



County of Santa Cruz

0500 591

BOARD OF SUPERVISORS

701 OCEAN STREET, SUITE 500, SANTA CRUZ, CA 95060-4069

(831) 454-2200 FAX: (831) 454-3262 TDD: (831) 454-2123

JANET K. BEAUTZ
FIRST DISTRICT

ELLEN PIRIE
SECOND DISTRICT

MARDI WORMHOUDT
THIRD DISTRICT

TONY CAMPOS
FOURTH DISTRICT

JEFF ALMQUIST
FIFTH DISTRICT

AGENDA: 5/22/01

May 15, 2001

BOARD OF SUPERVISORS
County of Santa Cruz
701 Ocean Street
Santa Cruz, CA 95060

RE: SUDDEN OAK DEATH SYNDROME

Dear Members of the Board:

As you are aware, Sudden Oak Death Syndrome has ravaged oak trees in coastal counties over the past several years. The disease has also now been found in bay and madrone trees, huckleberry bushes, manzanita, and rhododendrons. This means the pathogen is more widespread than even pessimistic observers initially had feared.

The Board of Forestry has declared a seven-county Zone of Infestation, which includes Santa Cruz County. It is likely that a quarantine will be declared soon prohibiting the sale of host plants outside those zones.

We thought it would be informative to have the Board hear a short presentation about Sudden Oak Death Syndrome and steps being taken to combat the disease from Mr. Steve Tjosvold, the Environmental Horticulturist with the Santa Cruz County Agricultural Extension Office and a member of the California Oak Mortality Task Force.

The County Agricultural Commissioner has also recommended we take steps to post information regarding Sudden Oak Death at trail heads and to provide accurate information to the public.

BOARD OF SUPERVISORS


May 15, 2001

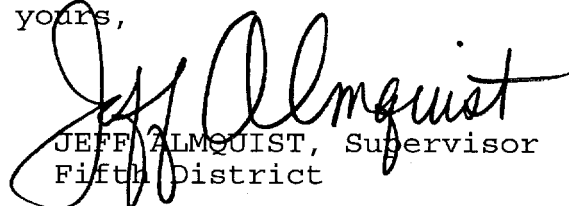
Page 2

Accordingly, we recommend that the Board of Supervisors take the following actions:

1. Accept and file the attached report regarding Sudden Oak Death Syndrome.
2. Invite Mr. Tjosvold to make a brief oral presentation on Sudden Oak Death Syndrome.
3. Make available, through the County Agricultural Commissioner's Office, current published information and website addresses on Sudden Oak Death.
4. Provide posters to the appropriate agencies and organizations which tell visitors what they can do to reduce the spread of the disease.

Very truly yours,


ELLEN PIRIE, Supervisor
Second District


JEFF ALMQUIST, Supervisor
Fifth District

EP/JA:lg
Attachment

cc: Dave Moeller, Agricultural Commissioner
Steve Tjosvold, Agricultural Extension

1048K2

Sudden Oak Death: Diagnosis and Management

By

Andrew J. Storer, Kim E. Keirnan, Nicole K. Palkovsky, Bruce W. Hagen,
 Garey W. Slaughter, N. Maggi Kelly and **Pavel Švihra**



The first step toward solving the Sudden Oak Death (SOD) problem is to become familiar with diagnosis and management. The knowledge base about this disease is evolving rapidly. Here are some facts we know:

- SOD is caused by a species of *Phytophthora* that was not previously known in California
- The pathogen attacks coast live oak, black oak, Shreve oak, tanbark oak, rhododendron and huckleberry. The host range is expected to increase
- The pathogen has been found in soil, rainwater, and downed wood
- No cure is currently available

Contents

Overview . . .	2
Sampling . . .	3
Disposal and Hygiene . . .	5
Look-alikes . . .	6
Monitoring . . .	9
Research . . .	11
Treatment . . .	11

SUDDEN OAK DEATH *Phytophthora*

Sudden Oak Death is caused by a pathogen in the genus *Phytophthora*. This pathogen was recently found for the first time in California, and is also known to cause **dieback** of rhododendrons in Europe. It currently has no species name, and for ease of reference we refer to it as the SOD *Phytophthora*. Sudden Oak Death is known to occur in seven of California's coastal counties: **Marin**, Monterey, **Napa**, San Mateo, Santa Clara, Santa **Cruz** and Sonoma. Work on determining the full distribution of the pathogen is underway. Sampling has occurred on reported oak mortality in Alameda, Butte, Colusa, Contra Costa, Del Norte, El **Dorado**, Fresno, Humboldt, Kern, Lake, Los Angeles, Mariposa, Mendocino, Placer, Sacramento, San Diego, San Luis Obispo, Santa Barbara, Shasta, Solano, and Yolo Counties. Sudden Oak Death has not been confirmed in any of these areas.

SPECIES AFFECTED:

The Sudden Oak Death *Phytophthora* is known to infect six species in two families. Four tree species in Fagaceae (beech family) are affected: coast live oak (*Quercus agrifolia*), black oak (*Quercus kelloggii*), Shreve oak (*Quercus parvula* var. *shrevei*) and **tanoak** (*Lithocarpus densiflorus*). In addition, two shrub species in Ericaceae (heath family) are affected: California or evergreen huckleberry (*Vaccinium ovatum*), and *Rhododendron* spp. Other species are being tested for susceptibility. The host list within these two families is expected to increase.

