3, and Figure 7, page 6).

Are you within the black-and-yellow dashed boundary that extends from the Rogue River to the California border? This is the area subject to quarantine regulations. In Oregon, the spread of SOD on state, private, and federal lands is managed by the designation of a *Phytophthora ramorum* quarantine area under the authority of the Oregon Department of Agriculture ORS 603-052-1230.

Are you near known infested trees? These are represented by black dots (Figure 3, page 3). Infested trees are concentrated in an area called the Generally Infested Area (GIA), where the disease is too widespread to control. The GIA is delineated by a red-and-black dashed boundary. Infested trees outside of the GIA are prioritized for treatment as described on page 8.

Are you located outside of the quarantine area? Landowners located outside of the quarantine area will not have disease present but should be concerned about SOD spreading past the quarantine area boundaries. Thus, disease recognition and prevention measures are paramount. For those located in drier inland areas of southwest Oregon, see "Which species are affected?" (page 2) to help differentiate the risk of spread in areas dominated by tanoak (the primary *Phytophthora ramorum* host in Oregon) versus areas of true oaks. The greatest risk of spread in dry inland areas is movement of infested plants or soils by humans, rather than the tanoak sporulation seen in the moist coastal area of southern Curry County.

Photo: Alan Kanaskie

Figure 5. Signs posted at quarantine areas warn against spreading contagion. Refer to OAR 603-052-1230 for complete quarantine regulations. Texts of these regulations (ORS 603-052-1230 and 7 CFR 301.92) are on the Oregon Department of Agriculture and the U.S. Department of Agriculture websites (see "Additional resources," page 12).

If you are within the quarantine area:

🚫 DO NOT collect or remove host plants or host plant parts from the forest. For a complete list of hosts and plants associated with *Phytophthora ramorum* see: https://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/usdaprlist.pdf

🚫 DO NOT collect or remove soil.

☑ Stay on established trails and respect any trail closures.

Before you leave infested areas:

☑ Clean and disinfect equipment (e.g., saws, shovels, pruning equipment) you have used in infested areas.

☑ Clean soil off shoes, mountain bikes, horses' hooves, and pets' paws.

☑ Use a 10 percent bleach solution or disinfectant (such as Lysol) for cleaning equipment and shoes (Figure 6).

Photo: Shawna Horner, © Oregon State University

Figure 6. Clean and disinfect equipment with 10% bleach solution.

If you travel or work in any of the 15 quarantined counties in coastal California:

☑ Follow the same rules outlined above for quarantine areas in Oregon.

☑ Become familiar with the most recent regulations related to Sudden Oak Death (see "Additional resources," page 12).

If you are planning a logging operation:

☑ Refer to Establishing Pest-Free Production Sites within the *Phytophthora ramorum* Quarantine Area in Curry County: A Guide for Landowners Harvesting Tanoak. http://www.oregon.gov/ODF/Documents/ForestBenefits/SOD_PFPS_2016.pdf

Quarantine regulations prohibit the harvest of host material (tanoak) from known infested areas within the quarantine area. If your harvest unit falls within the quarantine area, you may request a Pest-free Production Site (PFPS) be established so you can safely harvest tanoak. The Oregon Department of Forestry's Forest Health Unit is available to help guide you through this process.

If you are a nursery or Christmas tree grower in Oregon:

☑ Refer to the Oregon Department of Agriculture website: https://oda.direct/SuddenOakDeath

What are the symptoms of SOD?

Common symptoms of infection by *Phytophthora ramorum,* the pathogen that causes SOD in Oregon, are listed in Table 1. Other *Phytophthora* species and fungi can cause similar symptoms on tanoaks and other host species, which is why laboratory confirmation is required.

Photo: Alan Kanaskie

Figure 8. A bleeding trunk of an infected tanoak.

Photo: Alan Kanaskie

Figure 9. Inside the bark, dark cankers indicate areas killed by Sudden Oak Death.

Photo: Alan Kanaskie

Figure 10. The tree eventually is girdled and dies. It may look as if the tree dies suddenly, but it has been infected between 1 and 2 years.

