Myrtle Rust – what's happening?

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The story so far

Puccinia psidii (Eucalyptus Rust or Guava Rust, in Australia also known as Myrtle Rust) is an exotic rust fungus of South American origin. It attacks plants of the family Myrtaceae only, which includes Eucalypts, Tea-Trees, Bottlebrushes and Lillipillies. Recognition guides and other material are on the Web:

www.daff.qld.gov.au/plants/health-pests-diseases/a-z-significant/myrtle-rust

www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust

www.depi.vic.gov.au/agriculture-and-food/pests-diseases-and-weeds/plant-diseases/shrubs-and-trees/myrtle-rust.

The *Puccinnia psidii* pathogen has long been known overseas to infect some Myrtaceae of Australian origin, mainly Eucalypts in South American plantations. Plant pathologists had regarded it as a potential threat to native Australian Myrtaceae species, to Myrtaceae-dominated ecosystems, and to industries dependent on plants of this family. *P. psidii* gradually moved closer to Australia in the 2000s: to California and Hawaii in 2005, then to Japan and southern China in 2009. Plant Health Australia published an Australian Contingency Plan for Eucalyptus Rust in 2009.

Myrtle Rust was first detected in Australia on the New South Wales Central Coast in early 2010. Since then it has spread and naturalised along the east coast from Narooma in NSW to Cooktown in North Queensland, mostly in low-elevation coastal areas but extending further inland to the mid-upper Clarence Valley of NSW, the Toowoomba area in south-eastern Queensland, and onto the edge of the Atherton Plateau in North Queensland. There are no naturalisation records west of the Great Dividing Range so far. There have been numerous Victorian occurrences, mainly in the Melbourne-Geelong area in cultivation and the 'greenlife' industries, but it does not yet appear to have naturalised in bushland in that State, where an active containment and eradication strategy is being run by the Victorian Department of Environment and Primary Industries and partners. Myrtle Rust is nevertheless regarded there as an 'endemic disease'.

Other Australian States are not yet affected, but all predictive models to date show warm/moist areas in all States to be at risk of Myrtle Rust naturalisation, albeit with considerable uncertainty for the non-rainforest tropical coasts. The pathogen is also a threat to Myrtaceae in the Malesian and south-east Asian areas, and Africa. It arrived in both New Caledonia and South Africa in 2013.

Myrtle Rust spores are naturally wind- and animal-borne. There are however strong indications that much of the long-distance spread within Australia has resulted from human movement of infected plant material. Extreme vigilance in the greenlife industry and among non-commercial plant growers is vital in the uninfected areas of the country. Some restrictions on the inter-state movement of Myrtaceae plants and products are in place—see your Primary Industries departmental websites for details. Spores can also be moved on people and clothing. If you have been in infected vegetation, laundering of clothes and disinfection of tents, tarps, hats etc is needed before travelling to uninfected States or areas, especially if you intend to visit nurseries or bushland—see the websites above for guidelines.

There are several overseas variants ('pathotypes') of this fungal pathogen. They differ in their host-species preferences and severities, but are only very recently beginning to be studied in detail. The potential arrival in Australia of further strains is a big worry.

300 native host species…and counting

We appear to have only one variant of *Puccinia psidii* in Australia so far, but it is proving to be bad enough. In just four years it has proved capable of infecting more than 300 native Australian Myrtaceae species as hosts. This is an extraordinarily wide host-range—most rusts have only one or a few. Australia has about 2,250 native species of Myrtaceae, and approximately half of these occur in the climatic areas assessed as broadly suitable for Myrtle Rust establishment.

