Surveying for Sudden Oak Death in California¹

Walter Mark² and Amy Jirka³

Abstract
Sudden Oak Death (SOD) caused by Phytophthora ramorum is an apparently introduced pest in California. The disease was first reported in Marin County, California, in 1995 and at approximately the same time in Santa Cruz County. It was later determined that P. ramorum, then unnamed, was known as early as 1993 to affect Rhododendrons in Europe. Since the first report in California in 1995, P. ramorum has now been confirmed by isolation in ten counties in California as well as one county in Southern Oregon. The California State Board of Forestry (BOF) established a Zone of Infestation for SOD to include all counties with SOD, and the California Department of Food and Agriculture (CDFA) has implemented regulations restricting the movement of plant material with P. ramorum. Several states have established quarantines to attempt to prevent the importation of P. ramorum from California. Other countries including Canada and Korea have also established quarantines with the same objective. The enforcement of these quarantines and Zones requires detailed knowledge of the distribution of SOD in California. The determination of the distribution of SOD is the purpose of the statewide survey for SOD.

Host Range

Phytophthora ramorum was first noticed on oaks and tanoak in California and due to the symptoms of apparent rapid death and retention of dead foliage was called Sudden Oak Death. The known host range in California has now been expanded and includes many hosts outside of the family Fagaceae. Plant species from five families native to California are now known to be hosts of P. ramorum: Fagaceae—Quercus agrifolia, Q. kelloggii, Q. parvula var shrevei, Lithocarpus densiflorus; Ericaceae—Arbutus menziesii, Arctostaphylos sp., Vaccinium ovatum; Rhododendron sp.; Lauraceae—Umbellularia californica; Hippocastanaceae—Aesculus californica; Aceraceae—Acer macrophyllum; Caprifoliaceae—Lonicera hispidula; Rosaceae—Heteromeles arbutifolia; Rhamnaceae—Rhamnus Californica; and Viburnum in Europe. SOD exhibits varied symptoms on different hosts ranging from cankers and stem bleeding to foliar leaf spots.

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² Professor, Natural Resources Management Department, Cal Poly State University, San Luis Obispo, CA 93407 and Co-Chair, COMTF Monitoring Committee (e-mail: wmark@calpoly.edu)
³ Research Technician, Natural Resources Management Department, Cal Poly State University, San Luis Obispo, CA 93407
Distribution of SOD

Most of the current distribution is known from field and isolation work done at the University of California, Davis laboratory of Dr. Dave Rizzo and at the University of California, Berkeley laboratory under the direction of Dr. Matteo Garbelotto. Their labs continue to confirm new areas of SOD and to support researchers in their efforts to learn more about SOD. The California Department of Food and Agriculture (CDFA) are currently confirming additional isolations from within the known range of SOD. The known distribution of SOD has been determined by looking for visual signs and symptoms of the disease on plant hosts where the disease is suspected or reported. Much of this work has been done through following-up on reports of declining oaks or other hosts and by road survey work in areas where susceptible hosts occur.

The discovery of SOD in Oregon was accomplished through aerial surveys of areas where tanoak was present. From this survey 27 suspect areas were identified. Eleven of these were selected for ground checking and from those the pathogen was recovered from five separate sites.

An aerial survey of eight counties in California where SOD has been confirmed was conducted on July 5, 6, and 9, 2001. The purpose of the aerial survey was to determine the incidence and severity of oak and tanoak mortality in coastal California and to provide baseline data to monitor SOD. This survey resulted in mapping of 60 polygons representing 44,823 acres. Of the 60 polygons, there were 59 with tree mortality, 44 of which had mortality believed to be from SOD. This aerial survey represents the most complete survey to date of the extent of SOD.

No extensive survey for the presence of SOD has been done in areas outside the known infested counties, with the exception of southwestern Oregon. Aerial survey has also been done in coastal areas of Humboldt and Del Norte Counties. Regulatory actions of CDFA and CA State Board of Forestry require that a systematic survey of areas outside the infested area be done to determine the presence or absence of SOD.

Statewide Survey

Survey work for SOD on a statewide basis is similar to a rare plant survey. Such surveys are undertaken to determine the presence and location of rare species or events in a study area. These surveys can confirm the presence of the rare event, but they can seldom conclusively rule out the occurrence of the rare event in the study area. Traditional survey methods that focus on vegetation community classification are inappropriate and inefficient for rare event surveys. Quantitative vegetation analysis techniques tend to represent dominant vegetation species on a site and focus effort on small portions of a study area. Rare plants or rare events tend to have small discrete populations or to be thinly scattered on a landscape. They are more likely to be found by concentrating search efforts than by surveying larger areas. When the search area is too large to allow a detailed inspection of the entire area, searches should concentrate on as many likely sites as is feasible while still sampling each habitat represented in the study area. Search efforts should be pre-stratified to more intensely sample sites with a high probability of supporting the rare event.
Systematic search patterns are recommended to minimize overlap and maximize coverage.

