CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Phytophthora ramorum Werres, De Cock & Man in 't Veld 2001

Current Pest Rating: Q

Proposed Pest Rating: A

Comment Period: 11/15/2019 through 12/30/2019

Initiating Event:

None. A permanent rating for *Phytophthora ramorum* is proposed herein.

History & Status:

Background: Beginning in the mid-1990s, homeowners in the Mill Valley/Mt. Tamalpais area of Marin County reported the unusual deaths of tanoaks (*Notholithocarpus densiflorus*); the entire crowns were dying with bleeding basal trunk cankers (Svihra, 1999). Between 1995 and 1999, samples were taken from tanoaks and from other species of oaks: primarily tanoaks in Santa Cruz and Monterey counties, and black (*Quercus kelloggii*) and coast live oak (*Quercus agrifolia*) in Marin County. Initially no common cause of the tree deaths could be ascertained. Secondary pests, including bark and ambrosia beetles and decay fungi such as *Annulohypoxylon* were quickly moving onto dying trees, which obscured the primary problem (Garbelloto et al., 2001). In 2000, a *Phytophthora* species was isolated from symptomatic trees near San Rafael. DNA analysis suggested it was an undescribed species (Rizzo et al., 2002). At the end of 2000, the California isolates were matched to another previously undescribed *Phytophthora* species isolated from rhododendrons in Germany in 1993 (Werres and Marwitz, 1997). In 2001, Werres et al., described the pathogen as a new species attacking rhododendrons and viburnums in Europe and named it *Phytophthora ramorum*.

When *P. ramorum* was detected on rhododendron container plants in Santa Cruz County, movement of the pathogen in the nursery trade in North America and Europe immediately became a major concern. In 2001, CDFA issued emergency regulations that restricted the export of diseased oaks and rhododendrons from seven counties where detections of *P. ramorum* had been confirmed. USDA-APHIS followed by issuing an interim emergency federal regulation (7 CFR Part 301) in 2002 for domestic interstate movement of *P. ramorum* host materials from infested counties. In 2004, the federal emergency order expanded the regulated area to include nurseries with host plants that shipped interstate from all of California, Oregon, and Washington.

The expansion of the regulation came in response to inadvertent shipments in 2004. Two large wholesale nurseries in California and one in Oregon inadvertently sent *potentially P. ramorum*-infested host plant material to numerous states across the country. As a result, multiple trace-forward surveys were conducted by federal, state and local officials at 1200+ nurseries in 39 states. One hundred and seventy-six *P. ramorum* positive nurseries were found in 21 states (Frankel, 2008; and S. Frankel, *pers. comm*. 2019). These detections were considered episodic and the infested plants were destroyed. *Phytophthora ramorum* has also been found in nurseries in southwestern British Columbia, Canada (Goss et al., 2010), in the European Union, as well as the United Kingdom, Ireland and many other countries, including South Korea and Japan (Kliejunas, 2010). Internationally, regulations prohibiting import of potentially infested material were quickly issued by Canada, Mexico, the European Union, the United Kingdom, the Czech Republic, Australia, New Zealand, South Korea, and Taiwan. By 2009, more than 68 countries, including China, either included P. ramorum on their lists of regulated pests or mentioned the pathogen in their legislation (Sansford et al., 2009).

Phytophthora ramorum has been detected on infected plants or trees outside of nurseries or managed landscapes in only two states, California and Oregon. Although it has been found in nurseries and in drainage ditches and streams in Washington, it has been responded to quickly and has not resulted in wider quarantines in Washington (Chastagner et al., 2012). *Phytophthora ramorum* is under official control in the United States and Canada (NAPPO, 2016) and surveys continue on an annual basis in forest habitats, regulated nurseries and nearby areas (USDA-APHIS, 2016). Plants testing positive at a nursery triggers a regulatory response.

In the last 20 years, this pathogen has had locally devastating effects on coastal forests in California and Oregon, with estimates as high as 50 million trees killed, notably multiple species of oaks and tanoak but also coastal redwoods (*Sequoia sempervirens*) and other important trees, shrubs and herbaceous plant species in the coastal evergreen forests and tanoak-redwood forests (Meentemeyer et al., 2001; Frankel and Palmierei, 2014; Cunniffe et al., 2016). The infestations in California forests are patchy and limited to areas within 80 km of the Pacific Ocean (Frankel and Palmieri, 2014). In addition to causing “sudden oak death”, *P. ramorum* also causes “ramorum blight” and the known host range continues to expand, including rhododendrons, camellias, viburnums, and dozens of widely planted important ornamental species. Particularly affected are some California natives, including California bay laurel (*Umbellularia californica*), which is an important foliar host and a source of inoculum to nearby trees. Billions of plants and trees, covering over 20 million hectares of land, are threatened in California and Oregon (Lamsal et al., 2011).