Photo: Alan Kanaskie

Figure 13. Rhododendron

Photo: Alan Kanaskie

Figure 14. Evergreen huckleberry

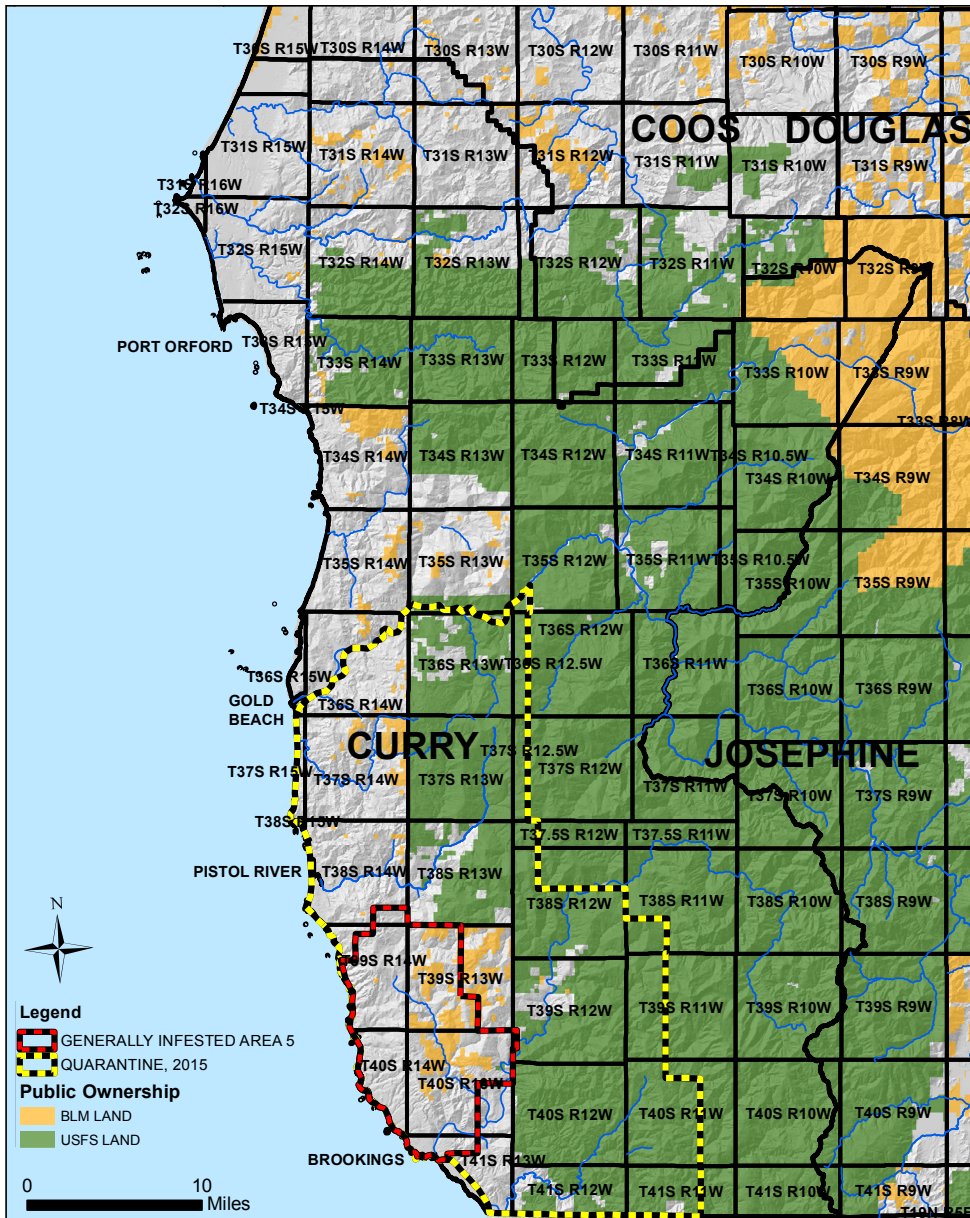Photo: Norma Kline, © Oregon State University