SIGNS AND SYMPTOMS:

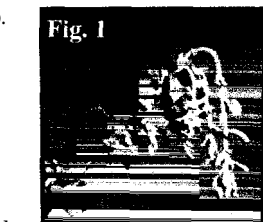
Tree species



Similar symptoms occur on all four tree species with one notable exception. Spontaneous drooping or wilting of new growth (**Fig. 1**) may occur throughout the crown on **tanoak** prior to the appearance of bleeding cankers. On true oaks (*Quercus*) bleeding is the first visible symptom (**Fig. 2**).

Infected stems develop bleeding cankers that produce a

reddish-brown to tar-black viscous seep. Cankers typically occur in the lower 10 ft of the stem and are restricted to above the soil line. Occasionally aerial cankers have been found up to 60 ft (tanoak). In advanced cases of the disease, bleeding may extend well up the main trunk and lateral branches. Removal of the outer bark, reveals a **zone of necrotic tissue delimited from healthy tissue by a dark, resinous line** (zone line, Fig. 3). Cankers are believed to cause mortality by eventually girdling trees. Controlled nursery studies indicate death in saplings may occur within a few weeks of inoculation with the pathogen. Time from infection to death in mature trees is still **unknown**.



Foliage changes occur in the advanced stages of decline. Color changes rapidly from healthy green to chlorotic yellow and finally brown. Leaves may cling to branches for up to one year **after** tree death.

Shrub species

Mortality does not occur on rhododendrons. Damage is restricted to leaf spotting and/or **dieback** similar to the many other *Phytophthora* spp. found on rhododendrons. Zone lines, dark lines separating healthy and necrotic tissue, are present in infected areas.

On huckleberry similar leaf spotting and **dieback** occur. In severe cases **dieback** may extend down the cane to the soil line resulting in mortality.

Proper diagnosis of the SOD *Phytophthora* in both trees and shrubs can only be accomplished through laboratory confirmation.

ASSOCIATED ORGANISMS

The western oak bark beetle (*Pseudopityophthorus pubipennis*), oak ambrosia beetle (*Monarthrum scutellare*) and minor oak ambrosia beetle (*M. dentiger*) are common associates of trees infected with the Sudden Oak Death *Phytophthora*. These beetles are known to attack weakened, diseased or severely injured trees. Ambrosia beetles are 2 to 4 mm long, penetrate deep into the **sapwood** where they create two to four galleries, and produce conspicuous piles of light tan

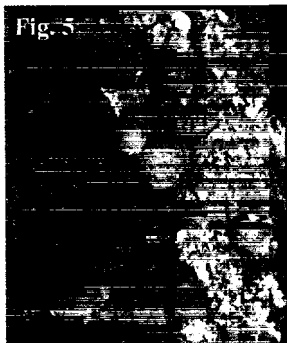


Fig. 5

colored **frass** (boring dust) on the bark surface (Fig. 4). The western oak bark beetles are ~2 mm long, produce reddish-brown frass piles (arrow),

and egg galleries score the wood while larvae tunnel and develop in the inner bark. Initial attack is common in bleeding areas on true oaks, but may occur anywhere on the main stem of oaks and **tanoaks**. Mass attack can occur on the entire main stem and extend to the lateral branches. The activity of these small beetles is believed to hasten tree death.

Hypoxylon thouarsianum is another common associate of oaks in the later stages of decline (Fig. 5). This **sapwood decayer** may occur on living trees, on oak and **tanoak** infected with the Sudden Oak Death *Phytophthora*, as well as trees killed by other causes. It is important to note that presence of bark beetles and *Hypoxylon* does not clearly indicate Sudden Oak Death. However, as frequent associates, they may serve as valuable



Fig. 4

identification tools.

Sampling for the Sudden Oak Death *Phytophthora*

To confirm that a symptomatic oak tree has the Sudden Oak Death *Phytophthora*, the pathogen has to be cultured on a special agar medium from a sample of the inner bark of the tree. Sampled bark pieces are placed in petri dishes containing pimarin-ampicillin-rifampicin-PCNJ3 agar (PARP), a selective media for *Phytophthora* species. Two protocols are presented here, the first for plating onto the PARP agar in the field prior to sending to the laboratory, and the second for sending samples to a laboratory for culturing.

Answers to questions about the availability of the PARP medium, and which laboratories are available to receive samples can be obtained from your local UC Cooperative Extension **office**.

