MPI's myrtle rust research programme

A summary

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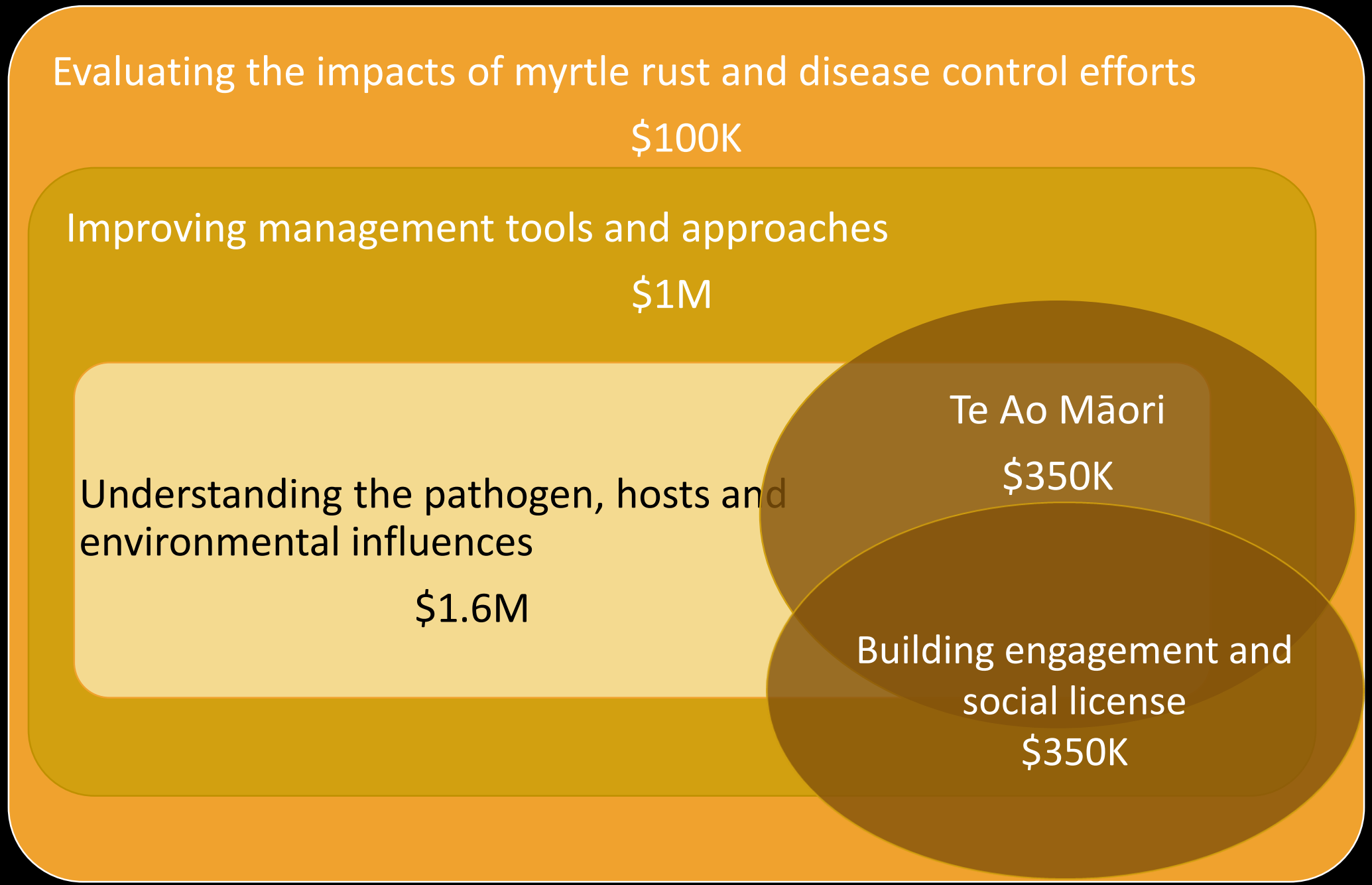
Ministry for Primary Industries
Manatū Ahu Matua

Department of Conservation
Te Papa Atawhai

Biosecurity New Zealand
Tiakitanga Pūtaiao Aotearoa

Topics covered in this presentation

- Original themes set by the myrtle rust SSAG
- Progress an initial insights
- Eureka moments
- Where to next?