Figure 15. Salal

Photo: Norma Kline, © Oregon State University

Figure 16. Snowbrush

Table 1. Symptoms of *Phytophthora ramorum* infection in selected host species

Hosts	Symptoms	Discussion
Tanoak is the primary host in southern Oregon.		
Tanoak *Notholithocarpus densiflorus*	Bleeding	Bleeding sap may appear on the surface of intact bark in relation to an underlying canker (Figure 8).
	Stem canker	Red-brown to black discoloration inside the bark (Figure 9).
	Lesions	Bark may show signs of splitting at canker site.
	Dead tree	Leaves often brown quickly over a period of 2 to 4 weeks (Figure 10).
	Foliage dieback	Gradual leaf loss may occur.
Other host species show symptoms of leaf spots and twig dieback, but typically are not killed.		
Douglas-fir *Pseudotsuga menziesii*	Shoot dieback	Shoots droop; may look like frost damage (Figure 11).
Grand fir *Abies grandis*		
Coastal redwood *Sequoia sempervirens*		

Photo: Alan Kanaskie

Figure 11. Douglas-fir

Hosts	Symptoms	Discussion
Oregon-myrtle *Umbellularia californica*	Leaf blight	Darkened petioles and midribs; leaf spots on edges or leaf tips; leaf spots with margins (Figures 12–16).
Rhododendron *Rhododendron macrophyllum*		Shoot blight may also occur; dead shoots associated with dead leaves and petioles.
Evergreen huckleberry *Vaccinium ovatum*		
Salal *Gaultheria shallon*		
Snowbrush *Ceanothus velutinus*		
Bigleaf maple *Acer macrophyllum*		

Photo: Norma Kline, © Oregon State University

Figure 12. Oregon-myrtle

Map: Sarah Navarro, Oregon Department of Forestry

Figure 7. Map of the Quarantine Area and Generally Infested Area. Note: These boundaries are subject to revision. See "Additional resources" (page 12) for quarantine updates.

How do I report new SOD locations?

Phytophthora ramorum can only be accurately identified by a USDA-certified laboratory using approved culture and molecular techniques. If you see host plants that have the symptoms described in Table 1 (page 5) and are located outside of known areas of an SOD infestation, take these three steps:

Photo: Alan Kanaskie

Figure 17. Using GPS to document locations of infested plants.

1. Document the location of the diseased plant; obtain latitude and longitude with GPS, smartphone, or a computer maps program (Figure 17).
2. Take a clear, closeup digital photo of the plant part showing symptoms, a photo of the entire plant, and a photo showing the general setting.
3. Contact the following resources for further instruction.

If you are located outside of known infested areas within Curry County:

- Oregon Department of Forestry, 415 Redwood St., Brookings, OR 97416. 541-469-5040.

If you are located outside of Curry County:

- Oregon Department of Forestry, Forest Health Unit, 2600 State St, Bldg D, Salem OR 97310. 503-945-7200. http://www.oregon.gov/ODF/ForestBenefits/Pages/ForestHealth.aspx
- Local Oregon State University Extension office: http://extension.oregonstate.edu/find-us

If you want to know what is killing your garden plant:

- Contact your local Oregon State University Extension Office: http://extension.oregonstate.edu/find-us
- Oregon State University Plant Clinic, 1089 Cordley Hall, Corvallis, OR 97331-2903. 541-737-3472. http://plant-clinic.bpp.oregonstate.edu

If you are an Oregon nursery owner/worker or a Christmas tree grower:

- Oregon Department of Agriculture's Plant Health Program, 635 Capitol St NE, Salem, OR 97301. 503-986-4570. https://oda.direct/SuddenOakDeath

Figure 18. Rapid tests can help rule out infection by the *Phytophtora* genus. See "Additional resources" (page 12) for more information.

Photo: Norma Kline, © Oregon State University

Additional resource for Sudden Oak Death reporting:

• Oregon Department of Agriculture's Plant Health Program, 635 Capitol St NE, Salem, OR 97301. 503-986-4570. https://oda.direct/SuddenOakDeath

Note: You can buy rapid tests to determine infection by the Phytophthora genus (Figure 18). See "Additional resources" (page 12) for more information.

What are my SOD management options?

Sudden Oak Death affects homeowners, small woodland owners, resource managers, and conservation groups. Management options depend on your goals and location.

