CALIFORNIA OAK MORTALITY TASK FORCE REPORT
MAY 2025

MONITORING AND MANAGEMENT

The California Board of Forestry and Fire Protection has added Del Norte County to its sudden oak death zone of infestation (ZOI). This brings the number of counties within the ZOI to fifteen full counties, plus a portion of a sixteenth (Trinity).

Zones of Infestation serve several regulatory and outreach purposes for the state related to forest pests. First, the ZOI designation enables the Board to specify required pest mitigation measures for timber harvest documents on state and private lands within the ZOI. Second, the ZOI designation formally gives the Board and the Department of Forestry and Fire Protection (CAL FIRE) the authority to enter private properties to abate pest problems if necessary. Third, the ZOI designation calls attention to the presence of the pest within the Zone and provides the Department with a talking point to motivate landowners and land managers to address problems caused by the pest in question. Other than for sudden oak death, ZOIs exist in California for bark beetles in specific geographic areas, goldspotted oak borer, the invasive shothole borers, and pitch canker.

Phytophthora ramorum was first detected in Del Norte County in 2019, and USDA APHIS added the county to its list of quarantined areas shortly thereafter. CAL FIRE has waited until now to add the county to the sudden oak death ZOI because of early management activities undertaken in 2020 with the hope of containing the pest to a specific portion of the county. However, since that time the pest has slowly spread, and new strains of the pathogen have appeared, making the ZOI designation necessary for the county as a whole. For more information about the sudden oak death ZOI, contact Chris Lee at christopher.lee@fire.ca.gov.

RESOURCES

Now available! Swiecki, Tedmund J.; Bernhardt, Elizabeth A.; Bourret, Tyler B.; Frankel, Susan J. 2025. Sampling to detect soilborne Phytophthora infestations in California habitat restoration plantings: a technical guide. Gen. Tech. Rep. PSW-GTR-279. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 63 p. doi.org/10.2737/psw-gtr-279. 15MB.

This illustrated guide provides background information and guidance to help resource management professionals and land managers identify habitat restoration sites that have been affected by introduced root-rotting *Phytophthora* species. Restoration sites have become persistently infested with soilborne *Phytophthora* species by the planting of nursery stock with Phytophthora root rot. These infestations can spread beyond planted material into adjoining native vegetation, resulting in expanding areas of plant decline and mortality. Root-rotting *Phytophthora* species decay fine roots and may cause basal stem cankers. This damage induces shoot symptoms related to acute or chronic water stress in infected plants. Because many

other agents and environmental conditions can induce similar or identical shoot symptoms, diagnosis of Phytophthora root rot requires sampling and testing to detect *Phytophthora* in the root systems of affected plants. We provide guidance for sampling plants to detect soilborne *Phytophthora* by baiting of root/soil samples. Topics include strategies to optimize detection and minimize false negative results; details of sample collection, including timing, plant selection, collection and handling; and phytosanitary practices to prevent spread of contamination. We describe specific methods for baiting samples with green (unripe) pears to detect *Phytophthora*. Identification of *Phytophthora* infestations in restoration areas can inform management to prevent further pathogen spread within and beyond infested sites.

COMTF presented a virtual summary of its 20+ year efforts to address *Phytophthora ramorum* through outreach, monitoring, and management coordination to the "Beyond Bunya Dieback" Symposium held on March 14 in Maleny (part of Jinibara Country), Queensland, Australia. The Symposium was held to inform the local community about efforts to slow and manage the Bunya pine dieback problem in eastern Australia, partly by reviewing previous experiences with *Phytophthora* management. For the presentation addressing California's experience, Susan Frankel assembled the slides and Chris Lee narrated them. Some may find these slides a useful overview for learning from COMTF and CalPhytos experiences in managing these damaging pathogens; they are now available at https://www.suddenoakdeath.org/wp-content/uploads/2025/04/SOD-and-other-Phytophthora-problems-in-CA_Lee.Frankel.pdf.