Equipment needs:

General:	Axe or hatchet Cleaning agent (70% ethanol, Lysol or 10% household bleach) Lighter or matches Pens for labeling samples
For plating:	Scalpel or sharp knife Forceps PARP selective media in petri dishes Tape to seal petri dishes
For sending samples:	Paper bags



Fig. 6

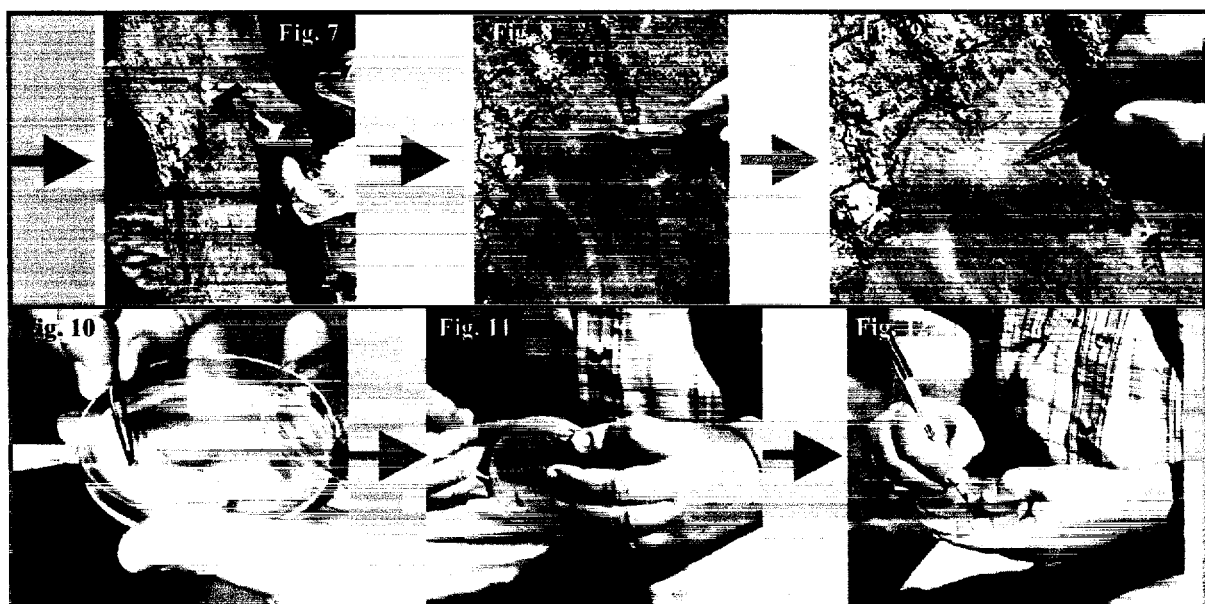
Before you get started:

- Clean all tools (hatchets, knives, forceps, etc.) with one of the cleaning agents listed above.
- Flame each tool to kill any microbes that may be present on them.

Hold the flame of a lighter so that it heats the edge of the hatchet blade, the knife and the forceps (Fig. 6). Take precautions against starting a fire by carrying out this work over an area where dead leaves and other duff have been removed.

For plating samples onto PARP medium in the field

1. Shave away the outer bark approximately 6" above or to the side of a seeping area (**Fig. 7**).
2. Shave away the bark in the area of the lesion until a canker margin (zone line) is evident.
3. Use the knife and forceps to excise small pieces (approx. ¼" x ¼") of the phloem including both healthy and necrotic bark tissue on both sides of the zone line (**Fig. 8 and 9**).
4. Place each phloem piece on the medium and push down until it is covered by the medium (**Fig. 10**).
5. When you have three to five pieces of phloem inserted in the medium, seal the plate with tape and label it, including the date, location and identifying information for the tree sampled (**Fig. 11 and 12**).
6. Plates should be incubated in the dark at 20-22°C and examined by a laboratory within 7 days.



7. Send plates to a laboratory for incubation and identification of the fungus. Note: identification of the SOD *Phytophthora* is carried out by pathologists, and may require DNA sequencing for **confirmation**.

For collecting samples to send to a lab

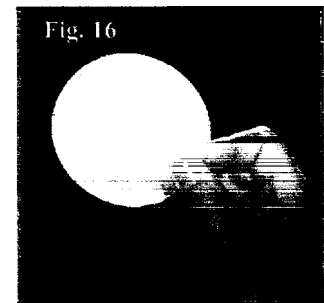
1. Ensure that transportation and laboratory facilities have been arranged such that samples will be processed and plated within 48 hours of collection. Shave away the outer bark approximately 6" above or to the side of a seeping area.
2. Shave away the bark in the area of the lesion until a canker margin (zone line) is evident.
3. Use the hatchet to remove a piece of phloem approx. 2" x 1" x 1" that includes the margin between healthy and diseased **tissue (Fig. 13)**.
4. Place the phloem piece in a paper bag. Label the bag with the date, location and identifying information for the tree sampled (**Fig. 14 and 15**).
5. Transport the samples to the laboratory facility for isolation and identification of the fungus.

The following points should be taken into consideration when interpreting results that come back to you from the lab:

- Approximately 60% of all samples **from** symptomatic trees test negative for the new *Phytophthora* and may require a re-sampling (i.e., false negatives).
- Other *Phytophthora* species often cause bleeding lesions and have identical zone lines in the bark.