So far, only a minority of host species are severely affected, although it is still early days and very few species have been scrutinised for susceptibility at critical life-stages like seedlings and resprouts, as distinct from seasonal growth. Even among those species that are highly susceptible, severity varies depending on growth stage and climatic conditions (the fungus needs damp nights and moderately warm temperatures). Myrtle Rust attacks mainly new leaf and shoot growth, i.e. seedlings, seasonal flush or resprouts. In some species it also attacks the flowers and in some soft-fruited genera, the fruits. Effects can include death of seedlings, eventual defoliation of older plants, and reduced reproductive capacity especially for those species that flower on younger shoots. Myrtle Rust does not make plants drop dead suddenly (except seedlings), but the attrition effects are cumulative. Death of adult plants after 2-3 years of repeated infections is now being recorded in a couple of highly susceptible shrub species.

Resistance to *Puccinia psidii* in several forestry eucalypt species grown in South America is relatively well documented, and has been bred into new clonal lines for some plantation species and hybrids. Disease-tolerant or 'resistant' plants or populations are also being detected in a few of the new Australian non-eucalypt host species, but the genetic and physiological bases of resistance are only now coming under study, and only for a very few taxa—resources are lacking for comprehensive survey and the necessary genetic analysis and selection trials except for commercially significant species. The heritability of resistance, even where it is present, may not be straightforward. In many or most wild populations of highly susceptible species it is very doubtful whether natural selection, to favour resistant genotypes, will kick in in time to compensate for demographic decline caused by the Rust, or without a drastic narrowing of the gene pool, either of which would add to the impacts of other threatening processes.

A few highly susceptible species are already showing signs of severe decline. Native Guava (*Rhodomyrtus psidioides*) and Scrub Turpentine (*Rhodamnia rubescens*) are widespread shrub species of moist sclerophyll forests along the coasts of NSW and QLD. Prior to the arrival of Myrtle Rust, they were of no conservation concern. Both are highly susceptible to Myrtle Rust. Strong evidence is now emerging that they are undergoing severe decline in normal growth and reproductive capacity (G. Pegg and A. Carnegie, work in progress). Many legislatively listed species in the same states are also likely to undergo decline.

Of great concern are the three broadleaved paperbark species that are important, sometimes dominant, trees across huge areas of coastal floodplain and river margins in eastern and tropical Australia: *Melaleuca quinquenervia*, *M. leucadendra* and *M. viridiflora* are all highly susceptible on their new growth.

The potential long-term effects on eucalypts are unclear. Some 80 eucalypt taxa, not counting hybrids, are recorded as susceptible (69 taxa in Eucalyptus, eight in *Corymbia*, and three in *Angophora*). However, in *Eucalyptus* itself a majority of these records are from experimental trials in the lab, including on non-east coast species, and only a minority have infection confirmed in the wild so far. No eucalypts are regarded as highly susceptible at this point, but there is a lack of observations for nearly all species on the critical life stages of seedlings and coppice growth (e.g. post-fire epicormic shoots).

The impacts of *Puccinia psidii* in Australia will become fully evident over a multi-decade time frame—only the earliest stages of impact are yet evident. It is not alarmist to forecast the extinction in the wild of a significant number of species as a direct result of this disease. Management of the pathogen in the wild is extremely problematic except at very small scales—fungicides are effective in cultivation but environmentally damaging in bushland. No effective broad-scale mitigation is in prospect for most wild situations. Accordingly there is no likelihood of eradication in bushland areas of entrenched naturalisation, and only a limited likelihood of practical mitigation in bushland.

Exotic Rust disease on Myrtaceae has been listed as a key Threatening Process in NSW since 2012. A nomination was submitted in March 2014 for a similar listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

*Mature small trees of Native Guava (*Rhodomyrtus psidioides*) killed by repeated infections of Myrtle Rust, west of Byron Bay, NSW. Photos: K. Kupsch*

Government and industry responses to date

The initial emergency response in 2010 was funded and coordinated at Commonwealth level, and was led in all jurisdictions by the primary industries agencies. From early 2011 to 2014, responsibility was devolved to the States, with some continued coordination, and limited but crucial Commonwealth funding for some aspects of basic research into the genetics, phylogeny and life cycle of the pathogen, the genetics of resistance in a few host species, and chemical treatment options for the greenlife industries. The primary industries agencies have all produced brochures and websites with good awareness and recognition guides, and advice on vigilance, reporting, hygiene and treatments in cultivation. Yet information flow remains somewhat fragmented. For example, no agency has taken on the maintenance of a consolidated national host list, although one has been maintained informally by dedicated primary industries people.

