Phytophthora ramorum: a threat to Australia?

Emer O'Gara[1], Daniel Hüberli[2] and Giles Hardy[1]

[1]Centre for Phytophthora *Science and Management, Murdoch University, Perth, Western Australia; Email: e.ogara@murdoch.edu.au*
[2]Department of Environmental Science, Policy, and Management, Forest Pathology and Mycology Laboratory, University of California, Berkeley, California, United States

What makes *Phytophthora cinnamomi* such a devastating plant pathogen in the Australian environment?

- It is a microscopic organism that lives in soil and plant roots.
- It can, and has, spread widely in many Australian landscapes through movement of infested soil from one location to another, naturally and by human activities ranging from bushwalking to mining.
- It can reproduce asexually and prolifically when conditions are optimal (warm and moist).
- It infects a very broad range of plants, and the susceptibility of much of Australia's unique flora indicates that it is exotic in origin.
- Once present in a landscape it cannot be eradicated, although management is possible with commitment from governments, industry and the community.

It's a fairly grim scenario...but it couldn't get any worse...could it? Unfortunately, it could! Imagine a species of *Phytophthora* that has all the characteristics of *P. cinnamomi*, but also has the capacity to be carried by wind-driven rain. *Phytophthora ramorum* is just such a pathogen.

P. ramorum was first discovered in 1993 on rhododendrons in Dutch and German nurseries. Within approximately 10 years it had been isolated from 300 nurseries across the UK, and nurseries in 9 other European countries, mostly from the popular garden shrubs rhododendron, viburnum, pieris and camellia (Pain 2004). The first signs of disease caused by *P. ramorum* in the US appeared on oak trees in San Francisco in 1995 (Werres *et al.* 2001). The disease has now reached epidemic proportions in some areas of California and extends 650 km along the Pacific coastline from Monterey to southern Oregon (Rizzo and Garbelotto 2003). The disease caused by *P. ramorum* has become widely known as 'Sudden Oak Death', which is misleading, because we now know that the host range is much broader.

P. ramorum causes two different diseases: large cankers on the main stem of oaks (*Quercus* spp.) and Tanoaks (*Lithocarpus densiflora*) that often kill the tree, and non-lethal foliar and twig infections on a wide range of plant species. Information from the US Department of Agriculture website (accessed 05/04/05), current as of the 10th January 2005, lists 31 proven hosts (i.e. *P. ramorum* has been isolated from naturally infected plants, and experiments have confirmed that the species can be infected by the pathogen) and 37 associated plants (i.e. *P. ramorum* has been isolated from naturally infected plants, but experiments have yet to be conducted to determine if they are hosts). As well as *Quercus* spp. and *Lithocarpus densiflora*, the proven hosts include species from the following genera: *Acer, Camellia, Photinia, Pieris, Pseudotsuga, Rhododendron, Rosa, Umbellularia, Viburnum* and the iconic *Sequoia* (Giant Redwoods). Plant species that are not killed appear to serve as a reservoir for the pathogen (Rizzo and Garbelotto 2003).

The origin of *P. ramorum* and most details of its biology and ecology remain unknown, but the high susceptibility of Tanoak suggests that *P. ramorum* is exotic to the US (Rizzo and Garbelotto 2003). Some scientists believe that unregulated international plant movements in the horticultural trade were responsible for the introduction (Hansen 2003). The problem is compounded by the use in nurseries worldwide of chemicals that suppress pathogens but do not kill them, so that infected plants can appear healthy to the consumer, and viable pathogens can be transmitted to home gardens and the broader landscape.

The suggested link between the introduction and spread of *P. ramorum* in the US and the international and national trade in plants has had a big impact on the nursery industry. In the US the nursery industry, which is concentrated in California and Oregon, is the third-highest value crop category in the US (Regelbrugge 2003). The imposition of a complete ban by some states on plants from California, and regularly updated federal regulations due to the epidemic, has the nursery industry reeling (Purdue University website, accessed 07/04/05). Earlier this year the US Department of Agriculture (USDA) issued new restrictions on the movement of nursery stock from California, Oregon and Washington (Landscape Management website, accessed 07/04/05).