NURSERIES AND MANAGED LANDSCAPES

California Department of Agriculture *P. ramorum* Nursery Program Update.
As of March 2025, there has been one positive nursery found. Seven California nurseries that were previously positive for *Phytophthora ramorum* (*P. ramorum*) in 2023 and 2024 are undergoing spring enhanced inspections in March and April. One previously positive nursery was found to be positive for *P. ramorum* in January after its fall enhanced inspection. The positive nursery is undergoing the USDA's Protocol for Interstate Nurseries Confirmed Positive for *Phytophthora ramorum* from the *Phytophthora ramorum* Domestic Regulatory Program Manual. Plants confirmed positive for *P. ramorum* at California nurseries so far in 2025 are: *Camellia* sp. varieties: Pearl Maxwell, Debutante Light Pink, Yuletide, and Chansonette. Trace inspections have yielded no additional positive plants.

Oregon Department of Agriculture *P. ramorum* Nursery Program Report.
Currently, there are six nurseries participating in the *Phytophthora ramorum* Nursery Program. Four nurseries are interstate shippers under federal compliance agreements (7 CFR 301.92). They are in Washington (2), Clackamas (1), and Marion (1) counties. Two nurseries is an intrastate shipper operating under state compliance agreements (both 7 CFR 301.92 and OAR 603-052-1230) in Clackamas County.

Compliance inspections for the 2025 Spring survey began on March 4th. There are six nurseries which require a compliance inspection entering the sampling season. During the Fall season, five nurseries were negative and one came back with positive samples.

To be released from the program, nurseries must achieve six consecutive negative results from compliance inspections over three years. One nursery was released from the program after the Fall survey. Two nurseries are eligible to be released after the Spring survey if results are negative. For more information, please contact Kevin Bailey at kevin.f.bailey@oda.oregon.gov or Kara Mills at kara.mills@oda.oregon.gov.

Washington State Department of Agriculture (WSDA) *P. ramorum* Program Update.
In January, WSDA received one new trace forward regarding a positive out-of-state nursery. An inspection followed, all plants appeared free of symptoms and no samples were taken.
Haley Palec (hpalec@agr.wa.gov) is the WSDA Plant Services Program Supervisor for Western Washington and is based in Tacoma.

EDUCATION

8th IUFRO Workshop on Resistance Mechanisms and Breeding in Forest Trees that will take place in Vernon, British Columbia, Canada from June 1 - 6, 2025.
https://evoque.swoogo.com/iufro2025/6064499

The Pacific Division of the American Phytopathological Society conducted a joint meeting with the annual Soilborne Pathogen Conference at UC Davis on March 25-27. Several talks and posters addressed topics relevant to *Phytophthora* species in general as well as some *P. ramorum*-relevant material. Cheryl Blomquist of the California Department of Food and Agriculture Plant Pest Diagnostic Center delivered the first day's keynote address, which included an in-depth look at the development of California's sudden oak death regulatory and diagnostic challenges from the first days of the discovery of SOD. Other talks or posters included new research on the modes of action of phosphite fungicides against oomycete pathogens; *Phytophthora* species detected in National Forest lands in northeastern California; detection of *Phytophthora bishii* on berry crops; transformation of *Phytophthora pini* with fluorescent biomarkers; and an explanation of the CalPhytos-developed Accreditation to Improve Restoration (AIR) program for restoration nurseries in California.

RESEARCH

Becker, E., Rajakulendran, N., & Shamoun, S. F. 2025. Biocontrol Potential of *Trichoderma* spp. Against *Phytophthora ramorum*. *Pathogens*, *14*(2), 136. https://doi.org/10.3390/pathogens14020136