Genetic evidence indicates that *P. ramorum* has been separately introduced into North America and Europe from a third area (or areas) that remains unconfirmed but may be in South East Asia, specifically in Northern Vietnam where both mating types have been found (Brasier, 2003; Ivors et al., 2004; Rizzo et al., 2005; COMTF Report, 2018). *Phytophthora ramorum* is a heterothallic species with two mating types, A1 and A2, and four known clonal lineages: two detected in Europe (EU1 and EU2) and two detected in North America (NA1 and NA2). Research indicates that divergence of these lineages occurred prior to the introductions to North America and Europe, and that *P. ramorum* originated from isolated populations and has migrated at least four times to North America and Europe

(Grunwald et al., 2009). However, since 2003, there have been only a few reports of the A2 mating type in Europe or the A1 mating type in the Pacific Northwest. The EU1 clonal lineage is common in nurseries in WA (Coats et. al., 2017) and the EU1 lineage has been found in OR, killing tanoak and on Douglas-fir and grand fir (Grünwald et al., 2016; LeBoldus et al., 2018).

Hosts: There are 150 confirmed hosts in 26 genera in 17 families

The following are proven hosts of *P. ramorum* and were added to this list upon completion, documentation and review of traditional Koch's postulates: *Acer macrophyllum* (bigleaf maple), *Acer pseudoplatanus* (planetree maple), *Adiantum aleuticum* (western maidenhair fern), *Adiantum jordanii* (California maidenhair fern), *Aesculus californica* (California buckeye), *Aesculus hippocastanum* (horse chestnut), *Arbutus menziesii* (madrone), *Arctostaphylos manzanita* (manzanita), *Calluna vulgaris* (Scotch heather), *Camellia* spp. (Camellia—all species, hybrids and cultivars), *Castanea sativa* (sweet chestnut), *Cinnamomum camphora* (camphor tree), *Fagus sylvatica* (European beech), *Frangula californica* (=*Rhamnus californica*) (California coffeeberry), *Frangula purshiana* (=*Rhamnus purshiana*) (cascara), *Fraxinus excelsior* (European ash), *Gaultheria procumbens* (eastern teaberry), *Griselinia littoralis* (griselinia), *Hamamelis virginiana* (witch hazel), *Heteromeles arbutifolia* (toyon), *Kalmia* spp. (kalmia—includes all species, hybrids, and cultivars), *Laurus nobilis* (bay laurel), *Notholithocarpus densiflorus* (tanoak), *Lonicera hispidula* (California honeysuckle), *Maianthemum racemosum* (=*Smilacina racemosa*) (false Solomon's seal), *Michelia doltsopa* (Michelia), *Parrotia persica* (Persian ironwood), *Photinia fraseri* (red tip photinia), *Pieris* spp. (pieris—includes all species, hybrids, and cultivars), *Pseudotsuga menziesii* var. *menziesii* and all nursery-grown *P. menziesii* (Douglas fir), *Quercus agrifolia* (coast live oak), *Quercus cerris* (European turkey oak), *Quercus chrysolepis* (canyon live oak), *Quercus falcata* (southern red oak), *Quercus ilex* (holm oak), *Quercus kelloggii* (California black oak), *Quercus parvula* var. *shrevei*, *Q. parvula* (Shreve's oak) (nursery grown), *Rhododendron* spp. (rhododendron (including azalea)—includes all species, hybrids, and cultivars), *Rosa gymnocarpa* (wood rose), *Salix caprea* (goat willow), *Sequoia sempervirens* (Coast redwood), *Syringa vulgaris* (Lilac), *Taxus baccata* (European yew), *Trientalis latifolia* (Western starflower), *Umbellularia californica* (California bay laurel, pepperwood, Oregon myrtle), *Vaccinium ovatum* (evergreen huckleberry), and *Viburnum* spp. (Viburnum-all species, hybrids, and cultivars).

