Surveillance systems of airborne pathogens in Australia's Botanic Gardens

Presenter: Dr Rohan Kimber, SARDI – Plant Health & Diagnostics, PRC, Urrbrae, Adelaide

Project team:

- Australian National University – Benjamin Schwessinger, Sonja Brodersen, Mareika Moeller, Yapeng Lang, Zhenyan Luo, Ashley Jones

- Data Effects – Andrew Baker, Paul Coldrey

- SARDI – Kelly Hill, Daniele Giblot-Ducray, Nicole Thompson, Jamus Stonor

Project partners

- Nine major Botanic Gardens, and

- Australian Network for Plant Conservation

Funded by:

- Department of Climate Change, Energy, the Environment and Water – Saving Native Species program

Key outputs

- **Improve monitoring of airborne *Austropuccinia psidii* (myrtle rust)**, using next generation automated cyclone samplers, in partnership with Botanic Gardens throughout Australia.

- Improve threatened species and risk assessments using an **early warning system of new or environmentally influenced threats from airborne myrtle rust** within the Botanic Gardens network and importantly, identify strains/variances of concern implementing a novel diagnostic tool (ANU).

- **Engage in communication and education activities**, with our collaborative partners, highlighting the importance of plant conservation and biosecurity with schools and special interest groups, and the general public..

Airborne myrtle rust surveillance in Botanic Gardens

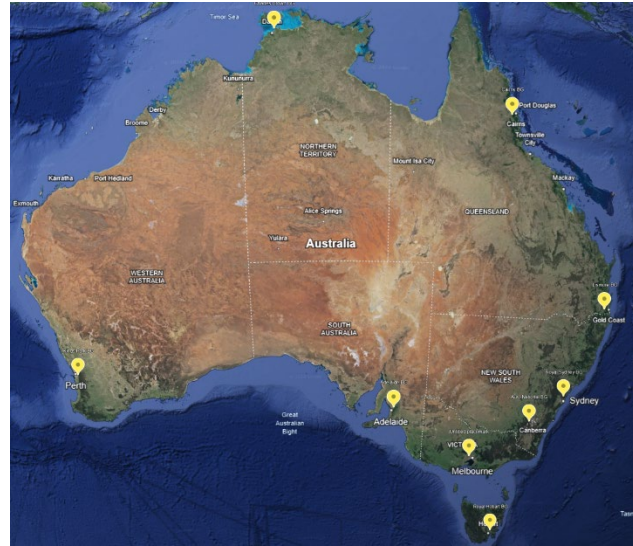**Myrtle rust**
A threat to native species

5 species Criticially Endangered due to the disease

A further **30** native species in decline

Over **300** known susceptible species

Primarily spread by wind

Typically affects new shoots and young leaves

Limited active treatments for land managers

Growing need to identify and breed genetic resistance

Identified by its yellow dust like spores

Threatens iconic World Heritage areas

For more information, visit
anpc.asn.au/myrtle-rust

AUSTRALIAN NATIONAL BOTANIC GARDENS

BOTANIC GARDENS OF SYDNEY

FRIENDS OF THE LISMORE RAINFOREST BOTANIC GARDENS INC

BOTANIC GARDENS & PARKS AUTHORITY

George Brown Darwin Botanic Gardens — NORTHERN TERRITORY GOVERNMENT

Royal Tasmanian Botanical Gardens

Royal Botanic Gardens Victoria

Botanic Gardens of SOUTH AUSTRALIA

Cairns REGIONAL COUNCIL Botanic Gardens

Spore Trapping
Spore samples are collected from our partner Botanic Gardens across Australia by Data Effects. SARDI extracts DNA from spore samples.

Myrtle Rust Detection
Strains of concern are reported to authorities via AusPESTCheck.

Strain Analysis
ANU uses sequencing to differentiate strains and detect other fungi.

Saving Native Species
We protect native plants through early detection, research, monitoring, and education.