Evaluating the impacts of myrtle rust and disease control efforts
$100K
Improving management tools and approaches
$1M
Understanding the pathogen, hosts and environmental influences
$1.6M
Te Ao Māori
$350K
Building engagement and social license
$350K

Understanding the pathogen, hosts, and environmental influences

We set out to	We found that
Identify host susceptibility to myrtle rust	There is resistance to myrtle rust in New Zealand provenance Myrtaceae
Identify asymptomatic periods	Myrtle rust can infect and produce new spores almost twice as fast as previously reported
Assess other myrtle rust biotypes	Other variants of the pathogen can infect New Zealand provenance Myrtaceae
Identify genetic markers of resistance	There are genetic markers for resistance to *A. psidii* that have been identified in eucalyptus and there are similar genomic regions in the mānuka genome
Sequence the genome	The first quality assembly of the pathogen genome is now available for future studies on how this pathogen infects a large number of host plants and causes disease
Identify endophyte populations	There are differences in the external microbial flora of Myrtaceae leaf tissue of different ages that may contribute to resistance to *A. psidii*

Building community engagement and social license

We set out to	We found that
Understand public perceptions, behaviours and their drivers	A number of barriers exist, in particular respondents reported that agencies did not effectively engage with potential partners, missing out on possible expertise and opportunities
Socialise emerging tools	The tools developed were shared with partners at a workshop and if developed further offer a potentially useful way to assess both social license to operate and partnerships
Support effective partnerships	There are several positive examples of motivated individuals and organisations working effectively as partners
Manage social license	Further investment in tools is needed before they can be implemented

Te Ao Māori

We set out to	We found that
Test Māori views of myrtle rust and its impacts	
Hold regional hui to identify priority taonga sites, species and specimens for surveillance and protection	
Map and prioritise taonga Myrtaceae and support mana whenua to develop self-management protection plans for these taonga	
Identify and discuss potential mātauranga Māori based tools, solutions and practices for eradicating and managing myrtle rust in the longer term and Māori approaches in management regimes	
Meet regularly with MPI and all project leads to ensure alignment across the myrtle rust research projects	

Improving management tools and approaches

We set out to	We found that
Develop a seed-banking and germplasm research strategy	More research is urgently required to: • Develop effective techniques for recalcitrant seed; • understand the optimal storage conditions; and • establish ex situ/ in vitro provenance collections of our native Myrtaceae
Improve myrtle rust surveillance, monitoring tools and approaches	Repeated capture remote sensing methods using unmanned aerial vehicles (UAVs) could provide useful data for long-term site monitoring to supplement ground-based assessments.
Map the distribution of high priority myrtle species and identify nationally important individuals	
Pilot trials of management tools for individual high priority trees and sites	
Review the scientific literature on potential disease control tools, including fungicides and biocontrol to identify those most likely to be effective	Active ingredients from the strobilurin and triazole groups are effective in controlling myrtle rust There are currently no commercial or registered biological control agents available specifically for the control of myrtle rust
Scope a resistance breeding programme approach, highlighting the likely requirements and constraints with respect to known biology of the hosts	