Abstract: *Phytophthora ramorum*, the cause of Sudden Oak Death and related diseases, threatens over 130 tree and shrub species. We evaluated the biocontrol potential of isolates from nine *Trichoderma* species against *P. ramorum* using growth-rate studies, dual-culture assays, and culture-filtrate assays. Results showed significant variation in *Trichoderma* growth rates and biocontrol potential. Some isolates exhibited rapid growth, effective overgrowth, and lethal effects against *P. ramorum* and produced potent antagonistic metabolites. Faster growth rates only partially correlated with biocontrol efficacy, indicating that factors beyond growth, such as metabolite production, play significant roles. Notably, isolates of *T. koningii*, *T. viride*, and the

commercial product SoilGard™ (*T. virens*) showed promising efficacy. We calculated a combined biocontrol variable to rank isolates based on vigour and efficacy to aid in identifying promising candidates. Our findings support the use of *Trichoderma* spp. as biocontrol agents against *P. ramorum* and underscore the need for a multifaceted approach to selecting and optimizing isolates. Our evaluation demonstrated the importance of using different assays to assess specific mechanisms of action of biocontrol candidates. Future research should further explore these interactions to enhance the sustainable management of *P. ramorum*.

Frankel, S.J.; Garbelotto, M.; Jones, C.; Grünwald, N.J.; Venette, R.C. 2025. The perils of naïve use of open-source data: A comment on "Spatiotemporal distribution of sudden oak death in the US and Europe." Agricultural and Forest Meteorology. 368: 110553. https://authors.elsevier.com/a/1kx2G_3qm8OEdD

Abstract: Kang et al. (2024) present a spatiotemporal analysis of Phytophthora ramorum outbreaks from 2005 to 2021 in the United States and Europe. However, the analysis and conclusions are flawed because of a lack of understanding of the pathosystems analyzed which led the authors to select improper methods for their analysis. The opensource data analyzed does not include sampling over all seasons of the year. Sampling is primarily conducted in the spring which makes the data unbalanced and inappropriate for examination of seasonality without transformation. Differences in characteristics, and significant driving factors (e.g., relative humidity) between the locations where infection clusters occur, irrigated nurseries with complex sources of inoculum and modified environments versus natural forests subject to only ambient environmental conditions, were not considered when analyzing relationships between moisture conditions and pathogen spread. Additional occurrence records exist for *P. ramorum* in the United States and the United Kingdom, but they were not included in the analysis. Clear descriptive language and proper study design are required to understand how environmental conditions influence *P. ramorum* establishment and spread so they can inform forest management and regulations to protect the resources at risk. An understanding of the temporal and spatial dynamics of Sudden Oak Death, Sudden Larch Death, Ramorum Blight and other diseases caused by *P. ramorum* is critical to serve as the basis for management strategies to limit losses and pathogen spread. The use of publicly available data presents specific challenges that need to be considered in spatiotemporal analyses to obtain meaningful results.

Langer, G.J., Bußkamp, J., Burkardt, K., Hurling, R., Plašil, P., Rohde, M. 2025. Review on temperate oak decline and oak diseases with a focus on Germany. Journal für Kulturpflanzen, 77 (02): 36–49. DOI: 10.5073/JfK.2025.02.04

Abstract: An overview of temperate oak decline and diseases with their different causes is given with special reference to Germany. We discuss the most important complex diseases of oak, i.e. acute oak decline and chronic oak decline, and diseases with a predominantly single cause (sudden oak death, root rot, *Phytophthora* diseases, and Oak powdery mildew), and the important insect pests oak leaf-feeding caterpillars, jewel beetle infestations. The damage patterns and the associated biotic and abiotic factors are analysed in terms of pre-disposing, triggering, and accompanying factors. The current damage processes, especially in north-western Germany, are presented and compared with known disease patterns in oak. The influences of the European megadrought 2018, which is interpreted as an effect of climate change, are discussed.

An example is the vitality loss of oak associated with the occurrence of *Diplodia corticola*. Finally, general recommendations for the management of the most important biotic pests, especially *Agrilus biguttatus*, and the affected oak stands are given.

Mainello-Land, A., Saville, A. C., Acharya, J., and Jean Ristaino. 2025. Loop-Mediated Isothermal Amplification Detection of *Phytophthora kernoviae*, *P. ramorum*, and the *P. ramorum* NA1 Lineage on a Microfluidic Chip and Smartphone Platform. Phytopathology 115:2, 192-203.