The following plant taxa are associated with *Phytophthora ramorum* - associated plants are those found naturally infected from which P. ramorum has been cultured and/or detected using PCR. For each of these, traditional Koch's postulates have not yet been completed or documented and reviewed:

Abies concolor (white fir, grand fir), *Abies magnifica* (red fir), *Acer circinatum* (vine maple), *Acer davidii* (striped bark maple), *Acer laevigatum* (evergreen maple), *Arbutus unedo* (strawberry tree), *Arctostaphylos columbiana* (manzanita), *Arctostaphylos uva-ursi* (bearberry), *Ardisia japonica* (ardisia), *Calycanthus occidentalis* (spicebush), *Castanopsis orthacantha* (castanopsis), *Ceanothus thyrsiflorus* (blueblossom), *Cinnamomum camphora* (camphor tree), *Clintonia andrewsiana* (Andrew's clintonia bead lily), *Cornus kousa × Cornus capitata* (Cornus Norman Haddon), *Corylus cornuta* (California hazelnut), *Distylium myricoides* (myrtle-leafed distylium), *Drimys winteri* (winter's bark), *Dryopteris*

arguta (California wood fern), *Eucalyptus haemastoma* (scribbly gum), *Euonymus kiautschovicus* (spreading euonymus), *Fraxinus latifolia* (Oregon ash), *Gaultheria shallon* (salal, Oregon wintergreen), *Hamamelis mollis* (Chinese witch-hazel), *Hamamelis × intermedia* (*H. mollis & H. japonica*) (hybrid witchhazel), *Ilex cornuta* (Buford holly, Chinese holly), *Ilex purpurea* (Oriental holly), *Illicium parviflorum* (yellow anise), *Larix kaempferi* (Japanese larch), *Leucothoe axillaris* (fetter-bush, dog hobble), *Leucothoe fontanesiana* (drooping leucothoe), *Loropetalum chinense* (lorapetalum), *Magnolia denudata* (lily tree), *Magnolia grandiflora* (southern magnolia), *Magnolia stellata* (star magnolia), *Magnolia × loebneri* (Loebner magnolia), *Magnolia × soulangeana* (saucer magnolia), *Mahonia nervosa* (creeping Oregon grape), *Manglietia insignis* (red lotus tree), *Michelia maudiae* (michelia), *Michelia wilsonii* (michelia), *Molinadendron sinaloense, Nerium oleander* (oleander), *Nothofagus obliqua* (roble beech), *Osmanthus decorus* (=*Phillyrea decora*; =*P. vilmoriniana*) (osmanthus), *Osmanthus delavayi* (Delavay osmanthus, Delavay tea olive), *Osmanthus fragrans* (sweet olive), *Osmanthus heterophyllus* (holly olive), *Osmorhiza berteroi* (sweet cicely), *Parakmeria lotungensis* (eastern joy lotus tree), *Pittosporum undulatum* (victorian box), *Prunus laurocerasus* (English laurel, cherry laurel), *Prunus lusitanica* (Portuguese laurel cherry), *Pyracantha koidzumii* (Formosa firethorn),*Quercus acuta* (Japanese evergreen oak), *Quercus petraea* (sessile oak), *Quercus rubra* (northern red oak), *Rosa* (specific cultivars Royal Bonica (tagged: “MEImodac”), pink Meidiland (tagged: “MEIpoque”),pink sevillana(tagged: “MEIgeroka”), *Rosa rugosa* (rugosa rose), *Rubus spectabilis* (salmonberry), *Schima wallichii* (Chinese guger tree), *Taxus brevifolia* (Pacific yew), *Taxus × media* (yew), *Torreya californica* (California nutmeg), *Toxicodendron diversilobum* (poison oak), *Trachelospermum jasminoides* (star jasmine, confederate jasmine), *Vancouveria planipetala* (redwood ivy), *Veronica spicata* syn. *Pseudolysimachion spicatum* (spiked speedwell). (Federal code of regulations: Title 7 Subtitle B Chapter III Part 301 Subpart X. 72 FR 8597, Feb. 27, 2007, as amended at 84 FR 16192, Apr. 18, 2019).