It will be many years before the impacts of *P. ramorum* on natural ecosystems and biodiversity in the US are fully realised and understood. However, it is already clear that dieback of native vegetation has created a habitat ripe for exotic weed invasion and soil erosion and has degraded wildlife habitat (Frankel 2003). The socio-economic impacts are already being widely felt. In the coastal counties of California, where 'Sudden Oak Death' was first recognised and where susceptible species are concentrated, the wildland-urban interface is heavily populated. The increasing number of large, dead trees in these areas poses a number of problems including the high cost of tree removal, the increased risk of fire and damage to life and property if they are not removed, the loss of amenity and recreation values, a reduction in property values, public fear about the potential of the disease in their gardens and forest,

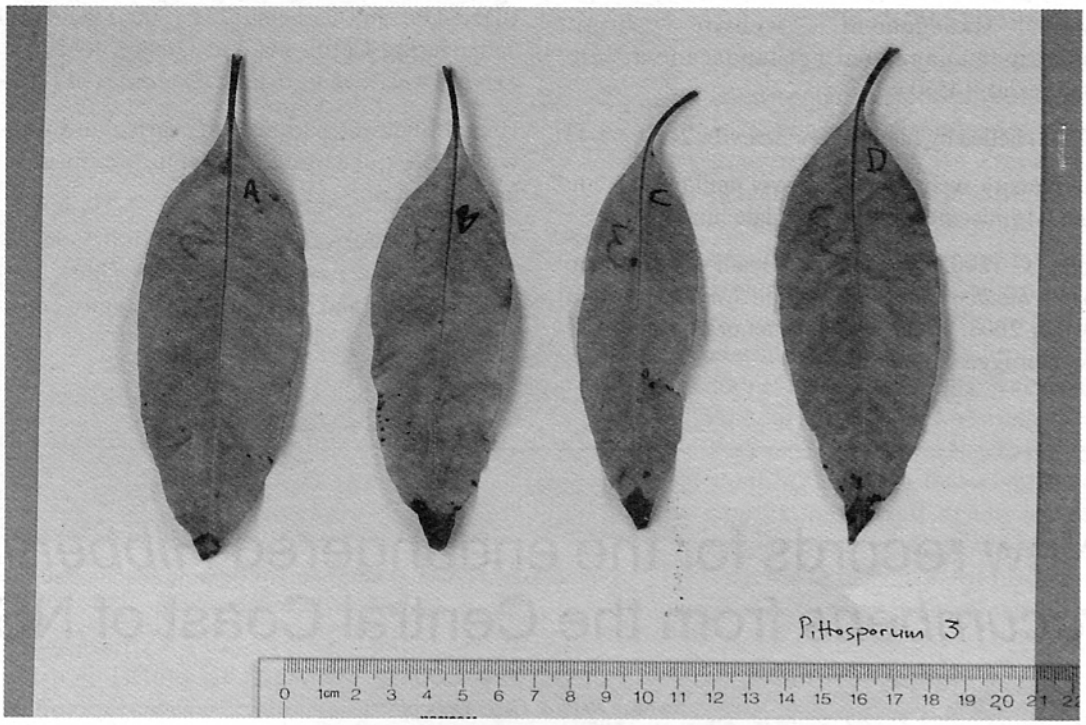


Figure 1. Leaves of Pittosporum undulatum *32 hours after they were inoculated with* Phytophthora ramorum *in trials in the US.* Pittosporum undulatum *is native to moist gullies in rainforest and sclerophyll forest from south-east Queensland to eastern Victoria, areas which are considered conducive to the establishment of* Phytophthora ramorum.
Source: Pathology and Mycology Laboratory, University of California, Berkeley

and initial outrage at what was perceived as insufficient action by the authorities to control it (Frankel 2003).

You may be wondering what all this has to do with Australia? It has plenty to do with us, for the simple reason that Australia also imports and exports plants as part of the worldwide nursery trade that has been implicated in the introduction of *P. ramorum* to the US. Historically, visual inspection of imported material has been the primary defence against introducing new pests/pathogens to an importing country (Regelbrugge 2003); however *Phytophthora* spp. can be present in the soil or in the plant without being apparent, even to the trained eye.

A recent evaluation of climatic conditions in Australia showed that many productive forests, old growth forests and temperate rainforests could be conducive to *P. ramorum* disease development (Smith *et al*, unpublished data). Some limited field observations and pathogenicity tests have indicated that a number of Australian species native to these high risk areas, including *Eucalyptus gunnii* (Brown unpublished data), *Nothofagus* sp (Brown, unpublished data) and *Pittosporum undulatum* (Hüberli *et al.*, unpublished data; Figure 1), are susceptible to *P. ramorum.*

P. cinnamomi and *P. ramorum* reproduce through the production of sporangia (see Fig 3 of Summerell et al. article on page 4). However, sporangia of *P. cinnamomi* remain attached to the main body of the pathogen (the mycelium) and thus remain in either infested soil or plant tissue, whereas the sporangia of *P. ramorum* break off the mycelium when they are mature and can then be carried in wind and wind-driven rain. In the event that *P. ramorum* was accidentally introduced to Australia, humans would pose the greatest risk in spreading the pathogen in the landscape, just as they do for *P. cinnamomi*. However, the fact that *P. ramorum* can also be spread by wind-driven rain means that the current containment methods for *P. cinnamomi* would not be directly transferable to or as effective for *P. ramorum.*

It is clear that action needs to be taken immediately in Australia to: a) guard against the introduction of *P. ramorum;* b) determine the risk of an introduction to Australia; and c) develop an emergency containment and management strategy in the event of an introduction. Current research proposals for collaborations between Australia, the UK and US will address the issues of preparedness and prevention of an incursion to Australia, and management of an incursion should quarantine measures fail.

