Australasian Myrtle Rust Conference (AMRC2023) – trans-Tasman

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This article by Jo Lynch is extracted from a full report on this recent conference, prepared by the ANPC's Bob Makinson, to be published soon on our website (https://www.anpc.asn.au/myrtle-rust/).

Myrtle Rust background

Australia and Aotearoa New Zealand face a common threat to our natural heritage and natural resource base.

The exotic fungal disease Myrtle Rust, first detected in Australia in 2010 and in New Zealand in 2017, is attacking many species in the plant family Myrtaceae. This family is of fundamental ecological importance in both countries, is a rich repository of biological and genetic resources, and is an intrinsic element of our national and cultural identities.

In Australia, close to 50 native plant species are known or suspected to be declining towards extinction, some catastrophically, as a result of this disease. In New Zealand, all indigenous species of the family have been placed on the 'Threatened' list. An unknown number of associated species of flora, fauna, and fungi is affected in both countries.

Further strains of the same disease are known to exist overseas. These pose a further threat and are recognised as a national biosecurity priority in both countries. As too, at the domestic level in Australia, is prevention of entry of Myrtle Rust to the mega-diverse south-west of Western Australia.

The biological threat process in both countries is broadly similar. AMRC2023, the latest in a series of Myrtle Rust conferences, was intended to enhance trans-Tasman communication and knowledge transfer about this common threat and it met that aim. It also highlighted the similarities and differences between institutional responses in the two countries.

Considerable progress has been made globally in understanding fundamental features of the Myrtle Rust pathogen and its mode of action. Much of this work has been done in Australia and New Zealand, or has involved international collaborations with Australasian researchers. Beginnings have been made in investigating host/pathogen interactions – the complex interplay of chemical attack and defence that determines whether the rust or the plant gains the upper hand – and towards identifying some of the particular genes in both organisms responsible for the process.

Myrtle Rust infections on *Syzygium hodgkinsoniae*. Photo: Geoff Pegg (DAF QLD)

Suitable chemical (fungicidal) treatments for Myrtle Rust exist for use in cultivation, but none yet exist that are suitable for use in the wild and at landscape scales. However, in recent months there has been exciting exploratory progress in the technique of 'interference RNA' as a non-toxic, non-GM short-term treatment, which if operationalised could be an important tool in the nursery and greenlife industries, and for conservation management *ex situ*. Such a tool would allow a reduction in the use of toxic fungicides.

On the conservation side, there has been vital groundwork laid on both the research and the conservation action fronts. New Zealand researchers have begun to look at the unexpectedly rich micro-biota (fungi, lichens, and microflora) that occur on host species threatened by Myrtle Rust (and are hence threatened with co-declines or co-extinctions), showing that these associated life forms number in the hundreds. Might some of them also have a role in helping their host plants against the rust? The cultural context in which conservation actions must be developed in New Zealand, where First Nations have a much more developed presence in land management, also has many lessons for Australia.

In Australia, emergency rescue actions in Queensland and New South Wales have saved representative living samples of a few of the most threatened host species. A large 'living library' of plants in protected cultivation is the only option for future recovery actions, as these species are rapidly approaching extinction in the wild. We are in the very early stages of screening for rust-resistant genotypes in these species, as possible reinforcements for the dwindling wild populations. The challenge is to expand this to the many other species seriously affected.

Australia has not been used to responding to environmental disease threats of this scale and rapidity before, and after the initial and vigorous – but unsuccessful – eradication and containment attempts of 2010–12, there was no effective transition to any directed and funded 'environmental' response over the decadal time scales needed as the disease took hold. A small and largely science-based Myrtle Rust 'Community of Concern' has driven the development of a *National Action Plan for Myrtle Rust*, which has provided some guidance for investment and action by governments and others in the absence of a legislatively based response at national level, albeit without any surety of resources for implementation. Resourcing overall remains well below what is needed. A key element needing specific support is Indigenous engagement and co-design of conservation responses.

In New Zealand, a more integrated national response has been operative since 2018. This has focussed on science projects, with a national *Science Plan for Myrtle Rust*, a national stock-take of relevant published science, and a vigorous set of programs funded over half-decade time frames. Engagement with First Nations interests on the issue is far more advanced than in Australia, and engagement of other social stakeholder sectors has also been healthy. However, just as in Australia, there has, as yet, been relatively little funding for assessment of the effects of the disease in the wild, or for direct conservation actions.

