The California Oak Mortality Task Force, 2017-2022 Work Plan: Managing Sudden Oak Death and Other Diseases Caused by *Phytophthora ramorum*

Sudden oak death, caused by the invasive plant pathogen *Phytophthora ramorum*, has killed millions of tanoaks and oaks in California and threatens millions more. This quarantine organism is also problematic in nurseries, particularly on rhododendrons and camellias. The 2017 – 2022 California Oak Mortality Task Force Work Plan outlines next steps to prevent and manage sudden oak death/*P. ramorum* in California using management, monitoring, education, and research to prevent and manage sudden oak death/*P. ramorum* in California and protect the vast ecological, social, and economic resources at risk.

The California Oak Mortality Task Force (COMTF; www.suddenoakdeath.org) aims to minimize *Phytophthora ramorum* spread and impacts to forests, urban and rural communities, nurseries, tribes and other natural and cultural resources of California. To meet that goal, we're developing strategies and providing information to prevent *P. ramorum* introductions, and we're also coordinating a collaborative response to manage and avert human-assisted *Phytophthora* spread. Our aims are to sustain forests and landscapes, assist the nursery industry, and promote public safety.

For a partial list of participating organizations and goals of the COMTF, see Appendix – Part 1. For background on *P. ramorum* and sudden oak death, see Appendix – Part 2.

Current concerns. Abundant precipitation throughout most of California in 2016-2017 will foster extensive *P. ramorum*/sudden oak death expansion, since pathogen reproduction and spread occur during in wet conditions. Similar conditions in 1998-1999 and 2006-07 caused explosive increases in standing dead trees in known infested areas and new infestations in outlying areas. The number of dead trees in the densely populated San Francisco Bay Area (Marin, Santa Cruz, San Mateo, and Sonoma Counties) is expected to be especially problematic due to safety hazards created by standing dead trees adjacent to powerlines and roads; however, increased mortality is expected to be a major threat to developed recreation and residential areas as well as wildlands throughout the infested area, from Monterey County to Humboldt County. **Needed actions include preparing communities, county emergency services, and utility companies to manage for these hazards.**

On the southern edge of California's infested area, San Luis Obispo County recently had false positive detections for *P. ramorum*, but the pathogen can be expected to arrive in the county in the near future. Many forest stands in San Luis Obispo County are more open and have a different species composition than those in the other infested counties, so the intensity, spatial configuration, and extent of these outbreaks, once they occur, will need to be monitored. Additionally, technical assistance will be needed for arborists, land managers, nursery growers, and others in San Luis Obispo and Santa Barbara Counties to understand science-based treatments and help protect citizens from non-proven remedies.

In northern California, the pathogen will likely spread to Del Norte County within the next few years, with extensive spread also expected in infested areas of Humboldt and Mendocino Counties. Certain forested areas in Del Norte and Humboldt Counties experience some of the highest rainfall totals in the state and also contain very high densities of tanoak. The Redwood National Park infestation, the most northern infested area in California is anticipated to spread, and commercial and private forestry interests will need technical assistance to facilitate forest management with the goal of sustaining forest health and preventing pathogen spread. Additionally, the EU1 strain was recently detected and observed to be killing trees in Oregon and is known to be present in a waterway in Humboldt County. This strain is considered more aggressive than the NA1 strain which has killed millions of trees in California since the mid-1990s. **Increased monitoring to detect possible EU1 infestations in California is paramount.**

Tribes place tremendous cultural value on tanoak and California bay laurel as traditional foods and for religious ceremonies. The COMTF and other concerned groups can provide support and facilitation for tribes to implement traditional ecological techniques to protect their lands and maintain the health of gathering areas. Actions needed include (1) applied research into the efficacy of traditional ecological land management techniques such as the use of prescribed burns for sudden oak death management and prevention; (2) assistance in thinking through the value of road closures, check stations, and other possible tactics to prevent pathogen spread; (3) support for proactive silvicultural actions to promote tanoak's continued presence on the landscape; (4) identification of areas where tanoak is more likely to survive on the landscape; and (5) other actions intended to provide clear articulation of tribal values and threats related to native habitats and native hardwood resources for the general public, for land management professionals, and for federal, state and local policy-makers.

To prevent and manage *P. ramorum*, our priorities include:

- **Raise awareness and ready resources to maintain safety in areas where mortality is expected to be elevated.** Utility companies need to be prepared to conduct dead tree surveys along powerline corridors twice a year, rather than the conventional, every 12 months. Fire departments in densely populated areas located within redwood/tanoak, Douglas-fir/tanoak, or mixed-evergreen forests need assistance to manage the disease impacts. Local elected officials and public safety professionals need to be prepared to field questions from concerned constituents.

- **Monitor the edges of California's infested area to assist counties such as Del Norte and San Luis Obispo that are threatened or recently identified as infested.** Counties with first-time wildland detections come under quarantine regulations. Landowners, nurseries, and arborists unfamiliar with the issue need technical assistance and guidance concerning treatment options and management strategies.