Within the quarantine area, options vary depending on whether you are located in the Generally Infested Area, a designated treatment area (identified by Oregon's interagency Sudden Oak Death program), or an infested area not designated for treatment.

Landowners located outside of the quarantine area will not have disease present but should be concerned about SOD spreading past the quarantine area boundaries; therefore, disease recognition and prevention measures are paramount.

Some treatments are best left to professionals due to safety concerns and the skills required; other treatments need to be approved by local regulatory agencies. Refer to the treatment checklist in Table 2 (page 8) prior to starting your project.

Management options inside the quarantine area

☑ **Well-established treatments for SOD**

◈ **Treatment options that may be used to promote general stand health but have not been observed to definitively slow the spread of SOD**

Refer to Table 4 (page 11) for discussion on the effectiveness of SOD management strategies.

Inside Generally Infested Area (GIA)

☑ **Cut dead tanoaks for safety and fuel reduction**. Consult quarantine guidelines prior to moving logs or slash (woody debris). Logs can be used for firewood within the GIA. Dispose of slash by chipping or piling and burning. Consult with your local fire agency or forestry office for information on current fire restrictions, permit requirements, and safe burning guidelines. See Table 2 (page 8) for a checklist of treatment options.

☑ **Control tanoak sprouts**. Tanoak vigorously sprouts from the stump. These sprouts will be susceptible to re-infection and will continue to spread disease locally. You can treat individual tanoak stems manually or by using herbicide treatments. For proper application method and chemical selection, see the current edition of the *Pacific Northwest Weed Management Handbook* (https://pnwhandbooks.org/weed). Always read and follow label directions.

☑ **Consider protecting surviving tanoak** in areas of mortality, as these trees might be resistant to the disease. Additionally, research from California has shown that phosphonate (also called phosphite) treatments may prolong tanoak survival. Phosphonate is applied either through injection or topically on the bark. Follow-up, annual treatments are necessary to provide continued protection. Cost is dependent on application method and the size of the tree. Refer to phosphonate treatment section in Table 4 (page 11) and "Additional resources" (page 12).

☑ **Replant**. See "What trees should I plant?" (page 8). Consider planting species not susceptible to SOD (Table 3, page 10).

☑ **Report**. No need to report SOD symptoms within the GIA.

◈ **Thin tanoak (as a management trial)**. Reduce density of noninfected tanoak with the objective of reducing spread from treetop to treetop. Mature tanoaks are sensitive to sudden exposure to sunlight. Aggressive thinning can cause the crowns to weaken and decline. Instead, reduce tree density in small steps (for example, remove 10% to 20% of stems in 3-to-5-year intervals). This treatment is still untested for control of SOD.

Inside designated treatment areas

- ☑ **Cooperate with** Oregon's Interagency Sudden Oak Death Program eradication treatments in high-priority infested areas.

- ☑ **Observe** the general treatment area and surroundings; report additional dying tanoaks to Oregon Department of Forestry (ODF).

- ☑ **Replant**. ODF will work with landowners to determine planting options.

Inside infested areas not prioritized for treatment

- ☑ **Cut hazard trees** for safety, fuels reduction, and to control sprouts.

- ☑ **Treat** infested tanoak areas according to the latest ODF Forest Health Program treatment guidelines for SOD to slow the spread of the disease.

- ☑ **Replant.** See "What trees should I plant?" Consider planting species not susceptible to SOD (Table 3, page 10).

- ☑ **Report** new locations of dead and dying tanoak and suspicious symptoms.

- ☑ **Thin** tanoak (as a management trial).

Management options outside of the quarantine area

- ☑ **Report** dead and dying tanoak and suspicious symptoms on hosts.

- ☑ **Preserve tanoak ecosystems.** Tanoak acorns are a food source for many animals; groves provide thermal cover, and refuge and nesting habitat for wildlife. Tanoak is also important to general watershed function and has important cultural values to Native American tribes.

- ☑ **Plant** trees and shrubs that are consistent with management objectives and risk tolerance. Consider planting a diverse species composition.

