

# 2010 Research Needs Assessment for Sudden Oak Death/*Phytophthora ramorum* in Wildland and Nursery Environments

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## INTRODUCTION

A decade has passed since the plant pathogen *Phytophthora ramorum* was recognized as the cause of Sudden Oak Death in the United States. In that time, Sudden Oak Death has killed more than an estimated 1 million trees in coastal California and Oregon (Meentemeyer 2008), and the pathogen has been detected in ornamental nurseries over 400 times. Despite quarantines established in 2002, *P. ramorum* remains a threat to forests and nurseries nationwide. The USDA-Forest Service, Pacific Southwest Research Station (PSW) has funded a *P. ramorum* research program since 2000 to provide a scientific basis for response programs and to develop management techniques to prevent or mitigate its effects.

Starting from scratch, researchers have provided the foundation for diagnostic, monitoring, management and regulatory programs for this pathogen and for prevention of future exotic pest introductions. This research has been summarized in "[Sudden Oak Death and \*Phytophthora ramorum\*: A Summary of the Literature](#)", and further details may be found in the [Proceedings of the Sudden Oak Death Science Symposia](#) and the [P. ramorum Bibliography](#). A full list of PSW-funded *P. ramorum* research projects, past and current, is available at the [PSW Sudden oak death/ \*Phytophthora ramorum\* website](#).

A Research Needs Assessment for *Phytophthora ramorum* was last conducted in March 2007 at the Sudden Oak Death Third Science Symposium. There, approximately 60 participants ranked a set of pre-gathered research needs as high, medium, or low priority. Many of the specific needs identified by those participants are now being addressed by research projects, but gaps remain. Thus, PSW and the California Oak Mortality Task Force (COMTF) partnered on a 2010 Research Needs Assessment (RNA) for *Phytophthora ramorum*. The purpose of this 2010 RNA was to assess current research needs for the pathogen in both nurseries and wildlands.

## METHODS

Following a model presented by Wolf and Kruger in the *Journal of Forestry* (Jan/Feb 2010), we conducted the RNA through anonymous, online questionnaires using a 2-phase Delphi model.

The Delphi method is a systematic interactive technique for obtaining information from a panel of independent experts without the need to meet face-to-face. It is used to help identify issues, set goals and priorities, clarify positions and differences across groups, and identify solutions (Delbecq et al. 1986, Rowe and Wright 2001). The Delphi approach is iterative, as experts are asked to respond to a small number of questions over two or more rounds. In each round, a facilitator sends out a set of questions (or one broad question) that is the focus of the

Delphi effort, and if the panel of experts accept, they follow instructions and present their understanding and perspectives. The second question set builds on first-round responses and may ask for clarification, level of agreement, or urges respondents to rank or prioritize items that have been submitted in previous rounds. After each round, the facilitator provides a generalized summary of the responses that have been received. The process stops when submissions have changed little between rounds, consensus is approached, or sufficient information is obtained to satisfy the needs of the effort (Delbecq et al. 1986). Final round responses are combined, summarized, and reported back to participants. From that, a framework or timetable of future activity can be derived. (Wolf and Kruger, 2010)

Questions were posed through the University of California’s online Survey Tool. The two Delphi rounds were administered over a 3-month time span (roughly March 15 to June 15, 2010). In round 1, participants were asked to list the three most important *P. ramorum* research questions (Table 1). This phase took place from mid to late March 2010.

At the close of round 1, responses were sorted into 10-11 broad categories. Round 2 took place from late April to mid May 2010. In round 2, participants were asked to rank the categories of issues submitted from round 1. Mean responses were calculated for each category. The final results of the topics and prioritization were then presented at the 2010 Annual COMTF Meeting, held at Dominican University of California in San Rafael on June 10, 2010, and meeting participants were invited to comment and respond orally.

**Table 1. RNA questions from each round.**

Round 1	(1) What are the three most important issues to research regarding <i>P. ramorum</i> in forests and wildlands? <b>OR*</b> What are the three most important issues to research regarding <i>P. ramorum</i> in nurseries?
	(2) What is your professional affiliation with <i>P. ramorum</i> ? (choose one: academic/non-profit; industry; government (local or county department; state department or agency; federal agency)
	(3) Please share any professional associations you are a member of which may be available for research and educational collaborations.
Round 2	On a scale of 1-5 (1 being most important, 5 being least), please rank how important each of these research issues are in terms of <i>P. ramorum</i> in forests/wildlands <b>OR*</b> On a scale of 1-5 (1 being most important, 5 being least), please rank how important each of these research issues are in terms of <i>P. ramorum</i> in nurseries

\*Forestry professionals were asked the wildland research needs question and nursery professionals were asked the nursery research needs question.