Abstract: Rapid, field-deployable assays such as loop-mediated isothermal amplification (LAMP) are critical for detecting nursery and forest pathogens such as *Phytophthora ramorum* and *P. kernoviae* to prevent pathogen spread. We developed and validated four LAMP assays for genus-level detection of *Phytophthora* spp., species-level detection of *P. kernoviae* and *P. ramorum*, and lineage-level detection of the *P. ramorum* NA1 lineage. The cross-reactivity of the two species-specific LAMP assays was evaluated using a set of 18 *Phytophthora* spp. known to infect nursery crop hosts. The correct target species were detected by the species-level LAMP assays. The *Phytophthora* spp. LAMP assay was evaluated against 27 *Phytophthora* spp. and other bacterial and fungal pathogens and reacted with all the *Phytophthora* spp. evaluated but no other bacterial or fungal species. The limit of detection (LOD) of the *P. kernoviae* LAMP was 100 fg/µl, and the LOD of the *P. ramorum* LAMP assay was 1 pg/µl of DNA. The NA1 LAMP assay was tested against the NA1, NA2, EU1, and EU2 lineages of *P. ramorum* and was lineage-specific but had a higher LOD (100 pg/µl) than the species-specific LAMP assays. Both *P. ramorum* and *P. kernoviae* LAMP assays were highly precise (>0.94) in detecting the respective pathogens in symptomatic rhododendron leaves and co-inoculation experiments. The four LAMP assays were run in tandem on a microfluidic chip and smartphone platform and can be used in the field to detect and monitor spread of these regulatory *Phytophthora* spp. in forest and/or nursery settings.

Neugebauer, K.A., Davenport, B., Harmon, C., Byrne, J.M., Miles, L., Snover-Clift, K., Rooney-Latham, S., Martin, F.N., Luster, D.G., and Miles, T.D. 2025. Validation of a Rapid, High Throughput Isothermal Recombinase Polymerase Amplification Screening Assay for *Phytophthora ramorum.* PhytoFrontiers. Published online: 19 Mar 2025. https://doi.org/10.1094/PHYTOFR-10-24-0114-FI

Abstract: *Phytophthora ramorum* is an invasive, federally regulated pathogen in the United States, with at least 75 confirmed hosts and over 100 associated hosts. As a regulated pathogen the movement of ornamental plants infected with *P. ramorum* across the U.S. resulted in a surge of samples experienced by diagnostic laboratories and has underscored the need for a specific and rapid screening assay. This work adapted and validated a previously published *P. ramorum* RPA diagnostic tool for commercial application. This assay was validated through inclusivity testing for the four *P. ramorum* lineages and exclusivity testing on a panel of *Phytophthora* species and other commonly detected oomycetes. The reformulated assay demonstrated sensitive and specific detection of *P. ramorum* down to 1 fg for each lineage, without cross-reacting with over 100 different oomycetes across at least 30 hosts. The RPA assay underwent three tiers of validation. In Tier 1, a single-lab, multi-operator validation, it achieved diagnostic specificity and sensitivity of 100% and 92%, respectively, with 100% reproducibility

and repeatability among operators. Tier 2 validation, performed on a blind sample set at two independent labs, resulted in 100% diagnostic specificity and sensitivity. Tier 3 involved a blind performance study across five independent labs using multiple fluorescent cycler platforms and operators. The reformulated RPA assay offers a rapid and simple approach for the molecular detection and identification of *P. ramorum*.

Treadwell Deuitch, E.M., Rooney-Lathan, S., Blomquist, C.L., Belisle, W.H., Soriano, M.C., and Grunwald, N. 2025. First Report of *Phytophthora ramorum* Causing Leaf Spot on *Arbutus* × *reyorum* 'Marina' in the United States. Published Online: 9 Feb 2025. HTTPS://DOI.ORG/10.1094/PDIS-11-24-2379-PDN