Additional hosts reported since 2012/2013 not yet included in the APHIS *P. ramorum* host or associated host lists:

Arctostaphylos glandulosa (Eastwood manzanita, Eastwood's manzanita), *Arctostaphylos hooveri* (Hoover's manzanita), *Arctostaphylos montaraensis* (Montara manzanita), *Arctostaphylos montereyensis* (Monterey manzanita, Toro manzanita), *Arctostaphylos morroensis* (Morro manzanita), *Arctostaphylos pallida* (Alameda manzanita, Oakland hills manzanita, pallid manzanita), *Arctostaphylos pilosula* (La Panza manzanita, Santa Margarita manzanita), *Arctostaphylos pumila* (Dune manzanita, Sandmat manzanita), *Arctostaphylos rainbowensis* (Rainbow manzanita), *Arctostaphylos silvicola* (Bonny Doon manzanita, Silverleaf manzanita), *Arctostaphylos virgata* (Bolinas manzanita or Marin manzanita), *Cornus nuttallii* (Pacific dogwood), *Garrya elliptica* (wavyleaf silk tassel), *Lophostemon confertus*, syn. = *Tristania conferta* (Brisbane box), *Notholithocarpus densiflorus* var. *echinoides* (Shrub tanoak), *Pickeringia montana* (chaparral pea), *Rubus ursinus* (blackberry), *Trillium ovatum* (Western wake robin), *Vaccinium parvifolium* (red huckleberry), *Vinca minor*, (dwarf periwinkle) (COMTF Newsletters; Rooney-Latham et al., 2017; Swiecki and Bernhardt, 2017).

Symptoms: There are three distinct types of diseases caused by *P. ramorum*:

Stem Cankers: The cankers are similar to those caused by other *Phytophthora* species. Plants of all ages except seedlings and small saplings can be infected and killed. The inner bark, the cambium, and the first few sapwood rings are discolored but the intensity of the discoloration is extremely variable, ranging from dark-brown, almost black lesions to slight discoloration of the infected areas. Black zone lines are often, but not always, present at the edge of the cankers. Smaller tanoaks (*Notholithocarpus densiflorus*) tend not to have any zone lines. *Phytophthora ramorum* cankers usually stop abruptly at the soil line, although there are exceptions with reports of root infection in tanoak (Rizzo et al., 2002) and *Rhododendron* (Parke and Lewis, 2007). *Viburnum* is the only host in which root collar infection is common (Werres et al., 2001). On many hosts, bleeding symptoms can be seen on the outside of the cankers. When cankers are growing slowly, typical decline symptoms can be seen in the crown and include chlorosis of the foliage, premature leaf abscission resulting in sparse crowns, and sometimes dieback of branches corresponding to portions of the stem affected by the canker. Rapidly expanding cankers can interfere with xylem function in the trees (Stamm and Park, 2012, Parke et al, 2007). In these cases, there is not a typical progressive crown decline; the whole canopy browns at once. The entire foliage turns orange-brown and then becomes grey or brown with time. The name 'sudden oak death' was chosen because of this high frequency of apparently rapid decline in trees. Secondary attacks by bark and ambrosia beetles, and acceleration of decay by fungi begin while the trees are still green. Epicormic shoots are often associated with both types of cankers (slow and fast).

Leaf Blight and Branch Dieback: On *Rhododendron* spp., *Pieris* spp. and *Frangula* spp., and other shrub and woody species, symptoms on leaves develop rapidly and may result in leaf death. Foliar infection can precede or follow twig infection and appear as leaf spotting with a characteristic blackening of the main rib of the leaf, with lesions continuing into the petiole. Cankers can develop on branches. In ericaceous hosts with small leaves like *Vaccinium ovatum* and *Arctostaphylos* spp., foliar symptoms are not as clear. Leaf abscission and cane cankers are more common, resulting in the death of clumps of branches. Symptoms on coniferous hosts such as Douglas fir (*Pseudotsuga menziesii*) and Grand fir (*Abies grandis*) are mainly limited to young branch tips that become girdled and wilt. Needles hang from the infected branch at first and then will drop. (Rizzo et al., 2002; Garbelotto et al., 2003).

Leaf Spots, Blotches, and Scorches: In some hosts, lesions are clearly associated with the accumulation of water on the leaf tip which facilitates spore germination and infection. These symptoms are more generic and of less value in field diagnosis. Lesions on *Umbellularia californica* for example are generally dark in color, occur mainly at the leaf tip or edge, and have an irregular margin, often with a chlorotic halo. Premature chlorosis of the entire leaf, followed by its abscission, is common in drier areas. Infection in *Aesculus californica* starts as light circular spots, coalescing into large blotches often affecting the whole leaf, including the petiole. In *Acer macrophyllum*, symptoms appear as a marginal leaf scorch (Rizzo et al., 2002; Garbelotto et al., 2003).