- ◆ **Consult** the ODF forest health program or an OSU Extension forester for harvest options to control the spread of SOD. Extensive harvesting of healthy tanoak outside the quarantine area (infested areas) to control the spread of SOD may not be practical or desirable when weighed against the ecosystem value of leaving it in place. Consider options carefully, depending on location, objectives, and current treatment protocol.

- ◆ **Thin** tanoak as a management trial.

- ◆ **Treat with phosphonate (phosphite).** Tanoak in newly infested areas may need to be cut whether or not treated with phosphonate. Refer to phosphonate treatment section in Table 4 (page 11) and "Additional resources" (page 12). When choosing to treat with phosphonate, consider risk of disease infestation and expense.

Table 2. Treatment checklist

- ☐ **Tree felling:** Consult local tree ordinances before cutting trees. Use experienced tree service technicians, as infected trees might be decayed or there may be nearby powerlines, roads, or structures.

- ☐ **Moving logs or vegetative debris:** Consult quarantine guidelines prior to work.

- ☐ **Burning:** Contact your local fire agency or forestry office for information on current fire restrictions, permit requirements, and safe burning guidelines.

- ☐ **Herbicide use:** Use herbicides safely!
  - Wear protective clothing and safety equipment as recommended on the label. Bathe or shower after each use.
  - Read the pesticide label—even if you have used the pesticide before. Follow the instructions on the label (and any other directions you have).
  - Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use. Use herbicides responsibly.

What trees should I plant?

Your planting strategy will depend on your location, management goals, and risk tolerance. It is important to recognize that while a number of native plant species are listed as host species on the USDA APHIS regulated host list (see "Additional resources," page 12), not all hosts support the spread of the SOD pathogen through sporulation or die from the disease. For example, Douglas-fir is susceptible to SOD while growing under tanoak, but it is unlikely that the disease will spread through a Douglas-fir plantation with no tanoak in the overstory.

In designated treatment areas, ODF will provide guidance regarding planting options. If you are concerned with mortality and infection of new plantings in the quarantine area, consider planting species from Table 3 (page 10) or selected native species not susceptible to SOD. If you want to help limit the spread of SOD in the quarantine area, avoid planting species that spread the disease through sporulation (listed in Table 5, page 12).

Inside the quarantine area, you can plant healthy nursery stock

species listed on the regulated host list. Follow the quarantine regulations regarding transportation of diseased plants, plant materials, and soil per OAR 603-052-1230. As discussed above, your planting decisions are based on your management goals and risk tolerance. Inside designated treatment areas, work with ODF to develop a planting strategy. In the quarantine area, consider planting species that do not support the spread of the disease through sporulation (listed in Table 3, page 10).

- **Select the right species for your site.** Make sure to plant species that are best suited for your growing conditions and management objectives. Choose plants grown from your seed zone area. (Note: The origin of the seed is more important than where the seedlings are grown.) Tolerance to different moisture levels, shade, and deer browsing are important considerations. Tolerance information for selected species is provided in Table 3 (page 10). Planting and maintaining a mixture of species provides forest health benefits and encourages wildlife diversity.

- **Choose the right planting stock.** Choose between container, bareroot, or seed depending on the size of the planting area and species. See *Selecting and Buying Quality Seedlings* (EC 1196), https://catalog.extension.oregonstate.edu/ec1196.

- **Select healthy nursery stock.** When planting container stock, make sure you start with a healthy specimen from the nursery. This will prevent introducing other pathogens to the landscape. At the nursery, assess a plant's overall health, checking for any symptoms or signs of disease. For restoration planting in wild landscapes, keep container plants in a holding area away from other landscape plants for 8 weeks. If plants are infected, this will allow time for disease symptom expression to occur before placing plants in the landscape. This is a prudent measure for landscape planting as well. Contact the ODA nursery program for help in locating a nearby nursery that uses best management practices that ensure clean nursery stock.