Abstract: The Marina strawberry tree (*Arbutus* × *reyorum* Demoly. 'Marina') is a popular ornamental tree species, prized for its glossy evergreen foliage, display of pink and white bell-shaped blooms, and strawberry-like ornamental fruits. In April 2024, a foliar sample from a Humboldt County, California nursery, where *P. ramorum* had been detected earlier in the year, was submitted to the CDFA Plant Pest Diagnostic Laboratory exhibiting symptoms of marginal leaf necrosis (Fig. S1). A limited number of symptomatic strawberry trees were located near infected *Cornus capitata* plants. Six 6-mm-diameter disks were excised from the margins of diseased leaf tissues and cultured on semi-selective CMA-PARP media (Jeffers and Martin 1986). After approximately 7 days, white, coralloid, and coenocytic hyphae interspersed with globose chlamydospores (22.5 to 52.3 µm in diameter, n = 30), and ellipsoidal, semi-papillate sporangia (32.5 to 75 × 20 to 22.5 µm, n = 30) grew from the disks. This morphology is consistent with that reported for *P. ramorum*. The pathogen was genetically identified by sequencing the internal transcribed spacer region (ITS) and cytochrome oxidase subunit 1 region (cox1) using the primers ITS5/ITS4 (White et al. 1990; accession no. PQ431562) and OomCox1Levup/Fm85mod (Robideau et al. 2011; accession no. PQ438384), respectively. A BLAST search of both amplicons revealed 100% identity with the *P. ramorum* ex-type strain CPHST BL 55G (MG865581 and MH136973). Based on microsatellite loci, the isolate was placed within the NA2 clonal lineage (Goss et al. 2011). Koch's postulates were performed to confirm pathogenicity using 4-year-old *Arbutus* × *reyorum* 'Marina' trees (58 to 75 cm tall) grown in 3.78-liter pots. The foliage of three plants was inoculated with 15 ml of a zoospore suspension of 1 × 104 zoospores/ml following the methods of Blomquist et al. (2021). Two control plants were sprayed with 15 ml of sterile water. All plants were placed in a dew chamber at 23°C. After three days, plants were moved to a growth chamber at 23±1°C with a 12-h photoperiod. During this time, black discoloration was noted on the youngest leaves of the inoculated plants. After approximately 7 days, symptoms characteristic of *Phytophthora* infection were observed including drooping leaves, dieback, and dark foliar lesions extending from the petiole along the midrib into the leaf. By 13 days, the discoloration extended into the flower panicles (Fig. S2). These symptoms differed from those in the original nursery samples, which only displayed lesions along the leaf margins. Both the marginal necrosis in the submitted samples and the symptoms from the pathogenicity tests are consistent with ramorum leaf blight on many hosts under varying environmental conditions. *P. ramorum* was consistently isolated from symptomatic foliage of the inoculated plants, while no symptoms were observed in the control group and no *Phytophthora* was isolated. Although *Arbutus unedo* and *A. menziesii* are known hosts for *P. ramorum* (Farr and Rossman 2024), to our knowledge, this represents the first report of *P. ramorum*

infecting *Arbutus* × *reyorum* 'Marina'. *P. ramorum* is a devastating pathogen affecting numerous plants across diverse environments. The identification of this popular landscape plant as a new host will increase the already extensive time required to inspect for *P. ramorum* in nurseries and may limit its usage in the wildland-urban interface, particularly in areas where *P. ramorum* is present in nearby forests.

RELATED RESEARCH

Dort, E.N., Feau, N., and Hamelin, R.C. 2025. Novel application of ribonucleoprotein-mediated CRISPR-Cas9 gene editing in plant pathogenic oomycete species. Microbiol Spectr 13:e03012-24. https://doi.org/10.1128/spectrum.03012-24

Abstract: CRISPR-Cas9 gene editing has become an important tool for the study of plant pathogens, allowing researchers to functionally characterize specific genes involved in phytopathogenicity, virulence, and fungicide resistance. Protocols for CRISPR-Cas9 gene editing have already been developed for Phytophthoras, an important group of oomycete plant pathogens; however, these efforts have exclusively focused on agricultural pathosystems, with research lacking for forest pathosystems. We sought to develop CRISPR-Cas9 gene editing in two forest pathogenic Phytophthoras, *Phytophthora cactorum* and *P. ramorum*, using a plasmid-ribonucleoprotein (RNP) co-transformation approach. Our gene target in both species was the ortholog of *PcORP1*, which encodes an oxysterol-binding protein that is the target of the fungicide oxathiapiprolin in the agricultural pathogen *P. capsici*. We delivered liposome complexes, each containing plasmid DNA and CRISPR-Cas9 RNPs, to *Phytophthora* protoplasts using a polyethylene glycol-mediated transformation protocol. We obtained two *ORP1* mutants in *P. cactorum* but were unable to obtain any mutants in *P. ramorum*. The two *P. cactorum* mutants exhibited decreased resistance to oxathiapiprolin, as measured by their radial growth relative to wild-type cultures on oxathiapiprolin-supplemented medium. Our results demonstrate the potential for RNP-mediated CRISPR-Cas9 gene editing in *P. cactorum* and provide a foundation for future optimization of our protocol in other forest pathogenic *Phytophthora* species.