- **Provide up-to-date mapping and reporting of *P. ramorum's* distribution** on at least an annual basis. Ideally, this information would come from aerial, ground, and streamwater detection activities, collected by a variety of surveyors throughout the state, so as to provide the highest-resolution snapshot of pathogen distribution obtainable. This information needs to be gathered by one clearinghouse to serve the varied constituencies with need for this information. Foresters need distribution information at the watershed level in support of CEQA-level environmental documentation submitted to California state agencies for forest management projects. Public land managers need to know how close the pathogen is to prioritize management activities. State and federal firefighters need a more precise snapshot of pathogen distribution to guide fire fighter hazard management and mandated decontamination and demobilization activities.
- Investigate **potential impacts the EU1 strain** (detected for the first time in the US on tanoak and other species in OR in 2015) would have if it spread into California. Investigations are needed to determine the EU1 strain's virulence on California redwood (*Sequoia sempervirons*) and other high-value California conifer species. Monitoring is needed to determine if the EU1 strain is already established on vegetation in California forests.

- Support research to **improve wildland treatment options**, develop resistant trees and test forest management strategies to slow the spread of *P. ramorum*, reduce impacts and support forest resilience. Sudden oak death will be the number one cause of tree mortality along the California coast in 2018 and in the following years. Land managers need tested and effective treatments, such as strategic removal of infected bay or tanoak and combining such removals with phosphite or other treatments. These treatments and strategies need to be applied in landscape-level trials in numerous forest types and environmental conditions to demonstrate their longevity and effectiveness.

- **Prevent pathogen spread through improved sanitation.** Field crews in parks, open spaces, utility corridors, and land management agencies need guidance on best management practices for practical sanitation of equipment and vehicles. Furthermore we need to gain a better understanding of the highest risk materials and operational pathways for accidental transmission. By raising sanitary standards, long-distance human-assisted spread to new areas may be slowed.

- **Continue to educate** the public, nursery trade, restoration practitioners, landowners, and land managers about *P. ramorum* and how to prevent its spread. The COMTF can serve as a bridge between plant pathologists, arborists, regulators, land managers, tribes, nursery growers, homeowners, and the general public. Coordination of education and outreach with the newly formed Oregon SOD Task Force will help keep messages up-to-date and serve cross-state audiences. Maintenance of www.suddenoakdeath.org is needed

to provide up-to-date, science-based information to all interested parties. The COMTF should develop unified messaging for the public concerning areas of scientific uncertainty, such as *P. ramorum*-wildfire interactions, sanitation and human-assisted movement, the necessity and appropriateness of wildland management of sudden oak death, and the interaction of this pathogen with a changing climate.

- **Provide educational and scientific documents that integrate our understanding of *P. ramorum* and its impacts with those of other *Phytophthora* species causing damage to native California trees, shrubs, and herbaceous plants.** Land managers have a poor understanding of the genus because of its cryptic and microscopic nature, because of its widely varied effects on plants, and because of varying epidemiology between different species and ecosystems. The genus *Phytophthora* needs to be placed into the context of invasive species in general, and this context needs to be clearly explained to a variety of audiences throughout the state so that we can reduce the likelihood of future new pathogen introductions.

- **Provide technical assistance concerning sudden oak death to policy makers at federal, state, and local levels** including county boards of supervisors, departments of the California Natural Resources Agency, nongovernmental organizations, and tribal and fire-safe councils.

Appendix – Part 1: About the California Oak Mortality Task Force

The COMTF is a volunteer coalition of forest health specialists, land management agencies, researchers, nursery growers, regulators, non-profit organizations, and other interested parties. Formed in 2000, its primary purpose is to coordinate a comprehensive program of management, monitoring, research, education, and policy to minimize the spread of *P. ramorum* in California and to promote science-based solutions to prevent and manage this invasive, damaging, quarantine pathogen.

COMTF Goals:
- Minimize the impact and spread of *P. ramorum* on natural, horticultural, and human communities.
- Coordinate an integrated response by all interested parties to address *P. ramorum*.
- Serve as liaison to local, state, national, and international groups.

Approach:
1) Provide technical assistance and public education to professionals, homeowners, tribes, and volunteers throughout California to protect against *P. ramorum*.

2) Develop strategies and techniques to support adaptive, integrated pest management programs; demonstration areas; and trials for *P. ramorum* in urban and wildland forests as well as horticultural nurseries. Update, collate, and evaluate the efficacy of best management practices.

3) Maintain www.suddenoakdeath.org as a science-based, comprehensive source for information and educational materials relating to the treatments, biology, and risks of *P. ramorum*.

4) Identify needs and potential sources of funding, staffing, and other resources to address *P. ramorum* and other plant pathogens and pests in California forests.

5) Strengthen working relationships between scientists, arborists, regulators, nurserymen, tribes, volunteers, and professionals.

