

# Process and Pattern in the Emergence of *Phytophthora ramorum*<sup>1</sup>

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The invasive sudden oak death pathogen, *Phytophthora ramorum*, has emerged repeatedly since its first detection in the 1990s in the United States and Europe. This paper will explore recent research by several groups published in the review by Grünwald et al. (Grünwald, N.J.; Garbelotto, M.; Goss, E.M.; Heungens, K.; Prospero, S. 2012. Emergence of the sudden oak death pathogen *Phytophthora ramorum*. Trends in Microbiology. 20: 131–138.), documenting the patterns observed and mechanisms inferred to explain these patterns. Briefly, four distinct clonal lineages are currently recognized, NA1, NA2, EU1, and EU2 named consecutively after the continent of origin on which they were first found, North America (NA) and Europe (EU). While the three clonal lineages NA1, NA2, and EU1 are found in Canada and the United States, Europe, to date, has the EU1 and EU2 clonal lineage. Detailed phylogeographic analysis has documented that the introduction of the NA1, NA2, and EU1 clonal lineages originated from separate populations. The status of the EU2 lineage has to date not been investigated using these evolutionary approaches, but the lineage appears to be distinct and clearly evolutionarily diverged from the three other lineages (Van Poucke, K.; Franceschini, S.; Webber, J.F.; Vercauteren, A.; Turner, J.A.; McCracken, A.R.; Heungens, K.; Brasier, C.M. 2012. Discovery of a fourth evolutionary lineage of *Phytophthora ramorum*: EU2. Fungal Biology 116: 1178–1191.).

The NA1 lineage was introduced into California from an unknown source population, while the NA2 and EU1 lineages were introduced into the Pacific Northwest (either British Columbia or Washington). While the source population for the NA2 introduction remains to be established, coalescent analysis supported introduction of the EU1 lineage into North America from Europe. The EU2 lineage was first found in Northern Ireland and more recently in Western Scotland and the source population remains to be established (Van Poucke et al. 2012). Further emergence of *P. ramorum* lineages is likely, given the observed repeated emergence of *P. ramorum* over the last 2 decades, and appears to be driven by shipment of infested nursery material.

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