EFSA Panel on Plant Health (PLH). 2025. Commodity risk assessment of *Alnus cordata, Alnus glutinosa* and *Alnus incana* plants from the UK. EFSA Journal 23 (1). https://doi.org/10.2903/j.efsa.2025.9189

Abstract: The European Commission requested the EFSA Panel on Plant Health to prepare and deliver risk assessments for commodities listed in Commission Implementing Regulation (EU) 2018/2019 as 'high-risk plants, plant products and other objects.' Taking into account the available scientific information, including the technical information provided by the applicant country, this Scientific Opinion covers the plant health risks posed by the following commodities: *Alnus cordata*, *A. glutinosa* and *A. incana* graftwood, bare-root plants and rooted plants in pots up to 7 years old imported into the EU from the UK. A list of pests potentially associated with the commodities was compiled. The relevance of each pest was assessed based on evidence following defined criteria. Two EU-quarantine pests (*Entoleuca mammata, Phytophthora ramorum* (non-EU isolates)) and one non-quarantine pest (*Phytophthora*

siskiyouensis) were selected for further evaluation. For the selected pests, the risk mitigation measures implemented in the UK and specified in the technical dossier were evaluated taking into account the factors reducing their efficacy. For these pests, an expert judgement is given on the likelihood of pest freedom taking into consideration the risk mitigation measures acting on the pest, including uncertainties associated with the assessment. The degree of pest freedom varies between the pests evaluated, with *E. mammata* being the pest most frequently expected on imported *Alnus* spp. small trees. Expert knowledge elicitation indicated, with 95% certainty, that between 9927 and 10,000 per 10,000 *Alnus* spp. small trees (bare-root plants or rooted plants in pots up to 7 years old) would be free from *E. mammata.*

EFSA Panel on Plant Health (PLH). 2025. Commodity risk assessment of *Taxus baccata* plants from the UK. EFSA Journal 23:e9277. https://doi.org/10.2903/j.efsa.2025.9277

Abstract: The European Commission requested the EFSA Panel on Plant Health to prepare and deliver risk assessments for commodities listed in Commission Implementing Regulation (EU) 2018/2019 as 'High risk plants, plant products and other objects.' This Scientific Opinion covers plant health risks posed by plants of *Taxus baccata* imported from the United Kingdom (UK) as: (a) bundles of 2-year-old bare root plants (whips), (b) 2- to 7-year-old bare root plants, either exported as single plants or in bundles, (c) 2-year-old cell grown plants exported in bundles, and (d) 3- to 15-year-old plants in pots. The assessment was performed considering the available scientific information, including the technical information provided by the UK. All pests associated with the commodity were evaluated against specific criteria for their relevance for this opinion. One EU quarantine pest, *Phytophthora ramorum* (non-EU isolates) fulfilled all relevant criteria and was selected for further evaluation. For the selected pest, the risk mitigation measures implemented in the technical dossier from the UK were evaluated taking into account the possible limiting factors. An expert judgement was given on the likelihood of pest freedom taking into consideration the risk mitigation measures acting on the pest, including uncertainties associated with the assessment. The fact that *T. baccata* is an evergreen plant on which *P. ramorum* can cause foliar infection was considered a critical element in the risk assessment. In addition, the age of the plants was considered, reasoning that older trees are more likely to be infected mainly due to longer exposure time and larger size. The degree of pest freedom slightly differs between bare root plants (including whips) and plants in pots (including cell grown plants), with plants in pots being less likely pest free. The Expert Knowledge Elicitation (EKE) indicated with 95% certainty that between 9699 and 10,000 3- to 15-year-old plants in pots and bundles of 2-year-old cell grown plants per 10,000 will be free from *P. ramorum* (non-EU isolates).