Evaluating the impacts of myrtle rust and disease control efforts

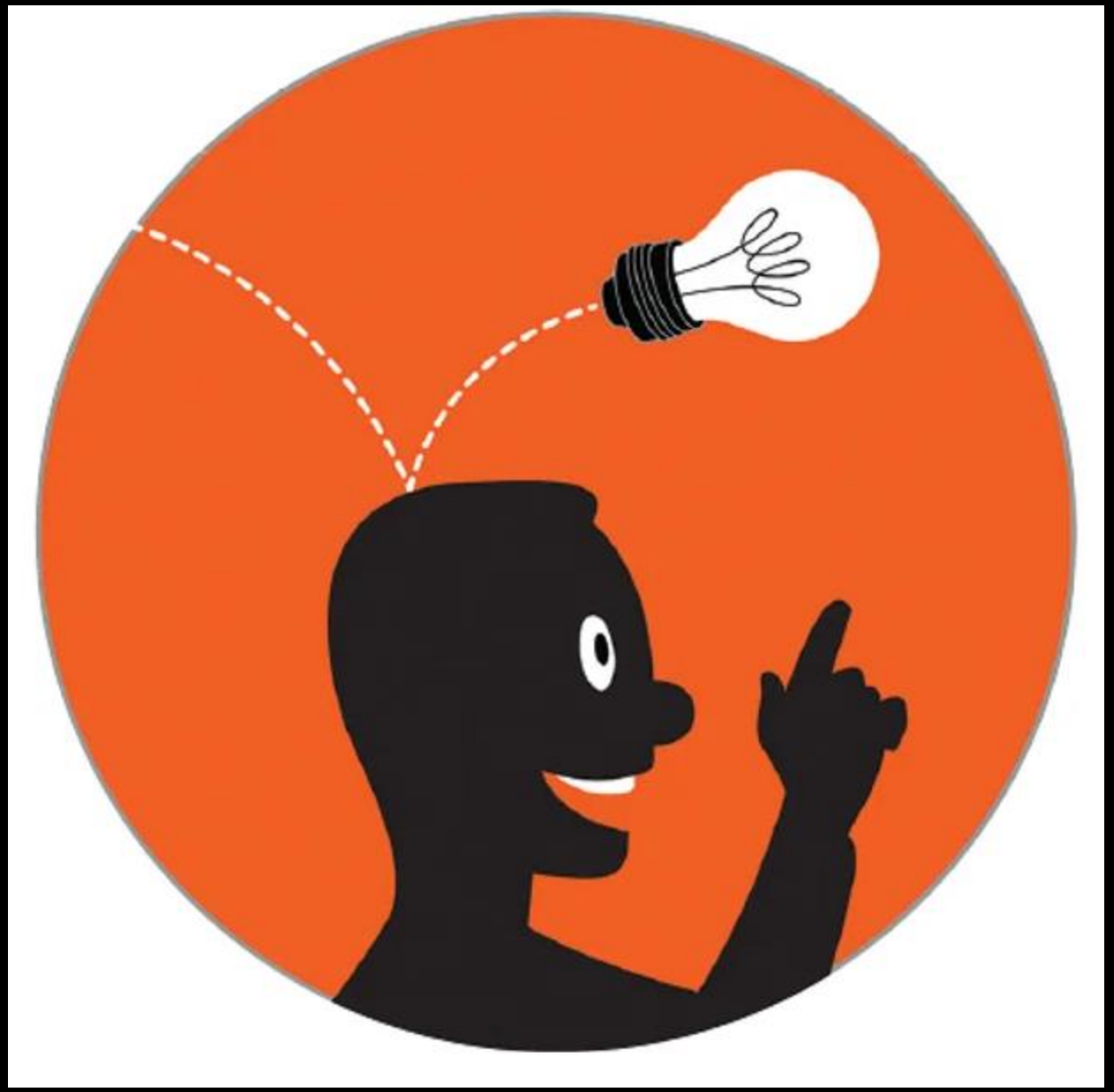
We set out to	We found that
Develop monitoring approaches for assessing the impacts of myrtle rust on environmental, economic, social and cultural values over time	For the mean scenario, the estimated economic impact at year 20 is approximately $157 million comprising: • $17 million value of carbon not sequestered • $49 million lost profits from mānuka honey production • $91 million value of avoided erosion
Develop an assessment tool for understanding the impact of management interventions	Identified 10 environmental, 10 economic, and 13 social–cultural indicators
Assess the effectiveness of efforts to control the disease and reduce its impact on susceptible species	Data to implement and test some environmental and economic indicators is available, but data for socio-cultural indicators is lacking Potential indicators will require assessment and prioritisation alongside potential Te Ao Māori indicators