Transmission: Natural dispersal of *P. ramorum* is by waterborne, soilborne, and wind-blown rain-borne spores, hyphae or infected plant parts. There are no known vectors of *P. ramorum,* but it can remain

viable as it passes through slugs (Parke et al., 2008). Anything that can move soil infested with *P. ramorum* carries a risk of pathogen movement, including vehicle tires, the feet of wild and domestic animals, and hiking boots (Cushman et al., 2008). Inoculum also moves with water in streams and in irrigation systems. *Phytophthora ramorum* has been moved through the trade of ornamental plants and green waste. There is evidence that mature compost is no longer infectious (CABI, 2019).

Damage Potential:
In California, millions of trees and shrubs have been impacted by *P. ramorum* but most are not commercial timber species. The loss of redwood, Douglas fir, grand fir, red fir, western hemlock, and other conifers would have a potential economic cost to the Christmas tree and timber industry, but *P. ramorum* infection of these hosts generally has only a minor effect on their growth and does not affect the wood. Additionally, the patchiness and wide extent of the disease has made assessment of losses difficult (Kelly and Meentemeyer, 2002; Meenetemeyer et al., 2008). Oaks on residential lots can increase property values and the loss of mature trees has decreased property values in areas near infected forests in Marin County (Kovacs et al., 2011). Costs of removal of dead trees and of disposal of the infectious green waste are also significant. The need for precautionary and sanitary practices is an added indirect cost to arborists and other tree professionals. Ornamental nursery plants have been affected by *P. ramorum*, (Linderman et al., 2002; Parke et al., 2002) along with the wood and green waste industries (Garbelotto, 2003). Death of large numbers of trees in popular parks and recreation areas, and the partial closure of some infested areas during the rainy season, are having an impact on the recreational value of open spaces. The cost of tree removal and disposal for agencies, public or private, inside the quarantine areas can be extremely high (Kliejunas, 2010). The impact of *P. ramorum* on wildland fires is significant and has been reviewed (Lee, 2010). The large body of research on changes in plant communities and the wildlife they support, the effects of the decreases in tree cover, the increases in rates of erosion, and increases in invasive plant species and the relevant literature has been reviewed by Kliejunas (2010). *Phytophthora ramorum* was under mandatory eradication in Oregon from 2001 to 2012, until the pathogen was deemed un-eradicable (Hansen et al., 2019). Modeling of the disease epidemic in California has shown that pathogen eradication is not a viable option here at this point either (Cunniffe et al., 2016).

Worldwide Distribution: North America: *Canada; United States* (California, Oregon, Washington); Europe: *Belgium, Croatia, Denmark, England, Finland, France, Greece, Germany, Ireland, Italy, Netherlands, Norway, Poland, Serbia, Spain, Sweden, Switerland, United Kingdom* (Farr and Rossman, 2019; EPPO Global Database, 2019; CABI Datasheets; 2019).

Official Control: *Phytophthora ramorum* is a Federal quarantined pest, only known to be established in the wildlands in parts of California and Oregon. All host plants are regulated in nurseries shipping out of quarantine areas and out of state in Washington, Oregon, and California. The United States, the European Union, Canada, New Zealand, Australia, the Czech Republic, Mexico, Taiwan, and South Korea have identified *P. ramorum* as a quarantine pest (Frankel, 2008). The European Union Pest Risk Analysis for *P. ramorum* (Sansford et al., 2009) lists 68 countries that mention *P. ramorum* in their regulations. The following places list *P. ramorum* on their “Harmful Organism list”: Australia, Brazil,

Canada, Chile, China, Colombia, Ecuador, Egypt, Eurasian Customs Union, European Union, Guatemala, Vatican City State, India, Israel, Japan, Republic of Korea, Mexico, Monaco, Nauru, New Zealand, Norway, San Marino, Serbia, South Africa, Svalbard and Jan Mayen, Switzerland, and Taiwan (USDA-PCIT, 2019). Regulations vary by country. Regulated items may include some or all the following: plants, plantlets, seedlings, fruit, cuttings, budwood, branches, grafts, plugs, roots, wood, wood chips, wood shavings, bark, logs, and lumber. Some restrict all known hosts and associated hosts plus woody material, whereas others restrict a shortened list.