Ficke, A. Schnitzler, J-P., and Wei, Q. 2025. Editorial: The use of volatile organic compounds in sustainable management of pests and diseases. Front. Hortic. 4:1591080. doi: 10.3389/fhort.2025.1591080.

Marques, M., Bugalho, M.N., Acácio, V., Catry, F.X. 2025. Disentangling research on oak decline factors in Mediterranean-type climate regions: A systematic review. Trees, Forests and People, Volume 19. https://doi.org/10.1016/j.tfp.2025.100803.

Abstract: The genus *Quercus* holds significant ecological and economic value in the Northern Hemisphere Mediterranean-type climate (MTC) regions. However, *Quercus* species and ecosystems are threatened by decline. Despite the importance of this genus, a comprehensive analysis of the causes of oak decline across these regions is still lacking. This study maps and analyzes research on oak decline in MTC regions, examining causal factors and *Quercus* species studied, while identifying knowledge gaps and future research priorities. We systematically reviewed 241 peer-reviewed articles on oak decline in MTC regions up to 2022, retrieved from the Web of Science and Scopus databases. Our findings show that scientific articles on oak decline began to be published in 1981 and peaked in 2021. Most studies focused on the Mediterranean Basin, with disparities between Northern Africa and Southern Europe. The most frequently studied species were *Quercus suber* L. and *Quercus ilex* L. in the Mediterranean Basin, and *Quercus agrifolia* Née and *Quercus kelloggii* Newb. in California, comprising 53% of all species mentioned. Pathogens (48%) and climate factors (17%) were identified as the most researched causes of oak decline. Additionally, multiple interactions between factors were identified, confirming that these combinations potentially exacerbate oak decline. Climate factors were the most frequently found in combination with others. Conversely, pathogens were mostly studied in isolation, reflecting their widely recognized role in oak decline. The study highlights the potential risk of pathogen and pest transference between MTC regions and the critical role of management practices in influencing oak decline in interaction with biotic and abiotic factors.

Senn, S., Enke, R. A., Carrell, S. J., Nations, B., Best, M., Kostoglou, M., Smith, K., Yan, J., Ford, J. M., Vion, L., & Presley, G. 2025. De Novo Leaf Transcriptome Assembly and Metagenomic Studies of Coast Live Oak (*Quercus agrifolia*). Applied Microbiology 5(1), 24. https://doi.org/10.3390/applmicrobiol5010024

Abstract: Coast Live Oak (*Quercus agrifolia*) is a native keystone hardwood species of the California coastal and semi-arid forest environment. *Q. agrifolia* is threatened by pathogens such as the oomycete *Phytophthora ramorum*, which is known to cause Sudden Oak Death in environments from Southern California to Oregon. This study considers oaks and their rootzone microbes recovering from moderate and low-intensity fires in rapid succession, compared to high- and low-intensity fires with a large time gap between them. cDNA libraries from nine oak leaf tissue samples were sequenced on DNBseq. Soil samples were sent out for shotgun metagenomics and for 16S community profiling. The de novo *Q. agrifolia* assembly yielded 521,817 transcripts with an average length of 805.2 bp. Among identified DEGs (differentially expressed genes) between the trail areas, several candidate genes were identified including shikimate dehydrogenase and myrcene synthase. The MegaBLAST results showed a high degree of similarity to WGS sequences from *Q. agrifolia* that had been previously annotated in other closely related *Quercus* species. There was a differential abundance of microbial genera associated with the different burn areas, including *Pedobacter*, *Filimonas*, *Cohnella*, and *Sorangium*. The data embody the first *Q. agrifolia* transcriptome that with further development could be used to screen oak seedlings for resistance; beneficial microbial populations have been identified that are associated with fire recovery under varied conditions.