Both countries urgently need renewed, focussed and funded attention to this disease in the immediate future, to prevent species declines and extinctions, and to protect national assets.

The Conference

The AMRC2023, held in Sydney on 21–23 July 2023 at the University of Sydney, was the largest trans-Tasman Myrtle Rust knowledge-exchange event to date, with 103 in-person attendees across most fields of Myrtle Rust activity. It equipped researchers and practitioners from both countries to cross-familiarise with progress, establish better collaboration, identify common and separate problems and potential solutions, and identify knowledge and resource gaps and needs (there are many!).

A workshop on selection and breeding for Myrtle Rust-resistant plants was then held on 26–27 June at the Botanic Gardens of Sydney.

A report will soon be published by the ANPC which presents a short precis of salient issues and major points to emerge from the conference and summarises all the conference presentations and workshop discussions. It also summarises the national update talks from the conference, and presentations covering recent work in the fields of genomics, proteomics, rust strain diagnostics for biosecurity, *ex situ* conservation, and practical biosecurity techniques. That conference report will be available for free download from https://www.anpc.asn.au/myrtle-rust/. Videos of conference presentations are available on the ANPC YouTube channel at https://www.youtube.com/playlist?list=PLuPMH5OJZz0ECW5mA5wyx2v8C4SZjTsco

AMRC2023 was the latest in a series of national and trans-Tasman events to bring together those involved in responding to the threat of Myrtle Rust plant disease in the region. Most previous events, and this one, have been primarily organised and driven by the Myrtle Rust 'Community of Concern', comprising plant health and plant pathology researchers, biodiversity conservation researchers and practitioners, and (particularly in Aotearoa New Zealand) First Nations stakeholders.

Previous Myrtle Rust conferences and workshops in the Australasian Region

Many smaller meetings and specific program gatherings are omitted.

Australia

- Myrtle Rust Research & Development Planning Workshop, Brisbane Qld, 28–29 Sept. 2011
- Myrtle Rust Research & Development Planning Workshop, Brisbane Qld, 19–20 June 2012
- Myrtle Rust in natural ecosystems - National Workshop, Canberra ACT, 12 Dec. 2012
- Myrtle Rust [National] Workshop, Brisbane Qld, 19–20 April 2016
- Myrtle Rust Symposium, Ballina NSW, 23–25 March 2021

Aotearoa New Zealand

- Workshop – The threats posed to New Zealand from myrtle rust – international perspectives, potential impacts and actions required, Wellington, 6–7 Dec. 2016
- Myrtle Rust Symposium, Auckland, 28 Aug. 2017
- Myrtle Rust Science Symposium, Wellington, Dec. 2018
- Myrtle Rust Science Symposium, Auckland, 9–10 Sept. 2019

AMRC2023 Conference participants, Day 2. Photo: Dan Turner

The genesis of AMRC2023, and its eventual theme 'Where to from here?', reflected a substantial increase in knowledge of the pathogen and its impacts in recent years, even since the Ballina Symposium of 2021 (videos of which are at https://www.apbsf.org.au/myrtle-rust/), and some parallel progress made in applied conservation actions for species affected by the disease in the wild. In the same period there has been progress in knowledge and practice relevant to management of the disease in crop and amenity plantings.

The conference originated in trans-Tasman discussions between a small number of researchers in late 2022, and took concrete form with an initiative of Dr Peri Tobias to host an event at the University of Sydney. Originally envisaged as a relatively small research-oriented gathering, the scope rapidly broadened to meet a felt need for direct discussions and information exchange right across the Myrtle Rust community of concern and practice.

The core Organising Committee for AMRC2023 comprised:

- **Peri Tobias**, University of Sydney, Australia
- **Stuart Fraser**, Scion Research, NZ
- **Mahajabeen Padamsee**, Manaaki Whenua Landcare Research, New Zealand
- **Alyssa Martino**, University of Sydney, Australia
- **Beccy Ganley**, Plant & Food Research, New Zealand
- **Renee Johansen**, then of Manaaki Whenua-Landcare Research and the Beyond Myrtle Rust programme, New Zealand
- **Craig Stehn**, NSW Department of Environments and Planning, Saving Our Species Program, Australia
- **Grant Smith**, Plant & Food Research, New Zealand
- **Angus Carnegie**, NSW Department of Primary Industries, Australia
- **Geoff Pegg**, Queensland Department of Agriculture and Fisheries
- **Bob Makinson**, Australian Network for Plant Conservation Inc.