California has a state miscellaneous ruling to restrict the movement of *P. ramorum* from infested to uninfested parts of California (3700. OAK MORTALITY DISEASE CONTROL, CDFA Plant Quarantine Manual, accessed 7-11-19). The ruling covers all known and associated host plants and all possible carriers of the pathogen including unprocessed wood and wood products. After *P. ramorum* was discovered in nurseries on the west coast of the United States, an emergency Federal Order was enacted for the entire states of California, Oregon, and Washington to eliminate the disease in the nursery environment and prevent further movement interstate. USDA has a federal domestic quarantine which restricts the interstate movement of *P. ramorum* with plants or associated materials including bark chips, mulch, and forest stock. (USDA-APHIS plant pest and disease programs. Accessed 7/11/19). This federal order divides California, Oregon, and Washington into quarantined and regulated areas based on detections. States can request pre-notification of shipments from quarantined areas under the federal order but by agreement do not have their own exterior quarantines against *P. ramorum*.

Nurseries, wood and wood product producers, green waste facilities, transporters, and composters in California who wish to move articles that could be carriers of *P. ramorum* intrastate or interstate are also regulated by either the CDFA miscellaneous state ruling or USDA's Federal order. These establishments enter into compliance agreements with their County Agricultural Commissioners and CDFA that cover how they securely handle, process, and move regulated articles, use permits, stamps and certificates, and maintain records for a minimum of two years. Additionally, any nursery that wishes to ship host plants or associated host plants interstate must do so under a compliance agreement that stipulates that the plants have been inspected, sampled, and tested annually and have been found free from *Phytophthora ramorum.* If infected plants are found at a nursery, that nursery will be suspended from shipping to regulated areas until the pathogen has been eliminated by established protocols without the use of fungicides, which could mask symptom expression.

California Distribution: *Phytophthora ramorum* has been found in forests and urban-wildland interface areas in the following counties: Humboldt, Trinity, Mendocino, Lake, Sonoma, Napa, Solano, Marin, Contra Costa, Alameda, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Monterey.

California Interceptions: None

The risk *Phytophthora ramorum* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction**: In California, infestations in natural settings have been found in 15 central and northern coastal counties. It has not been found in natural settings in the central valley, in the Sierra Nevada, or in Central or Southern California south of Big Sur. It has also been found in nurseries outside of the quarantined counties with unfavorable climates, for example, in the Central Valley under shade cloth.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **3**

   - Low (1) Not likely to establish in California; or likely to establish in very limited areas.
   - Medium (2) may be able to establish in a larger but limited part of California.
   - **High (3) likely to establish a widespread distribution in California.**

2) **Known Pest Host Range:** well over 100 diverse species of plants are hosts including hardwood and conifer trees, shrubs, herbaceous plants, and ferns.

   Evaluate the host range of the pest.

   Score: 3

   - Low (1) has a very limited host range.
   - Medium (2) has a moderate host range.
   - **High (3) has a wide host range.**

3) **Pest Reproductive Potential:** *Phytophthora ramorum* can be spread by wind-driven rain, water in streams, plant material, contaminated soil on tires and shoes, greenwaste, wood chips and raw compost. It produces multiple types of spores including swimming zoospores, sporangia, and long-lasting clamydospores.

   Evaluate the natural and artificial dispersal potential of the pest.

   Score: 3

   - Low (1) does not have high reproductive or dispersal potential.
   - Medium (2) has either high reproductive or dispersal potential.
   - **High (3) has both high reproduction and dispersal potential.**

4) **Economic Impact:** *Phytophthora ramorum* has killed millions of native and exotic trees and causes damaging twig and foliar diseases on many plant species. Nurseries have shipped infected or potentially infected plants that had to be recalled or destroyed. Ongoing nursery protocols and compliance agreements affect interstate moment of all regulated, restricted, or associated articles requiring sampling and record keeping. Forestry and nursery operations are affected in watersheds where *P. ramorum* is known to occur. The movement of green waste and compost is restricted.

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, B, C, D, G

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes quarantines).
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **3**
- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** Eradication is no longer considered a viable option in California (Cunniffe et al., 2016). An APHIS pest risk assessment for *P. ramorum* by Cave et al. (2008) rated the environmental impact of the pathogen as high based on the potential of the pest to disrupt native ecosystems and habitats within its current geographic range, the need for additional chemical or biological control programs, and the potential of the pest to directly or indirectly impact species listed as Threatened or Endangered (50 CFR § 17.11-12).

