

Ten New Provisional Species of *Phytophthora* and *Nothophytophthora* From California¹

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Abstract

Phytophthora diseases in landscapes have gained prominence during the 21st century, due to an increase in *Phytophthora* surveys and a greater focus on species-level diagnostics. Concurrently, the number of known *Phytophthora* species has increased from about 60 in 1996 to more than 300 today. In addition to entirely novel species being discovered, many of the most common and well-known 20th century species have been revealed to represent species complexes and are rapidly being divided into new taxa. Beyond the increasingly large *Phytophthora*, two *Phytophthora*-like related genera, *Calycofera* and *Nothophytophthora* were described in 2017.

Herein are presented nine novel species of *Phytophthora* and one novel *Nothophytophthora* species recently isolated from California. Each species is provisionally described by demonstrating it to be phylogenetically distinct from all other named species based on analysis of ITS rDNA and COX1 mtDNA sequences, the two barcoding loci used for *Phytophthora* species-level identification. Some species appear to be cryptic species within well-known complexes; these taxa are also found outside of California based on the geographic sources of publicly deposited sequence data. For other species, there is no evidence that they have ever been previously isolated. Whether these new species represent endemic Californian pathogens, long-term residents or recent invaders is unknown.

Two novel species are presented in *Phytophthora* clade 2: *Phytophthora* sp. *aureomontensis* is a member of the *P. citricola* species complex only known from California and Oregon coastal streams. *Phytophthora* taxon eriodictyon is a member of the *P. citrophthora* species complex that appears to be moving worldwide via the nursery trade; this species is known in California only from restoration outplantings. *Phytophthora* sp. *cadmea* is a novel species in clade 7a also

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baited from restoration areas. *Phytophthora* taxon *wysteria*, also a member of clade 7 was isolated from a commonly planted ornamental. *Phytophthora* taxon *agrifolia* represents a novel sub-clade within the vast clade 8. Two novel species are presented in clade 9, one of which, *Phytophthora* taxon *xguadalupesoil*, appears to be an interspecific hybrid. *Phytophthora* taxon *juncus* is closely related to the only other member of clade 11, *Phytophthora lilii*, while *Phytophthora* taxon *mugwort* represents its own subgeneric clade, clade 13. *Nothophytophthora* taxon *umbellularia* is known only from a single isolate, baited from a North coast creek with a California bay laurel (*Umbellularia californica*) leaf.

Although provisional, naming these taxa and depositing their barcoding sequences into public databases provides vital information to the worldwide *Phytophthora* diagnostics community about the distribution and movement of these potentially pathogenic and invasive organisms. More systematic work, including morphological characterizations and pathogenicity tests are needed to more fully characterize these provisional species, and live strains will be deposited in culture collections. Nevertheless, because the direct comparison of DNA sequences represents the most tractable and reliable way to compare *Phytophthora* isolates across space and time, this initial step serves to inform the scientific and regulatory communities of the existence of these species.