- **Plant your seedlings.** Successful planting requires preparing the site (creating a planting spot) by reducing woody debris and competing vegetation. After planting, continue to monitor (and control) competing vegetation to ensure that the new seedlings are not overtopped. Some species are preferred food by deer and elk (indicated in Table 3, page 10); protect these species from browsing animals. For more information refer to *Successful Reforestation: An Overview* (EC 1498), https://catalog.extension.oregonstate.edu/ec1498, and *Introduction to Conifer Release* (EC 1388), https://catalog.extension.oregonstate.edu/ec1388.
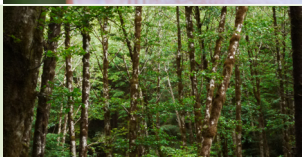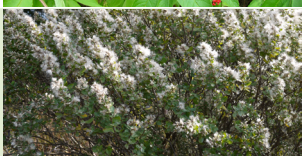

Photo: Alan Kanaskie

Figure 27. Sudden Oak Death specialist looking for symptoms on tanoak.

What is being done about SOD at the state level?

Oregon's Interagency Sudden Oak Death Program works to slow the spread of SOD in the state by surveying for the disease and treating high-risk, infested sites. Eradication treatments are the best approach to help slow the spread of the disease on high-risk sites (sites on the leading edge of the infestation). In these sites, SOD program contractors cut infected trees (primarily tanoak) and burn plant debris (when it is safe to do so) in a prescribed radius around infected trees, often 300 feet or more. Rapid treatment is necessary to help prevent the disease from spreading across the landscape.

Table 3. Selected native plant species not susceptible to SOD

Species		Drought tolerance	Tolerance to wet soil	Shade tolerance	Tolerance to browsing	Notes
Shore pine *Pinus contorta* var. *contorta*		High	High	Low	High	Tree found in boggy areas and sandy soils along the Pacific coast. Tolerant of salt spray. Incorrect pruning can cause Sequoia pitch moth infestations. (Photo: Bureau of Land Management, CC BY-NC-SA 2.0)
Port-Orford-cedar *Chamaecyparis lawsoniana*		Low	High	High	Medium	Severely affected by Port-Orford-cedar root rot. Only disease-resistant tree seedlings are recommended for planting. (Photo: John Rusk, CC BY 2.0)
Western redcedar *Thuja plicata*		Low	High	High	Low	Trees found in wet areas along streams and near springs. (Photo: Lynn Ketchum, © Oregon State University)
Red alder *Alnus rubra*		Low	High	Low	Low	Rapidly growing hardwood tree; does best along streams and on lower, moist slopes in deep, well-drained soils. Nitrogen fixer; it can improve soil quality. (Photo: Jon Souder, © Oregon State University)
Red elderberry *Sambucus racemosa*		Medium	High	High	High	Fast-growing deciduous large shrub or small tree. Often found in riparian areas and forest edges, elderberry prefers sun and part shade with moist soils. Dense rooting structure provides soil stabilization benefits. Produces berries in early summer. (Photo: brewbooks, CC BY-SA 2.0)
Coyote brush *Baccharis pilularis*		High	Low	Low	High	Moderately growing evergreen shrub adapted to dry sunny sites. Late blooming shrub is adapted to salt spray. Produces male and female flowers on different plants. Important plant for pollinators; the bloom period extends into fall and winter. Useful for erosion control. (Photo: Norma Kline, © Oregon State University)
Oceanspray *Holodiscus discolor*		Medium	Medium	High	Medium	Moderately fast-growing deciduous shrub tolerant to a wide array of soil types and moisture. Grows well in both sun and shade and is an important host for beneficial insects. Useful for riparian plantings and restoration planting on rocky or disturbed sites. (Photo: Mount Rainier National Park, CC BY-NC-SA 2.0)
Chinkapin *Chrysolepis chrysophylla*		High	Medium	Medium	Medium	Slow-growing evergreen shrub or small tree bearing spiny burrs (fruit). Chinkapin transplants with difficulty. Direct seeding is best. Although this species has been found to be susceptible to *Phytophthora ramorum* in California, it is not thought to be a high risk in Oregon. (Photo: Pat Breen, © Oregon State University)

What does the research say about effective SOD strategies?

Forest pathologists are focused on learning more about Sudden Oak Death to help develop control strategies. Effective strategies are those that are inexpensive and widely and safely applicable over the landscape. Table 4 describes what is currently known about the effectiveness of possible treatment strategies.