Partial list of COMTF participating organizations

California Department of Food and Agriculture
California Department of Forestry and Fire Protection
California Forest Pest Council
California State Parks
California Polytechnic University, San Luis Obispo
Golden Gate National Recreation Area, National Park Service
Hoopa Tribe
Humboldt State University, College of Natural Resources and Sciences
Marin County, Agricultural Commissioner's Office
Marin Municipal Water District
Mattole Restoration Council
Midpeninsula Regional Open Space District
National Ornamentals Research Site at Dominican University of California
Phytosphere Research
Redwood National and State Parks, National Park Service
San Francisco Public Utilities Commission
Sonoma County, Agricultural Commissioner's Office
Sonoma State University, Department of Biology
University of California, Berkeley, Forest Pathology and Mycology Lab
University of California, Cooperative Extension, Marin County
University of California, Cooperative Extension, Humboldt and Del Norte Counties
University of California, Davis, Department of Plant Pathology
USDA APHIS, California
USDA Forest Service, Pacific Southwest Region, Forest Health Protection
USDA Forest Service, Pacific Southwest Research Station
USDA Forest Service, Six Rivers National Forest
USDI Bureau of Land Management, Arcata Field Office
Yurok Tribe

Appendix – Part 2:

Background - What is sudden oak death?

Sudden Oak Death (SOD) is a forest disease caused by the invasive, quarantine plant pathogen *Phytophthora ramorum*, which was inadvertently introduced into the US on infested nursery stock (Mascheretti et al. 2008). *P. ramorum* is a water-loving organism that requires mild, wet conditions for infection (Rizzo et al. 2003).

Since 1995, *P. ramorum* has killed millions of native tanoak (*Notholithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), California black oak (*Quercus kelloggii*), Shreve oak

(*Quercus parvula* var. shrevei), and canyon live oak (*Quercus chrysolepis*) trees in the wildlands and urban/wildland interface of 16 coastal California counties, from San Luis Obispo to Humboldt. This unprecedented die-off is causing landscape changes that affect ecosystem function, increase fire and safety hazards, reduce land values, and diminish aesthetics (Rizzo et al. 2003; Kovacs et al. 2011).

California bay laurel (*Umbellularia californica*) is the primary foliar host for natural dispersal of *P. ramorum* in California forests, as the pathogen builds up on its leaves and can then be transferred into the local environment during rain events, infecting nearby oaks and other susceptible species. This sub-lethal foliar disease (referred to as ramorum blight) serves as an important reservoir for inoculum in infested regions during wet years as well as during extended drought periods. (DiLeo et al. 2009)

P. ramorum is also killing oaks and tanoaks in Curry County, Oregon forests (Goheen et al. 2002). In 2015, the EU1 lineage (there are four known *P. ramorum* lineages – NA1, NA2, EU1, and EU2; Van Poucke et al. 2012) was found for the first time in a US forest on a terrestrial plant (tanoak) in Curry County (Grünwald et al. 2016) and later in 2016 on grand fir (*Abies grandis*) (COMTF 2016). Like California, Oregon's *P. ramorum* program is now focused on pathogen containment and slow the spread, but eradication efforts are underway for those areas where the EU1 lineage has been identified given concern for spread to other forests.

In the United Kingdom and Ireland, *P. ramorum* is causing widespread mortality on Japanese larch (*Larix kaempferi*) (Brasier & Webber 2010). It has also been found causing damage in stands of European beech (*Fagus sylvatica*) and oak in the UK that are associated with infected rhododendrons (*Rhododendron spp.*), and it has been found infecting sweet chestnut (*Castanea sativa*) in southwest England in an area devoid of other infected plants (Brasier et al. 2004).

Also a foliar pathogen (causing ramorum blight) of more than 100 different horticultural plant species, *P. ramorum* has been found in US and British Columbia nurseries, one nursery in Asia, and in the nurseries of at least 25 European countries. It has also been recovered from gardens in the UK, other parts of Europe, and the US. Hosts include popular landscaping plants, such as camellia, rhododendron, *Pieris*, *Magnolia* and *Viburnum* (CABI 2017).

Because of *P. ramorum's* extensive host list and its ability to affect horticultural and forest plants alike, international, national, and state quarantines are in place to help contain the pathogen and stop further movement of infested nursery plants and other host material. In California, counties with forest infestations are quarantined, requiring all host material leaving their boundaries to meet regulatory compliance requirements. Similarly, nurseries in the US shipping host material interstate that are found positive for the pathogen fall under regulatory control for a 3-year-period, during which time they must remain pathogen-free to regain interstate shipping rights.

P. ramorum is currently only found in around 10 percent of California's at-risk forests. Infested lands span a wide range of ownerships and can be found in areas where millions of people live and recreate, making management to sustain open space greenbelts, recreation areas, tribal lands, and other landscapes a priority. The pathogen also affects nurseries, gardens, and forests, impacting numerous disciplines, including horticulture, forestry, arboriculture, and waste

management. With so many disparate interests at stake, *P. ramorum* poses unique challenges and opportunities. Through a sustained, coordinated effort, Californians can work to contain and minimize impacts to those areas currently infested and to protect at-risk forests from becoming infested.

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