Nursery & Garden Industry Australia has produced a comprehensive Myrtle Rust Management Plan (www.ngia.com.au) that is an indispensable resource for all commercial and community nurseries and the greenlife industry as a whole. Roads & Maritime Services NSW has produced biodiversity guidelines (www.rms.nsw.gov.au/environment/downloads/biodiversity_guidelines.pdf) with a general but useful section on Myrtle Rust precautions for staff and contractors, which could also be used as a template for procedures by other utilities and organisations.

The response of the environment agencies has been uneven and limited, partly because the natural and legislative lead role rests with the primary industries agencies (who have most of the plant disease expertise). Some states have produced 'bushland management' guidelines (NSW, QLD, and WA in prep.) Unfortunately a big gap has developed in preparing for the disease on the environmental (bushland) front, and in assessing its actual environmental impacts. The only active research on natural-system impacts is being driven by individual scientists within the Queensland and NSW primary industries agencies, assisted by people at a couple of universities and by informal non-government networks. No environment or conservation agency has yet launched any research of this sort, or baseline-knowledge assessments for the Myrtaceae (with the partial exception of the former Queensland Department of Environment and Resource Management before its dismemberment).

The environment agencies have however supported awareness activity, including in some States the Australian Network for Plant Conservation's training course (see below). The government conservation seed banks, grouped under the Australian Seed Bank Partnership and mostly administered by the major botanic gardens, have re-prioritised the collection of seed of potentially vulnerable Myrtaceae, within their current limited resources—but in few cases has this yet reached the level of really large and comprehensive collections for any but very localised species. Staff at some of the main botanic gardens have also been heavily involved in research, technical advisory, and training and awareness roles.

National coordination continues to be a problem. The Commonwealth-supported 'Transition to Management' program of 2011–13 is now unfunded, and no agency has picked up the baton for this role. The Council of Australian Governments' Standing Councils for Primary Industries (PISC) and Environment and Water (SCEW) were both abolished in late 2013, which may make the facilitation of the national response more difficult.

Australian Network for Plant Conservation's response

The Australian Network for Plant Conservation (ANPC) engaged with the Myrtle Rust problem from an early stage. A comprehensive one-day training module was developed in 2010–11, in partnership with the Royal Botanic Gardens Sydney, and has been delivered at 19 sessions in NSW, Queensland, WA and on Lord Howe Island, equipping some 525 people with detailed knowledge of the disease. These training events have been delivered with practical and some financial support from both the primary industry and environmental agency in each jurisdiction, and with invaluable support from the Rural Industries Research & Development Corporation and the Bjarne K Dahl Trust. This training course capability remains available for other States and regions.

Cut-down, seminar-scale versions of the ANPC course have also been delivered at the Albury Botanic Gardens Australia and New Zealand conference in 2011, the Papua New Guinea Biological Society conference in 2012, and at an informal botanical gathering in Java, Indonesia in 2012 (the latter two by Dr Barry Conn of Royal Botanic Gardens Sydney, on ANPC's behalf).

The background material on the ANPC website is now out of date, and will be refreshed in coming months, including a comprehensive bibliography and a version of the current national host list.

Myrtle Rust is not to be confused with 'Myrtle Wilt'; a fungal disease of Myrtle Beech (*Nothofagus cunninghamii*, family Nothofagaceae) caused by the pathogen *Chalara australis*—see www.soln.org/wp-content/uploads/2009/06/myrtlewiltfactsheet-2005.pdf, and soer.justice.tas.gov.au/2009/copy/49/index.php for further information.

Futher Reading

Australian Seed Bank Partnership (ASBP) website: www.seedpartnership.org.au.