Work on the statewide survey was started in the fall of 2001 following the protocol outlined at the August 30, 2001 meeting of the California Oak Mortality Task Force (COMTF) Monitoring Committee Meeting. The statewide survey will be conducted utilizing systematic aerial survey followed up with ground checking for sample collection to confirm the presence of *P. ramorum*. The areas to be surveyed will be determined by the use of host distribution mapping, risk maps, and areas that have been identified with canopy changes from remote sensing monitoring. The survey area will be concentrated in counties adjacent to those with confirmed SOD, boundary counties, and in areas where the risk and host ranges indicate a high probability of the presence of SOD. As the known confirmed distribution of SOD expands, the area of the statewide survey must be expanded to include additional boundary counties. The current boundary county survey covers parts of 20 counties from San Luis Obispo in the south to Del Norte in the north.

Prior to aerial survey work, host distribution maps and risk maps are prepared for flight planning. This stage of the effort is occurring at the present time. Vegetation maps are being prepared using the Gap Analysis Program (GAP) database and the California Department of Forestry and Fire Protection (CDF) Hardwood Management database. These two sources are prepared at different intensities and provide somewhat different information, but in combination provide a good indication of the location of potential host communities. Risk maps are utilized to plan the flight lines and to prioritize the survey areas. Some of the factors that are included in the risk mapping include: proximity to confirmed SOD cases, host species presence, summer fog zone, precipitation, maximum summer air temperature, minimum January air temperature, and proximity to roads and parks.

Aerial surveys are conducted in late spring from fixed wing aircraft flying at altitudes between 500 feet and 2,000 feet above the ground. Airspeed is generally around 80 knots. Flight lines are preplanned based on the area to be surveyed, host distribution, and risk maps. The timing of the aerial survey is critical to success in detecting SOD suspect areas. The flights have to be conducted late enough in the spring that moisture stress and visible symptoms are expressed in infected hosts. The flights also have to be conducted early enough that drought deciduous species, such as California buckeye, are not starting to fade due to normal leaf drop. The flight lines are continuously recorded using hand-held GPS. Areas of mortality are mapped as point features along the flight lines located using Global Positioning Systems (GPS) and are hand sketched on orthophoto GIS maps showing vegetation and other visible features. The scale of the orthophoto maps is 1:15,000. Still photos are taken of the infested areas to aid in location of the specific area in the ground follow-up work.

Ground follow-up is conducted for mapped areas that are identified as suspected SOD infections. The combination of the orthophoto mapping, still photos, and the GPS data are used to locate the suspect areas on the ground. Land ownership must be established to provide for access to the suspect areas for sample collection. Sample collection will proceed utilizing the *Regulatory Sampling Guidelines for Sudden Oak Death* (Phytophthora ramorum)—*Infected Foliar and Wood Hosts* approved at the August 30, 2001 COMTF Monitoring Committee Meeting.
Aerial survey techniques do not work for understory species or for species that only exhibit foliage symptoms. Techniques for surveying these species on a statewide basis have only recently been developed. The tasks for such survey work include host distribution mapping, risk mapping and ground checking of high-risk areas to collect stem and foliage samples for isolation work. The ground checking of high-risk areas will involve one of two methods for survey work. The method applied will depend upon the characteristics of the area to be checked. Meander searches will be used in irregularly shaped areas, such as riparian communities. Patterned searches will be used in areas where the community covers larger areas with varied habitats. A standard 2% Animal and Plant Health Inspection Service (APHIS) phytosanitary survey is planned for this survey work.

One additional survey methodology has been developed and approved for use for SOD, that is the “Free From” survey. This type of survey is necessary to obtain a permit to move plant materials of known host species within infested counties. This survey will be done in three different ways depending upon the land management and the proximity to known SOD cases. For “Free From” surveys for areas within 2 miles of the 1/4-mile radius confirmed site area, a 10% survey is recommended. This survey should be done by transect method with transects designed to cover all suspect habitat types. For areas outside of a 2-mile radius from a confirmed site, a 2% transect survey with similar design criteria must be conducted. In both cases all suspected SOD cases would have sample collections made for isolation testing at a CDFA laboratory. In areas where the proposed movement of potential host material is associated with a Timber Harvest Plan (THP), the Registered Professional Forester (RPF) or the RPF’s designee shall conduct the survey. The RPF must be trained in a CDF approved training program. The RPF is responsible for training any designees working on the “Free From” survey. Survey work will be conducted at all levels in the preparation and implementation of the THP. This will include inventory, pre-sale reconnaissance, sale layout, timber marking, timber felling, timber yarding, and slash disposal. Any suspected cases of SOD will be reported to the local County Agricultural Commissioner’s Office and will require sample collection for laboratory isolation work at a CDFA laboratory.

References


Mark, Walter R. [In press]. Ground Based Surveys: Designing Sampling Methods for Newly Introduced Diseases or Other Rare, Unevenly Distributed Organisms. In: Proceedings of the 2001 WIFDWC; 2001 September 11-14; Carmel, CA.