References

Frankel, SJ. (2003) Sudden Oak Death's impact on urban forestry and arboriculture. *Sudden Oak Death Online Symposium,* April 21 - May 12, 2003. http://www.apsnet.org/online/SOD/Papers/Frankel/default.htm

Hansen, E. (2003) *Phytophthora* in North American forests. *Sudden Oak Death Online Symposium,* April 21 - May 12, 2003. http://www.apsnet.org/online/SOD/Papers/Hansen/default.htm

Landscape Management website http://www.landscapemanagement.net/landscape/article/articleDetail.jsp?id=145705

Pain, S. (2004) Felled by fungus. *New Scientist* 2450: 40-43.

Purdue University website http://www.ppdl.purdue.edu/ppdl/hot04/3-15misc/news/news_by_date.html

Regelbrugge, C. (2003) Sudden Oak Death - U.S. nursery trade impacts. *Sudden Oak Death Online Symposium*, April 21 - May 12, 2003. http://www.apsnet.org/online/SOD/Papers/Regelbrugge/default.htm

Rizzo, DM. and Garbelotto, M. (2003) Sudden Oak Death: endangering California and Oregon forest ecosystems. *Frontiers in Ecology and the Environment* 1(15): 197-204.

United States Department of Agriculture website http://www.aphis.usda.gov/ppq/ispm/pramorum/pdf_files/usdasodlist.pdf

Werres, S., Marwitz, R. and Man in't Veld, WA. (2001) *Phytophthora ramorum* sp nov: a new pathogen on rhododendron and viburnum. *Mycological Research* 105: 1155-64.

New records for the endangered *Hibbertia procumbens* from the Central Coast of NSW

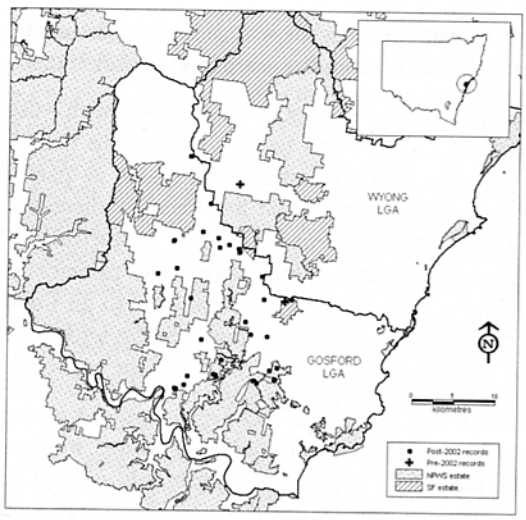
Stephen Bell[1] *& Colin Driscoll*[2]

[1]*Eastcoast Flora Survey; Email: sajbell@bigpond.com*

[2]*Eco Biological; Email: cd_enviro@bigpond.com*

Hibbertia procumbens (Labill.) DC (Dilleniaceae) is a summer-flowering prostrate shrub, currently listed in New South Wales as endangered under the *Threatened Species Conservation Act 1995*. Harden and Everett (1990) noted in the *Flora of New South Wales* that this species was known only from the Mangrove Mountain area of the NSW Central Coast. However, it is also present in Victoria and Tasmania, where it is locally common. It is likely that all New South Wales specimens may represent a new, currently undefined taxon (H. Toelken, pers. comm.).

In a review of the habitat of this species at the two then known locations, Bell (2002) suggested that with concerted survey effort in heath and scrub vegetation, it was likely that additional populations would be located. In recent years, a combination of targeted survey and more general vegetation survey, both by us and other workers, has significantly increased the number of known populations of this species. Currently, there are at least 30 known populations in NSW, with a distribution extending from the city of Gosford north to near Yarramalong, and west to the Popran National Park area (see map).



Known populations of Hibbertia procumbens *on the Central Coast of NSW*

New populations

As part of the development application process required under state planning legislation, searches for and assessment of threatened species are mandatory. Several workers have discovered a number of new populations of *Hibbertia procumbens* on private lands as a consequence of this process. Detailed population counts have been undertaken at some of these (eg: Bell & Driscoll 2003), where populations in the order of 1000 plants have been found. Ground-truthing of regional vegetation mapping has also uncovered new populations, simply by targeting potential habitat in a number of representative areas (Bell 2004).