Environmental Impact: A, B, C, D, E,

A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 3
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Phytophthora ramorum* is High

Add up the total score and include it here. **15**
-Low = 5-8 points
-Medium = 9-12 points
-**High = 13-15 points**

1) **Post Entry Distribution and Survey Information:**

Evaluation is 'Medium'. *Phytophthora ramorum* is established in 15 counties in California on many hosts, mainly in the mixed evergreen and redwood-tanoak forests. Risk maps show *P. ramorum* is a moderate threat to parts of the state that are not yet infested, specifically the Sierra foothills, and San Luis Obispo County (Kliejunas, 2010). Del Norte County in the northwest corner of the state has a high risk of establishment due to climate and susceptible hosts, and is situated between extensive infestations in Southern Oregon and Humboldt County. The EU strains are not widely distributed and are potentially much more pathogenic than the NA strains. There is a big danger of movement of the EU strains into the forests and around the state with the nursery industry.

Score: -2
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-**Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.**
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) The final score is the consequences of introduction score minus the post entry distribution and survey information score:

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 13***

Uncertainty: Four *P. ramorum* lineages have been detected in United States nurseries, emphasizing the role of the commercial plant trade in the movement of *P. ramorum*. Although sexual reproduction in nature has not been observed, the presence of isolates of both mating types at a single site might lead to genetic recombination, which could lead to an increase in pathogen fitness and/or an expanded host range. New strains produced by mating could have other undesirable characteristics such as resistance to fungicide.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Phytophthora ramorum* is A.**

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Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, California Department of Food and Agriculture, 204 West Oak Ave, Lompoc, CA 93436. Phone: 805-736-8050, permits[@]cdfa.ca.gov.

***Comment Period: 11/14/2019 through 12/30/2019**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at Permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.

- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: A

Comment from Dr. Susan Frankel, 11/26/19 USDA Forest Service, Pacific Southwest Research Station, Plant Pathologist. SFrankel@fs.fed.us

Thank you for this opportunity to comment on the California Department of Food and Agriculture (CDFA) "California Pest Rating Proposal for *Phytophthora ramorum* Werres, De Cock & Man in 't Veld 2001 Current Rating: Q Proposed Rating: A".

As a plant pathologist who has worked on *P. ramorum* for more than 20 years, I observe that there is a solid body of research, monitoring and management action to support this proposed shift from a temporary "Q" rating to a permanent rating of "A". To review the literature, please see the *P. ramorum* bibliography maintained by the California Oak Mortality Task Force, www.suddenoakdeath.org. The 50 million trees estimated to have been killed in California by this exotic pathogen demonstrate its virulence and the need for continued prevention of new introductions.

In the remainder of this letter, I note an error in the posted pest rating proposal that is based on my paper, Frankel, S.J. 2008. Sudden oak death and *Phytophthora ramorum* in the USA: a management challenge. Australasian Plant Pathology, 37(1): 19-25. I request that the error be corrected in the final version of this rating document. History and Status section, third paragraph. Current wording: "In 2004, two large wholesale nurseries in California and Oregon mistakenly sent *P. ramorum*-infested host plant material to numerous states across the country. As a result, multiple surveys conducted in 2004 detected *P. ramorum* at 1200+ nurseries in 39 states (Frankel, 2008)." Suggested correction: "In 2004, two large wholesale nurseries in California and one in Oregon inadvertently shipped millions of potentially infected plants to over 1200 nurseries in 39 states. (Frankel, 2008)." It may be helpful to add that the USDA APHIS, for 2004, reports there were 176 detections of *P. ramorum* in 21 states, with 125 linked to one nursery's shipments (USDA APHIS Program, 4th Quarter Summary; December 31, 2014**:** https://aphis.usda.gov/plant health/plant pest info/pram/downloads/updates/20 I 4/4tbqtr2 014.pdf.