AMRC2023 would not have been possible without the generous financial and in-kind backing of the following sponsors and supporting organisations:

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AUSTRALASIAN MYRTLE RUST CONFERENCE

In particular we thank the Australian Government for crucial funding assistance, and – for venues and related assistance – the University of Sydney (conference) and Botanic Gardens of Sydney (workshop).

Eleven reasons why we need strong national responses to the environmental threats posed by Myrtle Rust

The potential adverse effects of Myrtle Rust disease, in the absence of an effective remedial response, are multi-fold. Most of these received some level of attention in the conference:

- **Potential host-species extinctions and serious declines** are now being realised in Australia, with four host-plant species elevated to 'critically endangered' status, and about 45 more of identified immediate concern – all New Zealand Myrtaceae are now regarded as officially Threatened.
- **Declines or co-extinctions of associated flora, fauna and fungi** are likely, but there have been few investigations yet of these 'web of life' connections for Myrtle Rust host species.
- **Ecosystem-level changes** are already occurring; changes in the floristics and ecological function of one Australian forest ecosystem was reported at this conference.
- **Increase in short-term fire risk** is resulting from dead standing plant biomass and the long-term fire effects of changed floristics in different systems are unknown.
- **Potential increases in weed colonisation of priority natural ecosystems** – increased woody weed frequency has been noted in rust-affected forest.
- **Loss of fixed carbon due to plant death in forest ecosystems** is documented and the potential and rate for replacement carbon capture are unknown.
- **Loss of social and cultural heritage, and aspects of national and local identity**: these effects cut across all social groups but are especially acute for First Nations peoples.
- **Loss of identified values for World Heritage Areas** – at least four WHAs in Australia are already affected.
- **Potential loss of ecological function** – for example, erosion prevention (*Tristaniopsis exiliflora* in Australia's Great Barrier Reef catchment; kānuka in degraded landscapes in New Zealand; *Melaleuca* species in Australia floodplains and freshwater wetlands); and maintenance of water quality and freshwater aquatic habitat (*Melaleuca* species).
- **Loss of known and unknown (yet to be evaluated) biological, economic, and cultural assets**: the Myrtaceae is a family rich in biochemical and genetic resources, providing many 'ecological services' and having a vast range of medicinal and culinary uses, resources for climate change adaptation, wild-stock for ornamental and production horticulture, food and wood products, and many other attributes.
- **Potential loss of public confidence in biosecurity processes and response capabilities**: a robust and coordinated national response, directed at remediation of impacts, would play a major role in building confidence and capacity for future environmental biosecurity threats.

Key messages from the conference discussions

Facing future threats

Myrtle Rust will not be the last aggressive environmental pathogen to enter the Australasian region. Biosecurity agencies recognise others 'waiting in the wings'. Global movement of such threats is increasing. Neither country was prepared for such a broad-spectrum, fast-moving disease in the natural environment. If we do not learn the lessons of Myrtle Rust, and move to a more active response, we will not improve our readiness for the next such pathogen.

Time is not on our side

In Australia, several species have crashed towards extinction since 2010. The lack of a conservation response prior to 2019 led to a very narrow window of time to 'rescue' living samples of some of these species as they dwindle towards extinction. This is the raw material with which it may be possible to breed stronger, rust-resistant stock to reinforce the survivors. The technique is feasible, is in use overseas, and is similar in principle to the selection and rewilding programs for warming-tolerant Great Barrier Reef coral species currently underway. Other species in steep decline from Myrtle Rust have yet to be sampled in the same way. The longer we take, the more of their natural genetic diversity will be lost.

Many knowledge gaps need to be filled

As papers at this conference showed, progress has been made to fill some of the basic knowledge gaps about the pathogen, as a prelude to investigating its mode of action in detail. Less progress has been made in understanding the at-risk plant species themselves – their original and remaining extent and abundance, and the features that make them susceptible or resistant to the disease. We know next to nothing about which of their many associated species of flora, fauna and fungi may be at risk of co-declines and co-extinctions.

Dead Native Guava trees at Bongil Bongil National Park, NSW, 2013, only two years after the arrival of Myrtle Rust. In recent surveys in NSW and QLD, no adult trees remain of this once common rainforest plant. Photo: Peter Entwistle

Coordination is needed at national levels, and sustained directed funding

A piecemeal approach based only on competitive short term funding will not allow us to meet the challenge. Just as with serious agricultural pathogen threats, sustained and planned investment is needed over decadal time frames. This needs to encompass basic and applied research, conservation action, and cultural co-design of the response. All are urgent.