- The new *Phytophthora* has been found almost exclusively in mixed oak forests, woodlands, or urban-forest interface type situations, mainly on shady hillsides and ridges, in relatively natural stands of mixed hardwoods or hardwoods and conifers,
- A few positive samples (**Fig. 16**) have been collected in urban situations where a residential backyard tree is a remnant of a previously natural stand (e.g., Miwok Park in **Marin Co.**).
- None of the samples in residential or other urban locations (generally single trees or planted rows along streets or engineered creeks) have been SOD-positive, although some have had *Phytophthora cinnamomi*, or other unidentified *Phytophthora* spp.



Disposal and Hygiene

In General:

Avoid movement of potentially infected material away from infested areas. This includes movement of host plants (from nurseries), plant material (wood, chips, acorns, leaves, etc.), and soil.

Tree Removal:

- The best time to remove SOD killed trees is during the hot summer months when the *Phytophthora* and beetles are least active.
- Leave felled trees on site if possible.
- Chip branches and scatter on site.
- Do not leave wood near roads where it may be taken out of infested areas and used as firewood.
- Infected wood may be used as firewood as long as it is used locally and not transported out of the infested area.
- Keep wood piles as far away from susceptible hosts as possible. Homeowners have two options for managing wood piles:
 - ♦ Covering wood with clear plastic in a sunny area for six months will prevent beetle emergence and promote **solarization** by trapping solar radiation that will weaken or kill the *Phytophthora*.
 - ♦ Leaving wood uncovered in a sunny area to promote drying will discourage the growth of the *Phytophthora* which is favored by cool moist conditions.
- Clean/disinfect all equipment used on infected trees before using on healthy trees or travelling to an uninfested area. Pruning, cutting and chipping tools can be cleaned with Lysol, 70% alcohol solution or 10% household bleach solution. Mud should be washed off of all vehicles and boots before leaving infested areas.

Wood disposal:

We are currently working on identifying sites where infected wood can be taken if it is not feasible to leave it where it was cut. Potential sites include green waste disposal operations. Until proven otherwise, all forms of infected woody material will be assumed to be capable of dispersing the fungus. Composting infected material is a very promising

means of disinfection, as typical composting temperatures are generally adequate to kill most fungal pathogens. Another possibility for disinfecting woody material is solarization, or the use of plastic covering to trap lethal amounts of solar radiation. Experimentation is needed before this treatment can be recommended.

Common Oak Pests That Can Cause SOD-Like Symptoms

Symptoms are the visual clues indicating changes in the normal growth and/or appearance of a tree in response to insects, pathogens, environmental factors and horticultural practices. Signs are evidence of the cause, e.g., the pest itself, or pest produced materials or structures left behind.

Sudden Oak Death (SOD), caused by a new species of *Phytophthora*, is characterized by a relatively rapid decline and bleeding (oozing or seeping) cankers on the lower trunk of affected coast live and black oaks and **tanoak** trees. Insects and other diseases can mimic these symptoms, making diagnosis difficult. Symptoms commonly seen in native oaks that might be mistaken for SOD are listed below. The most likely insect pests or disease pathogens causing these symptoms are included. These pests commonly occur on a wide range of oak species.

SYMPTOMS:

1. Tree died suddenly or appears to be declining, e.g. sparse foliage, premature leaf-drop, branch dieback, undersized and chlorotic leaves, bleeding etc.

Probable causes:

- OAK ROOT FUNGUS (*Armillaria mellea*) - often causes a general decline in oaks, characterized by sparse, off colored foliage. Healthy appearing trees may die suddenly after foliage wilts and fades. Resin, gum or watery liquid exudes from the lower stem. A common problem of landscape oaks in irrigated settings (**Fig. 17**).
- PHYTOPHTHORA ROOT DISEASE (*Phytophthora cinnamomi*) - is characterized by general decline, twig and branch dieback, small, yellow and sparse foliage, premature leaf-drop, and lesions on the lower trunk and root flare (**Fig. 18**). Typically with bleeding or oozing through bark cracks near root-flare, often appearing as black to rusty streaking. Wood and inner-bark appear discolored. Frequent irrigation, poor drainage and poor soil aeration favor this pest.



Fig. 17

- ROOT LOSS INJURY - caused by root pruning, excavation, soil compaction and/or trenching within the dripline.

2. Foliage partially or totally missing (defoliation)

Most likely pest causing this type of injury:

- CALIFORNIA OAK MOTH (*Phryganidia californica*) - a common defoliator of coast live oak. Larvae are black with longitudinal, yellow to olive stripes, and up to 1 1/4" long. Adults are silvery to tan moths with prominent wing veins. There are 2 or more generations per year, and the last generation larvae overwinter on the foliage. Deciduous oaks are seldom defoliated as the eggs are shed with the foliage.



Fig. 18

3. Leaves or portions thereof dead and brown, symptoms distributed fairly uniformly throughout tree or portions of the canopy, some leaves or portions appear unaffected

Common pests causing these symptoms:

- TWIG BLIGHT (*Cryptocline cinerescens*) - causes dieback of leaves and twigs of current year's growth, dead leaves are scattered throughout much of the mid-to lower canopy (**Fig. 19**). Trees under stress are most susceptible. This disease is more noticeable during wet years.
- OAK ANTHRACNOSE (*Apiognomonina quercina*) - causes irregular brown, dead areas or small spots on leaves,

entire canopy may be affected and fall prematurely (**Fig. 20**).