Projects started before myrtle rust arrived in New Zealand

Description	Organisation
Real-time PCR test to ensure reliable, sensitive and fast diagnostics	MPI Plant Health & Environment Laboratory
DNA barcoding database linked to a herbarium for accurate host plant identification	Scion
Comprehensive analysis of myrtle rust's environmental and economic impact	MAF (2011)
Risk analysis of the *Puccinia psidii* fungal complex on nursery stock	MAF (2011)
Climate model to determine the survival and spread of myrtle rust in NZ	B3/Lincoln University (2013)
Identification of risks of myrtle rust to taonga species	Plant and Food Research/B3
Review of the potential impact of myrtle rust on the NZ forestry sector	Scion (2016)
Catalyst collaborative project to determine the susceptibility of key native myrtle species to myrtle rust; build scientific knowledge for successfully storing germplasm of Myrtaceae, and develop plant pathogen detection and surveillance systems for use in the field	PFR, Scion, B3, NSW Department of Primary Industries, QDAF, Wellington Botanic Gardens, Kew and Te Tira Whakamātaki (2017-20)
Māori solutions to biosecurity threats and incursions to taonga species	Biological Heritage National Science Challenge, PFR, BioProtection Research Centre, TTW

Projects initiated by MPI when myrtle rust arrived in New Zealand

Description
Non-market evaluation of the impacts of biodiversity loss and impacts to landscapes and ecosystems for New Zealanders under low, medium and high impact scenarios
Economic impact assessment of potential national level impacts
Risk assessment of myrtle rust transmission via bees
Modelling risk spread of myrtle rust from Australia and Raoul
Climate mapping for myrtle rust risk forecasting
Cryopreservation and propagation trial including seed storage physiology, storage protocols and development of in-vitro conservation protocols for recalcitrant native myrtles
Scoping a nursery industry accreditation scheme for plant production biosecurity including a myrtle rust unit



Eureka

Lessons from Australia

Lophomyrtus obcordata

Rhodamnia sessiliflora

teliospores

Collaboration is key
Kew and Karin

Rhodamnia sessiliflora
Rhodamnia sessiliflora

People value practical tools

New Zealand Myrtle Rust Monitoring form

This form has been designed for use by trained myrtle rust observers and can be completed on paper or digitally using a tablet (or another electronic device).
The unit of interest is an individual plant or stand of small trees/shrubs or a hedge of the same species in a specific location. Any seedlings of these plants should be included in the unit of interest and recorded on the same form as the adult plant or stand.
It is extremely valuable to know where, and on which hosts, myrtle rust is present. It is also extremely valuable to know where, and on which hosts, myrtle rust IS NOT PRESENT. Please complete all relevant fields each time you monitor, regardless of myrtle rust presence or absence.

What we define **a Myrtle Rust positive site**:

Confirm host identification by a trained observer, OR expert confirmation of a submitted photo of the host,

AND,

Confirmed observation of myrtle rust symptoms by a trained observer, OR expert confirmation of a submitted photo of suspect myrtle rust symptoms on a host.

How to fill the form

The first time you visit a site complete the site description on page two. You will only need to do this once.
Fill page 3 at least once a year for an annual monitoring.
Fill the rest of the form each you come back to a site to monitor the same plant.
Use separate forms to record results for different host species in the same stand or hedge.