Some areas of action and research that should be included in renewed planning and investment in both countries can be easily nominated – these are however not an exhaustive list. Bodies with funding or oversight responsibilities for the environmental effects of this disease should engage closely with the Myrtle Rust community of concern, including First Nations stakeholders, to generate a planned approach for all potentially fruitful areas of action and research.

Specific areas of research needing investment

- Ecology of the host species, including their associated biota.
- 'Omics' investigations (transcriptomics, proteomics, metabolomics) to clarify the mode of interaction between plant and pathogen.
- Investigation of what makes a plant, and its various tissues, susceptible or resistant.
- Incorporation of First Nations perspectives in setting and executing goals and processes.
- Potential novel treatments for Myrtle Rust control, particularly interference RNA (RNAi).
- Germplasm conservation, including seed storage, tissue culture, and cryopreservation.
- Ecosystem-level impacts of Myrtle Rust, and remedial options.

Specific areas of conservation action needing investment

- Expedited development of conservation planning for Myrtle Rust-affected species and ecosystems, dovetailed across jurisdictional boundaries.
- Expansion and support of collaborations across jurisdictional and agency boundaries, recognising the national and supranational nature of the threat.
- Capture and maintenance of highly representative germplasm from priority species, as a basis for downstream conservation actions.
- Gathering of baseline data on the affected species and ecosystems.
- Establishment and expansion of First Nations input to conservation planning; co-design as a principle wherever capabilities allow.
- Establishment, with a decadal-scale perspective, of a supported network of screening and breeding programs and sites, and associated capabilities.
- Expanded genomic investigations of at-risk species to optimise conservation strategies.
- Regional investment in capabilities and action in north-east Queensland.
- Field assessment of Myrtle Rust impacts, and establishment of long-term monitoring sites.

Specific areas of biosecurity action needing investment

- Continued improvement in diagnostics for new strains or novel emergent genotypes.
- Public awareness, including a sustained and a resourced 'citizen science' component.
- Development of the First Nations role in on-country surveillance and assessment.
- Continued improvement in surveillance and detection networks and readiness plans, especially for priority regions such as Western Australia.
- Continued development of detection technologies.
- Expansion of knowledge of the interplay between climate, weather, spore-load, and host species, to better understand the dynamics of the disease in the wild and in cultivation.

National capabilities

- Embedded planning and resourcing for medium term (at least decadal-scale) research and action, with adequate review and renewal options to avoid funding 'cliffs' and associated loss of momentum and expertise.
- Supported and stable national information hubs, data directories and/or repositories.
- The attention of authorities is drawn to the progressive decline in recent decades of the scientific and technical labour force and skills formation needed to assure adequate response to environmental biosecurity threats.
- Streamlining and appropriate updating of permit arrangements for control chemicals.

AMRC2023 Conference underway. Photo: Dan Turner

Conference thematics

Overall conference theme: "Where to from here?"

Thematic sections: 40 presentations overall, ten posters.

- Opening updates on the status of Myrtle Rust and response to it in the Australasian region (2 presentations)
- Fundamental science of the pathogen and host (12 presentations, 4 posters)
- Indigenous perspectives (3 presentations, 1 poster)
- Biosecurity (5 presentations, 3 posters)
- Environment and Ecology (6 presentations, 2 posters)
- Conservation and Applied Science (14 presentations, two workshops)

Workshop: Conservation and Research gaps and the way forward

Conference opening address: **Dr Bertie Hennecke**, Australian Chief Environmental Biosecurity Officer, on 'Australia's Biosecurity Outlook: An environmental biosecurity perspective'.

Keynote presentations:

- **Dr Richard Sniezko**, US Department of Agriculture Forest Service, Dorena Genetic Resource Center, Oregon: 'Developing disease resistance tree populations for restoration: lessons from successful US resistance programs to apply to Myrtle Rust'.
- **Roanne Sutherland**, New Zealand Department of Conservation: 'A conservation perspective of managing myrtle rust in Aotearoa New Zealand'.