- **LIVE OAK GALL (Hymenoptera: Cynipidae)** - leaf tips and margins appear dead and brown. In one species, small, slightly oval galls with two horn-like projections, one at each end, can be found on the undersides of affected leaves along the leaf veins. A tiny pumpkin-shaped gall formed by another gall-wasp causes similar symptoms. Species within the black oak group are affected (**Fig. 21**).

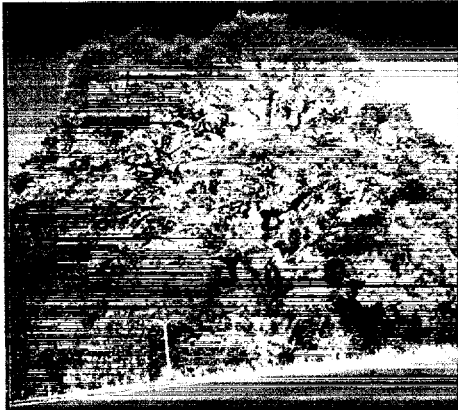


Fig. 19

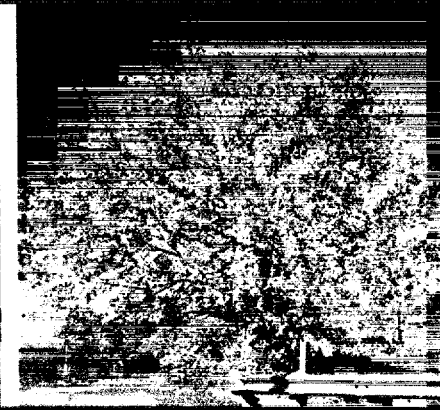


Fig. 20

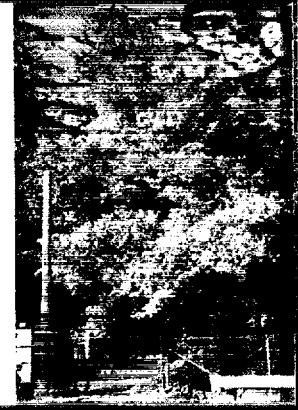


Fig. 21

4. Bark on lower trunk dead, cracked, missing, loosened, sunken or darkly stained by a thick exudate or fluid-like discharge. “Bleeding” may be described as wet and copious or as dark, thick droplets oozing through small bark fissures. In some cases, the exudate has dried, leaving behind a light to rusty colored residue. Lesions or cankers (dead, often sunken areas of the bark) may be elliptical, elongate, pyramidal or irregularly shaped. Some cankers show strong callusing along the margins.

Possible causes:

- **CANKER-ROT PATHOGENS** - these pathogens cause a white rot of heart and **sapwood**, leading to branch and trunk failure. Canker-rots are unique in that they move from the heartwood into the **sapwood** and cambium, causing branch and trunk cankers. Bleeding may occur as the pathogen kills the bark. Some produce elliptical, concentrically ringed target-like cankers at branch stubs. Other cankers are elongate with strong callusing along the margins. The pathogen enters through dead branch stubs and broken branches.
- **BACTERIAL WETWOOD**- is characterized by a copious, wet discharge (fermented sap) flowing from a narrow lesion or crack in the bark. The exudate, which is initially clear, gradually darkens and thickens or becomes slimy. Upon drying, the exudate leaves a conspicuous, whitish to brown crust-like residue on the bark below the lesion. Lesions typically dry and close with time (**Fig. 22**).
- **OAK ROOT FUNGUS** - may cause lesions and occasionally bleeding from the soil-line to several feet above. (see 5 below.)
- **PHYTOPHTHORA ROOT DISEASE** - is characterized by lesions on lower trunk and root-flare, typically with dark staining and oozing of a dark, tar-like exudate on lower trunk. Bleeding may also appear as nearly black to rusty colored streaking down the lower trunk.
- **BORERS** - boring injury caused by the carpenterworm (**Fig. 23**), Pacific flatheaded borer, western sycamore borer (**Fig. 24**) and oak bark beetle may cause bleeding on the bark (see 6 below.)

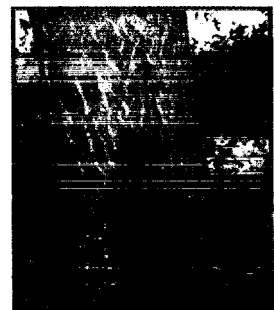


Fig. 22

5. Root--are with lesions - areas of dead, sunken, cracked, missing or loosened bark, usually accompanied by bleeding (seeping or oozing) through small, bark fissures. Vigorous callusing may be seen at lesion margins, sometimes with adventitious roots growing from the callus to the soil.

Most probable pests:

- OAK ROOT FUNGUS - distinctive thin, white fans of **fungal** material growing between bark and wood, smells like common edible mushrooms, bark nearby is often dead, loose or missing, light brown mushrooms may appear at the tree's base in winter, although **often** characterized by decline, canopy symptoms may be lacking.
- PHYTOPHTHORA ROOT DISEASE (CROWN ROT) - is characterized by general decline, twig **dieback**, small, yellow and sparse foliage, premature leaf-drop, and wounds on lower trunk and root flare, often with black to rusty colored bleeding or streaking on trunk.