A list of “expert” participants was generated based on subject matter experience, with subsets strategically selected to provide a diverse base of affiliations. More than 80 experts representing academia and nonprofits; industry and land management; and local, state, and federal agencies were recruited for the assessment. The project team developed, pretested, and finalized the Delphi questions and then recruited expert participants. An e-mail invitation provided a link to the online Delphi questions. All responses were anonymous.

In order to reach a larger pool of individuals, we extended our reach beyond this list of Delphi “experts” to include the participation of the more generally experienced members of the *P. ramorum* community (hereafter referred to as “community”). We advertised participation through the COMTF website ([www.suddenoakdeath.org](http://www.suddenoakdeath.org)) and numerous professional e-mail

lists. We then ran two rounds of four simultaneous surveys each: Expert Nursery, Community Nursery, Expert Wildland, and Community Wildland. In this way, we were able to follow Delphi guidelines for smaller surveys of invited content experts while also broadening the survey out to a larger audience. This approach provided an additional opportunity to check that our “experts” were not missing any important issues, and to assess whether there were already-completed research projects that needed to be better advertised to the larger community.

During the query phase (Delphi round 1), there were 61 of 89 (69%) responses (Table 2). For the ranking phase (Delphi round2), there were 50 of 89 (56%) responding.

**Table 2. Participant response rates.**

	Total	Forestry	Nursery	Academic	Management	Government
Invited experts	89	42	47			
				26	28	31
Round 1 responses experts	61	29 (69%)	32 (68%)	22 (85%)	19 (68%)	30 (97%)
Round 1 responses community	125	70	55	48	27	56
Total Round 1	186	99	87	70	46	86
Round 2 rankings experts	50	23 (55%)	27 (57%)			
Round 2 rankings community	179	71	108			
Total Round 2	229	94	135			
TOTAL	410			38%	25%	44%

## RESULTS

The categories that received the highest ranking in the Wildland area include: “Evaluation of management approaches” (expert rank = 1, community rank = 3); “Spread in forests” (2, 1); “Eradication and remediation” (3, 2); and “Detection and diagnostics” (4, 4). The community also highly ranked (mean > 4) the category “Ecological impacts.” See Table 3 for the full ranking results for wildlands.

For the Nursery area (see Table 4), the most highly ranked categories included: “Best Management Practices” (expert rank = 1, community rank = 1); “Eradication and remediation” (2, 3); “Diagnostics and detection” (3, 2); and “Pathogen characterization and spread” (4, 4). There was slightly less agreement on further categories, with experts highly ranking (mean > 4) the research topics “Potting media and soils under pots” and “Water” while the community highly ranked “Hosts and symptoms.”

In general however, there was a high degree of agreement between the expert and community responses in both the nursery and wildland areas. In both cases, the top four research concerns from each area were similar, though ranked slightly differently between the two groups.

**Table 3. Forestry results.**Ranked research needs for sudden oak death/*Phytophthora ramorum* in wildland environments.

Category	Expert				Community			
	Delphi 1	Delphi 2			Delphi 1	Delphi 2		
	% of 81 responses	Rank	Mean <sup>a</sup>	SD	% of 173 responses	Rank	Mean <sup>a</sup>	SD
<i>Evaluation of management approaches</i>	25	1	4.70	0.47	28	3	4.20	0.82
<i>Spread in forests</i>	32	2	4.52	0.90	32	1	4.39	0.69
<i>Eradication &amp; remediation</i>	6	3	4.13	1.10	1	2	4.22	0.98
<i>Detection &amp; diagnostics</i>	5	4	3.91	1.06	7	4	4.03	0.99
<i>Ecological impacts</i>	9	5	3.70	0.93	17	5	4.01	0.79
Host plants (including resistance)	9	6	3.34	0.97	5	7	3.68	0.95
Human dimensions of management (regulatory and policy)	2	7	3.30	0.97	5	9	3.44	0.98
Restoration	7	8	3.22	1.00	3	6	3.75	0.98
Social & economic impacts	4	9	3.04	0.88	0.5	10	3.15	1.02
Pathogen characterization	2	10	3.00	0.95	2	8	3.49	1.03

<sup>a</sup>Prioritization is noted as a number along a scale with 1= Very Low Priority and 5 = Very High Priority. The results are organized to show the highest prioritized content categories sorted to the top, with shaded boxes representing any issue deemed at least High Priority (Delphi 2 Mean > 3.9).