These comments bring out the importance of public reporting of *P. ramorum* statistics for nursery detections as part of a federal or state regulatory program. The number of detections is fundamental information to allow for an understanding of the effectiveness of these taxpayer supported programs. I encourage CDFA to work together with USDA to improve public reporting of *P. ramorum* interceptions. The program report, linked above from December 2014, is the most recent report that is posted by APHIS. It would be beneficial if CDFA would also post similar statistics for detections within California nurseries but by county. There are other technical errors in the report that I have relayed directly to Heather Scheck, CDFA, Primary Plant Pathologist and Responsible Party for this draft. Since these sentences improperly cited my paper, I wanted to be sure they are publicly noted as incorrect.

Heather Scheck**, 12/30/19 -** Thank you for your comments and information. The correction in “History and Status section, third paragraph”, has been made. The list of *Phytophthora ramorum* hosts reported since

2012/2013 and missing from the APHIS *P. ramorum* host or associated host list that you have provided has been added.

Comment from Mark Stanley, 12/9/19 California Oak Morality Task Force

The California Oak Mortality Task Force (COMTF) appreciates this opportunity to comment on the California Department of Food and Agriculture (CDFA) "California Pest Rating Proposal for *Phytophthora ramorum* Werres, De Cock & Man in 't Veld 2001 Current Rating: Q Proposed Rating: A.". These comments represent the views of the Executive Committee of the COMTF, www.suddenoakdeath.org. Created in 2000, we are a voluntary coalition of research/educational institutions, public agencies, non-profit organizations, and private interests formed to address sudden oak death/*P. ramorum* for California. Part of the COMTF's mission is to provide technical assistance to ensure that up-to-date scientific information is applied to prevent the introduction and spread of *P. ramorum*. In this letter, we express agreement with CDFA's proposed rating change, but include an appendix (see page 2) with a suggested correction to a statement about the risk rating for Del Norte County. The suggested correction would not change the numerical rating for *P. ramorum* but would more accurately describe the risk. We also include a note about additional known *P. ramorum* hosts that have not yet been recognized by USDA APHIS.

We agree with the proposed change to California's Pest Rating for *P. ramorum* from its current rating: "Q" to its proposed rating: "A." In California, an "A" rating is assigned to an organism of known economic importance subject to state- (or agricultural commissioner) enforced action such as: quarantine regulation & exclusion, rejection, eradication, containment, and holding actions. A "Q" rating is assigned to an organism requiring a temporary "A" rating pending determination of a permanent rating. Over the more than 15 years since P. ramorum was first regulated by California (2001) and by the US (2002), our understanding of this invasive pest has improved, as evidenced by the publication of hundreds of research papers that describe its biology, detection methods, and impacts in nurseries and forests. Additionally, monitoring and management actions conducted over the past decade inform our knowledge of *P. ramorum*'s impacts, movement on nursery stock, and treatment outcomes when it becomes established in new areas. In sum, we believe this body of work reduces the uncertainty and supports strict regulation of *P. ramorum* to prevent pathogen introduction and spread.

Reflection on the past 20 years of *P. ramorum*'s impacts in California, coupled with attempts at control, demonstrate why strong, effective regulations are needed to protect plants and industries from irreparable harm. Not only has the pathogen killed an estimated 50 million trees, but since 2017, has been detected damaging threatened and endangered species in wildlands (i.e., *Arctostaphylos pallida*, pallid manzanita) and botanic collections (i.e., *Arctostaphylos morroensis*, Morro manzanita). This spread to rare hosts demonstrates that once a damaging invasive pathogen becomes established in a new environment, despite our best efforts, the impacts can continue to intensify and spread for decades. Prevention, grounded in strict regulations, is key.

Additionally, despite current regulations, the nursery industry continues to struggle with inadvertent, long-distance shipments of the pathogen on planting stock, as evidenced by the 2019 "*Phytophthora ramorum* in

Commerce" shipments that resulted in *P. ramorum* detections (NA2 lineage) in multiple states in the Midwest and Eastern US. We encourage CDFA to continue to work with the National Plant Board and APHIS to prevent future inadvertent nursery stock shipments of potentially infected plants. The COMTF is eager to continue to work with CDF A and partners to protect forests, communities, and nurseries and strengthen California's *P. ramorum* regulatory program. We hope this dialogue may continue and encourage ongoing interaction between regulatory officials and natural resource stakeholders.

Heather Scheck, 12/30/19 - Thank you for your comments and information. The correction to “a statement about the risk rating for Del Norte County”, has been made. The list of *Phytophthora ramorum* hosts reported since 2012/2013 and missing from the APHIS P. ramorum host or associated host list has been added.