Note: root diseases caused by *Armillaria* spp. (**oak root fungus**) and *Phytophthora* spp., are associated with frequent irrigation, poor drainage, restricted soil aeration and/or raised soil grade around tree.

6. Scattered holes in bark, coarse or powdery sawdust-like boring material (frass) in bark crevices and on ground, bark appears riddled in patches, wet/frothy spots or dark brown to black bleeding on bark



Fig. 23

Common pests causing this type of injury:

- CARPENTERWORM (*Prionoxystus robiniae*) - a wood-boring moth. Larvae are dirty-white and up to 2 1/2" long. They tunnel in inner-bark and wood. The bark is sometimes missing in patches or may appear roughened, and the underlying wood is riddled with tunnels (**Fig. 23**). Abundant boring dust expelled through 1/2" exit holes. Empty pupal cases may be found protruding from exit holes.
- OAK BARK BEETLES (*Pseudopityophthorus* spp.) - white, legless grubs under bark, 0.04 to 0.1" long, adults are dark brown and shiny. Extensive tunneling etches wood, leaving horizontal and vertical grooves in a grid-like pattern (**Fig. 25**). Often causes some bleeding or a foamy/frothy exudate. Look for reddish frass to help ID pest.
- OAK AMBROSIA BEETLES (*Monarthrum* spp.) - adults bore into the **sapwood** and heartwood of severely stressed, dying, or recently dead trees; windfall; broken branches and cut firewood. Look for small, cone-shaped piles of fine, light-colored boring dust **on** the bark surface or accumulations of frass around the tree's base. Black-stained tunnels can be found in the wood and 'pin' can be seen in the bark.
- PACIFIC FLATHEADED BORER (*Chrysobothris mali*) - larvae are off-white with flattened, amber colored



Fig. 24

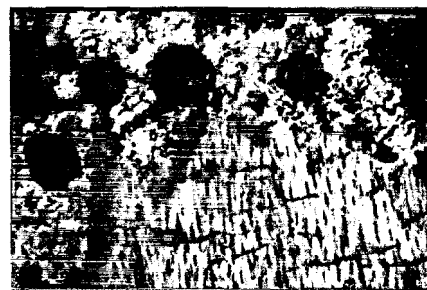


Fig. 25

heads. They are up to 3/4" long and found under bark and in the wood of dead and dying branches and trunk. Larval tunnels, primarily in the inner-bark, are shallow, oval and packed with coarse boring dust (frass). Saplings, branches and large areas of the bark may be killed (girdled) by meandering tunnels.

- WESTERN SYCAMORE BORER (*Synanthedon resplendens*)- a wood-boring moth (**Fig. 24**). The larvae are pink, and up to 3/4" long. Their burrowing riddles the bark, giving it a roughened appearance and often causes bleeding. The larvae seldom damage the cambium or bore in the wood. Reddish frass can be seen accumulating in bark crevices below or on the ground. Larval cases can sometimes be found protruding through 1/8" wide exit holes.

7. Clear, sticky fluid dripping from acorns, or large, sticky droplets falling from tree (acorns), creating a nuisance.

Probable cause:

- DRIPPY ACORN (NUT) DISEASE - a bacterial disease that invades insect wounds, causing profuse clear and sticky bleeding from acorns. Often associated with **filbertworm** and acorn weevil, a cynipid gall wasp (perhaps *Callirhytis flora* - the summer generation), and another cynipid gall wasp (*Drycosma minusulis*) that lays its eggs on the upper leaf surface in spring, causing a clear fluid to drip.

SOD Monitoring Strategy

The University of California's Center for the Assessment and Monitoring of Forest and Environmental Resources (CAMFER), along with the California Oak Mortality Task Force (COMTF), has developed a strategy for monitoring incidences of Sudden Oak Death (SOD) that involves gathering reports of the disease with spatial information (ideally a GPS), followed by sampling of reported trees. California Department of Food and Agriculture samples trees within the infested areas, and UC Davis samples outside of those areas. There are 2 avenues for reporting SOD symptoms: contacting the County Agricultural Commissioner's Office or Cooperative Extension (CE) Office, and also submitting

OakMapper
Sudden Oak Death Report Form
<http://camfer.cnr.berkeley.edu/oaks/tree-database.htm>

The Report has 6 parts:

Step 1: Tree Species.
Enter tree species. CalFlora guide is linked to these images.

Step 2: Tree Symptoms.
Enter which SOD symptoms you see on the tree. Each symptom image is linked to more information.

Step 3 and 4: Personal Information and Environmental Information.
Enter information about yourself and where you found the tree.