Access and recordings: Conference attendance was by in-person attendance only (not live on-line). Video recordings of all presentations are on the Australian Network for Plant Conservation YouTube channel at https://www.youtube.com/playlist?list=PLuPMH5OJZz0ECW5mA5wyx2v8C4SZjTsco

International guest speaker Dr Richard Sniezko from the US Department of Agriculture Forest Service, presenting on developing disease resistance tree populations for restoration. Photo: Dan Turner

The post-conference workshop

AMRC2023 was followed, with an overlapping attendance, by a two-day 'hybrid' workshop (in-person and live online) on 26 and 27 June 2023. This workshop took a deeper dive into the options and issues around **selecting and breeding from wild genotypes for myrtle rust resistance as part of a conservation strategy** – a theme that was also the subject of some conference presentations. Like the conference, the workshop was able to take advantage of the presence of Dr Richard Sniezko, a world expert in this area of work.

All AMRC2023 registrants were invited, and an additional invitation list circulated to others thought likely to have an interest or expertise that would be needed as activity grows in this area of conservation action.

The workshop was held at The Royal Botanic Gardens, part of Botanic Gardens of Sydney, and we are grateful for that organisation's support in provision of the venue and recording and communications facilities, catering, and for the presence of a number of their staff.

The goals of the workshop (here slightly edited), were:

- To develop a common level of understanding among a core body of Myrtle Rust practitioners of the global (and particularly the North American) experience in successful and unsuccessful disease resistance breeding programs (RBPs) in woody plants, especially for rusts, and the features that promote success.
- To develop a common understanding on the ways in which RBPs directed at biodiversity conservation goals differ from those for commercial crop and timber species, e.g. in width of genetic base, maintenance of ecological fidelity and variation, and other aspects.
- To generate an overview of the human and institutional landscape within which an RBP model must develop.
- To generate an overview of the existing expertise and facilities, government and non-government, that should be investigated in more detail for RBP involvement.
- To develop an agreed flexible and adaptive conceptual architecture for an RBP meta-program in the A/NZ context, noting that in Australia's case up to 50 or so species may be eventual candidates for inclusion, such is the scale of the Myrtle Rust problem.
- To develop priority directions for scoping studies, information assembly, communications, and concept promotion in pursuit of integrated RBP in the two countries.

The workshop was not aimed at development of any specific funding proposal.

A set of discussion starter topics were prepared for each of the following areas:

- Practical workflow of resistance selection and breeding.
- Case study (already in early stages of implementation): Scrub Turpentine (*Rhodamnia rubescens*).
- Expertise needed.
- Facilities needed.
- Candidate species.

Key websites, Aotearoa New Zealand:

- New Zealand Myrtle Rust website: https://www.myrtlerust.org.nz/
- New Zealand Myrtle Rust outputs to date: https://data.bioheritage.nz/dataset/myrtle-rust-science-stocktake
- *Beyond Myrtle Rust* program: https://www.landcareresearch.co.nz/discover-our-research/biodiversity-biosecurity/ecosystem-resilience/beyond-myrtle-rust/
- *Beyond Myrtle Rust* webinar series: https://www.landcareresearch.co.nz/discover-our-research/biodiversity-biosecurity/ecosystem-resilience/beyond-myrtle-rust/webinar-series/
- Ngā Rākau Taketake: https://bioheritage.nz/research/saving-our-iconic-trees/
- New Zealand *Myrtle Rust Science Plan* (2019): https://www.myrtlerust.org.nz/assets/Uploads/Myrtle-Rust-Science-Plan.pdf
- New Zealand *Myrtle Rust Strategy*: https://www.myrtlerust.org.nz/how-you-can-help/myrtle-rust-strategy/

Key websites, Australia:

- Australian Network for Plant Conservation *Myrtle Rust information hub*: https://www.anpc.asn.au/myrtle-rust/
- Myrtle Rust in Australia – A National Action Plan. (2020). https://www.anpc.asn.au/wp-content/uploads/2020/11/Myrtle-Rust-National-Action-Plan-2020.pdf
- Myrtle rust: Biosecurity alert (Western Australia): https://www.agric.wa.gov.au/plant-biosecurity/myrtle-rust-threat-western-australia

Global information:

- Global Host List: Soewarto *et al*. (2019) *Austropuccinia psidii* (Myrtle Rust) Global Host List. Version 4. https://www.anpc.asn.au/myrtle-rust/
- *Austropuccinia psidii* (myrtle rust) – CABI Factsheet (Carnegie & Giblin 2014). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.45846