How to submit photos to confirm the plant species identity and/or myrtle rust infection

Photos can be submitted through the Myrtle Rust Reporter App available from iTunes: https://itunes.apple.com/nz/app/myrtle-rust-reporter/id1283825389?mt=8
and Android: https://play.google.com/store/apps/details?id=com.intranel.myrtlerustreporter&hl=en

How to submit the completed forms

Scanned copies of the form can be sent to the following email addresses:
An excel spreadsheet is also available which can be filled in and submitted
Karyn.froud@biosecurityresearch.co.nz or Julia.Soewarto@scionresearch.com or Roanne.Sutherland@scionresearch.com

SCION

Biosecurity New Zealand
Tiakitanga Pūtaiao Aotearoa

How to remove infected myrtle plants and safely dispose of the waste

This document provides advice for landowners who choose to remove infected myrtle plants on their properties. Please note that **there is no requirement to remove infected plants.** However, landowners with infected myrtles on their property have the choice to remove these plants if they choose. If you choose to remove your infected plant you can use the method on the following pages. Larger trees may need the assistance of an arborist. Infected myrtle plant material can be taken to local landfills as general waste, as long as the following process has been completed.

If you find myrtle rust for the first time and it hasn't previously been found in your region please call the **MPI Biosecurity Hotline (0800 80 99 66).**

What you will need for removing plants

- Hairspray
- Large rubbish bags
- Disposable gloves
- Methylated spirits or bleach
- Change of clothes or overalls
- Secateurs and or saw
- Water
- Paper towels

Identification

Identify that the tree is in the Myrtle family. This can be done by using the myrtle rust reporter app, through the NZ Plant Conservation network or using MPI's Myrtle Rust ID Guide.

Common New Zealand myrtles include:

- Pōhutukawa
- Rātā
- Kānuka, Mānuka and tea tree
- Ramarama
- Lilly pilly
- Feijoa
- Willow myrtle
- Gum trees/Eucalyptus
- Bottle brush
- Guava

New Zealand Government

Ministry for Primary Industries
Manatū Ahu Matua

What next?

- Symposium (September 2019)
- Catalyst continues in 2020
- Surge funding $5m (2019-21)
- Beyond myrtle rust $13M (2019-23)

Beyond Myrtle Rust

Towards Ecosystem Resilience

Myrtle rust is caused by an airborne fungal pathogen (*Austropuccinia psidii*) that was first detected on the New Zealand mainland in May 2017.

Manaaki Whenua – Landcare Research is spearheading a multi-agency research effort into this significant threat to native forest health.

The research programme has four key interlinking elements: Pathogen Dynamics; Ecosystem Impacts; Novel Mitigation Techniques; Kaitiakitanga & Māori-Led Solutions.

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Pathogen Dynamics

- Monitoring of *A. psidii* population genetics and associated host symptoms
- Sexual reproduction drives pathogen diversity and may widen host range – focus on understanding host/environmental drivers of sexual reproduction
- Both natural and planted Myrtaceae stands will be studied

Led by:

Stuart Fraser
Scion

Alistair McTaggart
University of Queensland

Ecosystem Impacts

- Broad-scale investigation of *A. psidii* impacts on ecosystem functions, including nutrient and carbon cycling
- Impacts of pathogen spread on the forest microbiome both above and below ground will be explored
- The influence of plant traits over disease susceptibility, infection mode, and rate of spread will be examined

Led by:

Gwen Grelet
Manaaki Whenua

Mahajabeen Padamsee
Manaaki Whenua

Novel Mitigation Technologies

- Determine the genetic basis of host resistance using mānuka (*Leptospermum scoparium*) as a case study
- Select pathogen-resistant genetic lines of mānuka
- Search for biological control agents among Myrtaceae microbiome members, and investigate their mechanisms
- Search for Māori rongoā solutions with biocontrol capabilities

Led by:

Grant Smith
Plant & Food Research

Kaitiakitanga & Māori-Led Solutions

- A focus on strategies to facilitate Māori leadership in responses to *A. psidii*
- Develop a framework to assess impacts on Te Ao Māori and to prioritize management actions
- Develop protocols that support Māori-led methods to boost ecosystem resilience

Led by:

Nick Waipara
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Programme partners

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Manaaki Whenua
Landcare Research