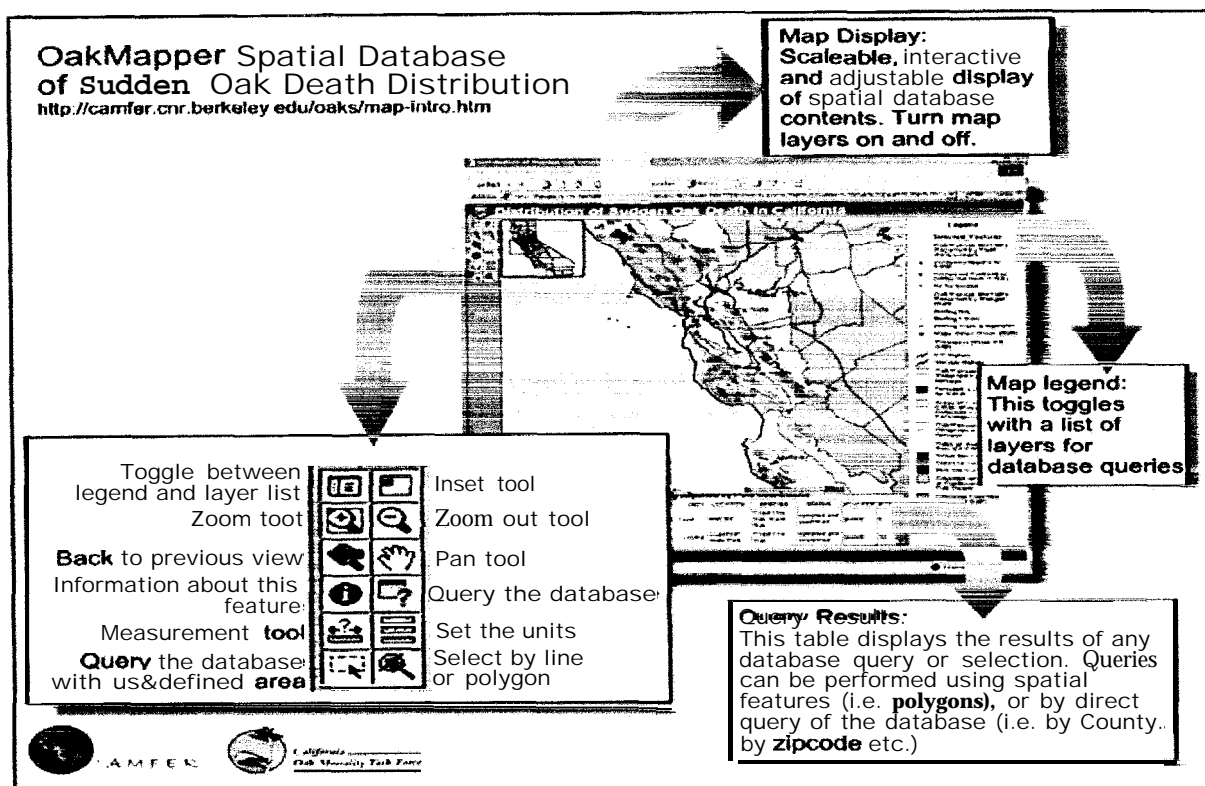
Step 5: Location.
Enter address of tree, x,y location of tree, or some other location description.

Step 6: Submit Report.
Press Submit button to send information to the SOD database.

CAMFER
California Oak Mortality Task Force

information directly to the SOD spatial database via the OakMapper website.

To find contact information for the County Ag. Commissioner's Office or County CE office go to:



www.suddenoakdeath.org and find the contact in your county under the section: 'More Information on SOD and What You Can Do'.

OakMapper website information and tools:

To use the Individual Tree Report on the OakMapper website:

Go to www.suddenoakdeath.org 'More Information on SOD and What You Can Do' section, or directly to the OakMapper (http://camfer.cnr.berkeley.edu/oaks/tree_database.htm) site to report trees that might have SOD.

The OakMapper website can be used for:

- Logging occurrence of trees with possible SOD;
- Educating the public on symptoms and hosts;
- Scaleable viewing of current distribution coverages;
- Performing simple geographic queries.

Examples:

- ◆ Where are confirmed cases of SOD in my area?
- ◆ How many confirmed cases are in Sonoma Co.?
- ◆ Supported Queries:
 - County, Zip-code, Congressional District
- ◆ User-defined area (polygon).

- Database queries.

COMTF Monitoring Committee Information: <http://www.suddenoakdeath.org> and click on COMTF Information Page.

Research and Resources

Information about Sudden Oak Death is rapidly developing as a result of continuing research efforts. One challenge facing **arborists** is keeping **up-to-date** with the latest information about the disease. The **timeline** below shows how rapidly new pieces of information have become available in recent months:

July 2000: A new *Phytophthora* is discovered as the causal agent of Sudden Oak Death
 Jan 2001: The new *Phytophthora* is reported to be the same as one on Rhododendrons in Europe
 Feb 2001: Santa Clara and San Mateo county are added to list of infested counties
 Feb 2001: Huckleberry is added to list of host species
 March 2001: Shreve Oak is listed as a host species
 March 2001: The new *Phytophthora* is recovered from soil and rain water

Whenever reviewing information about Sudden Oak Death, pay close attention to the date that the information was reported. The best source for new information is the Internet. The California Oak Mortality Task Force **website** is at www.suddenoakdeath.org. This **website** has links to other relevant **websites** including research and monitoring websites. It also has contact information for the chairs of the committees of the task force, including the management, regulation, monitoring, and education committees. Participation in the activities of one of these committees, or in full task force meetings that are held every two months, provides access to up-to-date information, and the opportunity to have questions answered. New information coming from research will be reported in as timely a manner as possible.

