Since 2004, Rizzo lab and collaborators have monitored California watersheds during spring and early summer for the presence of Phytophthora species. This primarily served as an early detection tool for the sudden oak death (SOD) pathogen, P. ramorum, but other species were encountered and notable isolates occasionally saved. From 2013-2015 a more concerted effort was made to isolate species of Phytophthora other than P. ramorum

- Streams were baited using submersed Rhododendron leaves
- Isolations were made with Phytophthora-specific media; P. ramorum was identified on the basis of morphology and other species were identified with sequences of ITS nrDNA

The exotic, invasive P. ramorum was found at the greatest number of sites, followed by members of clades 3 and 6

- P. chlamydospora, P. gonapodyides and P. syringae were isolated from all five well-sampled coastal counties
- Though otherwise relatively common, species in clade 3 were never isolated from San Luis Obispo, the southernmost county; P. plurivialis, recently documented as a foliar conifer pathogen in Oregon was not isolated south of Mendocino Co.
- Four species were only isolated from the two northernmost counties; the three species in clade 2c were restricted to the two northernmost counties
- Limited sampling of interior counties in the foothills of the Sierra Nevada yielded only species in clade 6

### Table 1. List of Phytophthora species recovered by Rhododendron leaf-baiting of streams and rivers, 2004-2015. The number of unique sites from which a species was isolated is indicated. *Not described in published literature. DNO = Del Norte Co., HUM = Humboldt Co., MEN = Mendocino Co., MON = Monterey Co., SLO = San Luis Obispo Co. Interior counties include Butte, El Dorado, Nevada, Placer and Yuba Cos. The central coastal counties Santa Cruz and San Benito were relatively sparsely sampled and not included in the table. P. chlamydospora and P. ramorum were isolated from Santa Cruz Co., while P. gonapodyides and P. riparia were isolated from San Benito Co.

<table>
<thead>
<tr>
<th>Species</th>
<th>North Coast</th>
<th>Central Coast</th>
<th>Interior</th>
<th>Clade</th>
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<tbody>
<tr>
<td>P. cactorum</td>
<td>6</td>
<td>X</td>
<td>X</td>
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<tr>
<td>P. taxon sequoia*</td>
<td>1</td>
<td>X</td>
<td>1</td>
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<tr>
<td>P. multivora</td>
<td>4</td>
<td>X</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>P. pini</td>
<td>1</td>
<td>X</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>P. siskiyouensis</td>
<td>2</td>
<td>X</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>P. taxon obisstream*</td>
<td>1</td>
<td>X</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>P. nemorosa</td>
<td>18</td>
<td>X</td>
<td>X</td>
<td>3</td>
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<td>P. plurivialis</td>
<td>14</td>
<td>X</td>
<td>X</td>
<td>3</td>
</tr>
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<td>P. pseudosyringae</td>
<td>39</td>
<td>X</td>
<td>X</td>
<td>3</td>
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<td>P. chlamydospora</td>
<td>25</td>
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<td>X</td>
<td>X</td>
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<td>P. gonapodyides</td>
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<td>X</td>
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<td>P. lacustris</td>
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<td>X</td>
</tr>
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<td>P. riparia</td>
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<td>X</td>
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<td>X</td>
<td>6</td>
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<td>X</td>
<td>6</td>
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<td>P. sp. NJB-2015*</td>
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<td>X</td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>P. lacustris X riparia</td>
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<td>X</td>
<td>8</td>
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<td>P. ramorum</td>
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<td>X</td>
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<td>P. syringae</td>
<td>11</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>P. aff. syringae*</td>
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<td>8</td>
<td></td>
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<td>&quot;Hydrophyllomyces&quot; sp.1*</td>
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<td>X</td>
<td>X</td>
<td>8</td>
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</tbody>
</table>

*Fig. 1. Watersheds from which Phytophthora species were identified. Colored polygons highlight watersheds upstream from Phytophthora-positive sampling sites. Inset, left: Rhododendron leaves exhibiting symptoms consistent with Phytophthora infection. Inset, right: Rhododendron leaves in mesh sachets deployed in a stream.

"Phytophthora sp. NJB-2015" is the provisional name given to two strains recovered from natural waterways in MA, USA. ITS, beta-tubulin and nrCOX1 sequences have recently been uploaded to GenBank, and the taxon appears to be phylogenetically valid. P. taxon obisstream falls within the P. citrinula species complex and is distinct from previously described members of the complex by ITS, nrCOX1 and nrCOX2 sequences. Two strains were isolated from the same San Luis Obispo Co. creek in February and May of 2015.

P. taxon sequoia is a novel species in clade 1a, closely related to but distinct from P. cactorum and P. pseudotaxon. It was isolated only once by the stream monitoring project, but additional strains have been isolated by the Rizzo lab from SOD study plots in Big Sur, CA baiting soil and direct isolation from tanoak (Umbellularia californica) leaf submerged in a Sonoma Co. stream.

P. aff. syringae ambiguously represents a new subspecific clade within P. syringae or a novel species in clade 8; it is phylogenetically distinct from other strains of P. syringae from which sequences are available, but additional studies are ongoing to clarify the boundaries of P. syringae.

"Hydrophyllomyces" forms a monophyletic group with Phytophthora and Phytophthora (including downy mildew) but is distinct from either group, indicating that it may require the description of a new genus (Fig. 2). The two isolates obtained in the current study correspond to a single species, and from a separate project in the Rizzo lab a third, phylogenetically distinct isolate corresponding to a second species in the putative genus was isolated from a California bay (Umbellularia californica) leaf submerged in a Sonoma Co. stream.

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