**Table 4. Nursery results.**Ranked Research Priorities for *Phytophthora ramorum* in Nurseries

Category	Expert				Community			
	Delphi 1	Delphi 2			Delphi 1	Delphi 2		
	% out of 97	Rank	Mean <sup>a</sup>	SD	% out of 146	Rank	Mean <sup>a</sup>	SD
<i>Best Management Practices</i>	11	1	4.56	0.64	12	1	4.44	0.68
<i>Eradication &amp; Remediation</i>	11	2	4.50	0.95	10	3	4.26	0.96
<i>Diagnostics &amp; Detection</i>	13	3	4.30	0.95	12	2	4.29	0.89
<i>Pathogen Characterization &amp; Spread</i>	13	4	4.26	0.76	4	4	3.98	0.84
<i>Potting Media &amp; Soils Under Pots</i>	20	5	4.12	0.99	16	9	3.53	1.10
<i>Water</i>	8	6	4.00	1.07	4	7	3.64	1.03
<i>Hosts &amp; Symptoms</i>	6	7	3.48	1.05	14	5	3.92	0.89
Distribution	5	8	3.30	0.87	7	6	3.64	0.97
Economic Impacts	1	9	3.22	1.12	n/a <sup>1</sup>			
Resistance	2	10	3.22	1.09	5	8	3.55	1.07
Regulations	7	11	2.89	1.05	8	10	3.31	1.12

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(1) Unlike the Expert Nursery survey, the Public Nursery survey in Round 1 did not include any submitted research questions under the category “Economic Impacts so we did not include that category in Round 2 of the Public Nursery survey.

## DISCUSSION

The wildland responses from the last PSW–COMTF sudden oak death/*Phytophthora ramorum* research needs assessment, in 2007, can be grouped into a few general categories: water detection, survival in soil, host resistance, conifer susceptibility, management tools, restoration, etc. The 2010 results show that many of these same issues remain paramount, particularly a better understanding of pathogen spread and the development of effective management tools. Now that there is a baseline understanding of the pathogen and the diseases it causes, there seems to be a growing need for more specific knowledge on how to stop the pathogen from spreading to new areas (“Spread in forests”), finding it quickly if and when it does arrive (“Detection and diagnostics”), and then having effective management tools to eradicate it or mitigate its effects (“Eradication and remediation” and “Evaluation of management approaches”).

From previous efforts (COMTF 2007; COMTF 2008), nursery research issues have included the following: spread prevention and reduction, symptomless hosts, root infection, repeat/recurrent nurseries, buffers, fungicides, etc. In 2010, the issues for nurseries remain finding the pathogen (“Diagnostics and detection”) and eradicating it (“Eradication and remediation”), along with better nursery management tools to prevent the introduction, establishment, and spread of the pathogen all together (“Best Management Practices”). Among experts, there is particular concern for soil and water as vectors for pathogen spread.

As noted by some of the participants, many categories, and specific research questions, are common to both nursery and forest systems. Also, many questions and topics of concern are closely related and ideally would be addressed simultaneously.

Differences between the artificially contrived “expert” and “community” groups were fairly small. This suggests that the research issues important to the experts were also those important to the larger community. It also suggests that the “community” we surveyed has a very solid knowledge of the issues. This is likely due to the methods of advertising (professional e-mail lists and websites) we employed. Rather than selecting a random sample of people to gauge their understanding of this issue affecting wildland and nursery environments, our survey attracted those who were already interested and aware. A broader and more truly “public” survey could potentially yield different results.

While most participants were able to negotiate the limitations of our survey methodology, it is possible that our constructs did not allow for the full expression of people’s thoughts on *P. ramorum* research needs. We received comments that the categories we provided for the second Delphi round were not well named or separated from one another, that there was too much

overlap, or that the specific research questions within those categories were misplaced. This likely swayed the ranking of specific categories for those cases, but over the course of the 200+ responses, we feel that this issue would not significantly change the results.

These research needs can guide horticultural and wildland research programs to assure that the most critical needs for sudden oak death/*Phytophthora ramorum* are being addressed. Periodic reassessment of research needs is recommended as new findings and new problems arise.

## LITERATURE CITED

California Oak Mortality Task Force. 2007. Research Needs Assessment for *Phytophthora ramorum* in wildlands. <http://nature.berkeley.edu/comtf/pdf/SOD3RNAsummary.pdf>

California Oak Mortality Task Force. 2008. Nursery Committee research needs. <http://www.suddenoakdeath.org/pdf/NurseryResearchNeedsList3-9-08.pdf>

Kliejunas, John T. 2010. [Sudden Oak Death and \*Phytophthora ramorum\*: A Summary of the Literature](#). Gen. Tech. Rep. PSW-GTR-230. Albany, California. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 181 pages.

Meentemeyer, R. K., N. E. Rank, D. A. Shoemaker, C. B. Oneal, A. C. Wickland, K. M. Frangioso, and D. M. Rizzo. 2008. Impact of sudden oak death on tree mortality in the Big Sur ecoregion of California. *Biological Invasions* 10:1243-1255.

Wolf, Kathleen L. and Linda E. Kruger. 2010. Urban forestry research needs: A participatory assessment process. *Journal of Forestry* 108(1): 39-44.