Research questions that are currently being investigated and that are of importance to arborists include:

- How does the pathogen get **from** tree to tree?
- How well does the pathogen survive when material is chipped, composted or **tarped**?
- Are some individual hosts resistant to the pathogen?
- What other plant species can harbor the pathogen?
- How should we manage Sudden Oak Death in areas with other herbaceous hosts such as huckleberry?
- What roles do insects play in the spread of the pathogen?
- Are there fungicide treatments that may be useful in managing Sudden Oak Death in some situations?
- Do insecticide treatments prolong tree life, and how might this impact disease progression?

Recommendations for management of sudden oak death will change as new research findings are made. Therefore, management activities that are currently recommended may change in the light of new findings. The task force will maintain up-to-date management guidelines, but all of the answers to management questions will be a long time in coming. Maintaining the vigor of oak trees, and being aware of the pathogen and other organisms associated with Sudden Oak Death will help arborists to make pertinent recommendations to their clients.

Treatment and Management (cemarkin.ucdavis.edu/treatment.html)

Trees Without Symptoms of Sudden Oak Death

The best defense against a range of plant pathogens and insect pests is to promote tree health. The following are some general guidelines.

Irrigation - Avoid frequent irrigation of oak trees. Oaks are adapted to the dry Mediterranean climate that prevails in central coastal California and most established oaks do not require supplemental irrigation except under severe drought conditions.

Root zone management - The root zone, the area under the crown + 1/3, is the most vulnerable part of oaks and should be treated as a ZONE OF NO DISTURBANCE. Do not damage the roots by activities such as paving and soil compaction. Apply a 4 - 6 inch deep layer of mulch under the tree canopy. Make sure that the mulch is at least two feet away from the root crown.

Pruning - If possible, only prune dead and dying branches, or others needed to maintain a safe canopy structure, in the dry summer months (June - September) when the activity of both **fungus** and insects are at a minimum.

Fertilization - Fertilize if the tree shows external symptoms of deficiency, such as yellowing of the leaves, and the deficiency is confirmed by a laboratory test.

Injury - Protect the stem and lower limbs from injury.

Symptomatic Individual Trees in a Garden Setting

The following discussion of treatment recommendations is for individual trees in garden and landscape conditions with a managed understory and do not apply to woodland trees. Monitor oaks in urban settings for the bleeding symptom year round. If the bleeding symptom is detected, seek confirmation that the cause is the new *Phytophthora* species.

CAUTION Not all bleeding on oak stems and limbs is indicative of Sudden Oak Death. Other causal agents such as *Phytophthora cinnamomi*, wet wood, sycamore borer, or carpenter worm, may be responsible.

At this time there is no known cure for trees with symptoms of Sudden Oak Death; however, if the new *Phytophthora* species is confirmed in a tree in an urban setting, a number of treatment options are available that may extend its life. However, it must be stressed that tests yielding conclusive data regarding the effectiveness of these treatments have not been completed at the current time. Options may include the use of **fungicides** that are registered for, and useful in, the management of other *Phytophthora* caused diseases. In addition, registered insecticides that target the beetles, but not the underlying causal fungus, are registered for use against oak bark beetles. Insecticide treatments should be avoided from mid-October to mid-March when beetles are not active.

All pesticides must be used in accordance with their labels.

Product	Target Organism	Discussion
Subdue[®]MAXX (active ingredient Metaxyl)	<i>Phytophthora</i> species	Field trials are underway. Resistance may be a problem with this compound. Overuse may render this product ineffective as a treatment.
Phyton-27[®] (active ingredient copper sulphate pentahydrate)	<i>Phytophthora</i> species	Field trials are underway.
Astro[®] & Dagnet[®] SFR (active ingredient permethrin)	Bark and ambrosia beetles	Preliminary data suggests that treatment may prolong the life of symptomatic trees; however, retention of these trees may not be desirable. Treatment with permethrin does not kill the <i>Phytophthora</i> fungus.

About the authors: Andrew J. Storer, Division of Insect Biology, University of California, Berkeley; Kim E. Keiman, Nicole K. Palkovsky and Pavel Švihra, University of California Cooperative Extension, Marin County; Bruce W. Hagen, California Department of Forestry and Fire Protection; Garey W. Slaughter, Department of Plant Pathology, University of California, Davis; N. Maggi Kelly, Division of Ecosystem Sciences, University of California, Berkeley.

The University of California, in accordance with applicable Federal and State laws and University policy, **does** not discriminate on the basis of **race**, color, national origin, **religion**, sex, disability, age, **medical** condition (cancer-related), ancestry, marital status, citizenship, sexual orientation, or **status** as a **Vietnam-era** veteran or special disabled veteran. The University also prohibits sexual harassment. Inquiries regarding this policy may be addressed to the Affirmative Action Director, University of California, Agriculture and Natural Resources, 1111 Franklin Street, 6th Floor, Oakland, CA 94607-5200, (510) 987-0096.