Table 4. Effectiveness of SOD management strategies

Treatments	Effectiveness	Discussion
Burning to eradicate SOD by cut/pile/burn of infested material	High, if detected early and all target species are removed within at least a 300-foot buffer	High cost
Controlled under-burning to kill the pathogen in forest floor	Not known; likely not effective due to foliage infestation in tanoak	Expense of burning preparation and risk of fire escape
Thinning to promote stand health	Not known; likely not effective due to foliage infestation in tanoak	No known relationship between plant health and disease susceptibility.
Harvesting healthy tanoak as a preventative measure	Not known	Needs to be weighed with the value of retaining tanoak for ecosystem values, and of losing genetic diversity and potential resistant trees
Manage for a diverse species composition	Not known; a general strategy to promote forest health	May provide insurance against losses from other disease and insects.
Phosphonate treatment (systemic fungicide, also referred to as phosphite)	Research trials have shown reductions in girdling at the bole, promoting survival.	Phosphonate is applied either through injection or topically on the bark. Follow-up, annual treatments are necessary to provide continued protection. Cost is dependent on application method and size of tree. Tanoak treated with phosphonate may still become infested in the upper branches, providing a breeding ground for further sporulation and spread. At this time, phosphonate is used primarily in an effort to keep important trees alive in infested areas.
Genetic resistance	No known genetic resistance of tanoak	Genetic resistance programs are long-term programs, starting with the identification of surviving trees. A Port-Orford-cedar root-rot resistance breeding program, initiated in 1997, has had promising initial results, and the disease-resistant seedlings from nursery trials have been planted in restoration sites. Ongoing monitoring will assess seedling survival over time.

Table 5. Native host plants that are known to spread Sudden Oak Death by sporulation

Tanoak	*Notholithocarpus densiflorus*
Azalea	*Rhododendron* sp.
Huckleberry	*Vaccinium* sp.
Madrone	*Arbutus menziesii*
Manzanita	*Arctostaphylos* sp.
Rhododendron	*Rhododendron* sp.
Salal	*Gaultheria shallon*

Note: Table 5 lists native species that are currently known to spread Sudden Oak Death in Oregon by supporting pathogen sporulation. For the full list of host plants regulated under OAR 603-052-1230 refer to the USDA APHIS list of regulated hosts in "Additional resources".

Additional resources

OSU Extension publications

Selecting and Buying Quality Seedlings (EC 1196), https://catalog.extension.oregonstate.edu/ec1196

Successful Reforestation: An Overview (EC 1498), https://catalog.extension.oregonstate.edu/ec1498

Introduction to Conifer Release (EC 1388), https://catalog.extension.oregonstate.edu/ec1388

Quarantine regulations

Map of Quarantine Area, oregon.gov/ODA/shared/Documents/Publications/NurseryChristmasTree/CurryCountySODquarantine.jpg

Oregon Administrative Rules, https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=158438

USDA Agricultural and Plant Health Inspection Service (APHIS), https://aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs

APHIS list of regulated hosts, https://aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/usdaprlist.pdf

Disease identification

Pacific Northwest Pest Management Handbooks, https://pnwhandbooks.org/plantdisease/host-disease/tanoak-notholithocarpus-densiflorus-sudden-oak-death

*Sudden Oak Death and Phytophthora ramorum: A Guide for Forest Managers, Christmas Tree Growers, and Forest Tree Nursery Operators in Oregon and Washington (*EM 8877), OSU Extension Service, https://catalog.extension.oregonstate.edu/em8877

Oregon Department of Forestry, oregon.gov/ODF/ForestBenefits/Pages/ForestHealth.aspx

California Oak Mortality Task Force, www.suddenoakdeath.org

Resources for Disease Management

Oregon Department of Agriculture, https://oda.direct/SuddenOakDeath

Pacific Northwest Pest Management Handbooks:

Diagnosis and Control of Phytophthora diseases, https://pnwhandbooks.org/plantdisease/pathogen-articles/common/oomycetes/diagnosis-control-phytophthora-diseases

Fungicidal Activity and Nutritional Value of Phosphorous Acid, https://pnwhandbooks.org/plantdisease/pesticide-articles/fungicidal-activity-nutritional-value-phosphorous-acid

Information on *Phytophthora* rapid tests, homeorchard.ucdavis.edu/8002.pdf