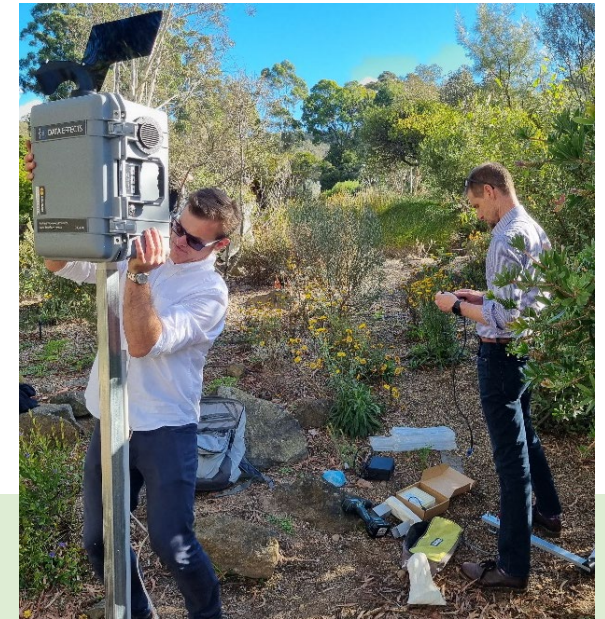**Teaching Outreach**
ANU leads STEM programs and workshops to engage the public.

Airborne myrtle rust surveillance – Next Gen technology systems

Sampler install at ANBG

Samplers ready for BGs

Delivery pipeline for airborne pathogen data

Sentinel Surveillance in Botanic Gardens

High volume cyclone sampler: MYRTLE RUST TARGET

LTE

DATA EFFECTS

Samples

Data

DNA extraction & Pathogen diagnostics 1

GIS referenced sampling

Real-time environmental data

**Diagnostic output 1** — **High throughput analysis (qPCR)**

Molecular ID (qPCR & NGS)

Pathogen diagnostics 2 — **Metabarcoding**

Australian National University

DNA

Data

Secure data management

Field, real-time IoT & laboratory diagnostic data matching

API

Data

API
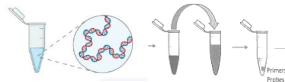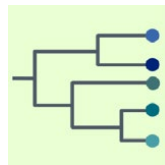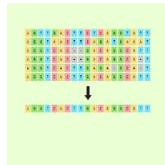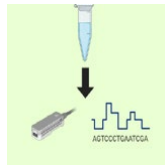
Data

Exotic strain & sensitive detections reported to relevant state biosecurity agency as per established biosecurity reporting protocols

DATA EFFECTS

Central Databases
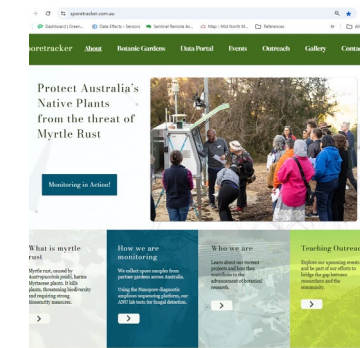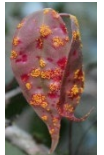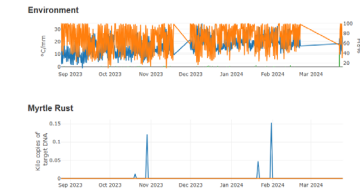
Pathogen incursions reported via web URL for Botanic Garden network and ANPC collaborators

Diagnostic pathway #2

1 Sampling and DNA extraction

DNA are extracted from spores, infected leaves, or sporetrap samples.
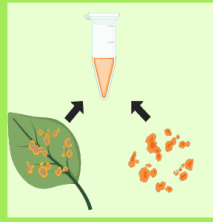
2 Amplification

PCR amplifies eight loci in the *A. psidii* genome.
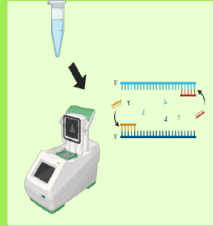
3 Sequencing

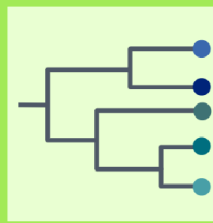PCR products are sequenced with Nanopore long-read sequencing.

AGTCCCTGAATCGA
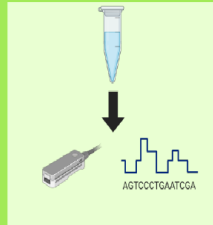
4 Reconstruction of alleles

Alleles of each locus are generated by clustering and consensus sequence reconstruction.
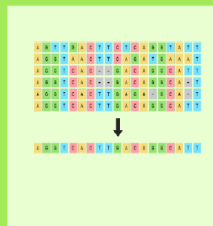
5 Comparison

Compartive analysis enables clear differentiation of exotic strains from the pademic biotype.

Australian National University

Strain variant tool

Eight novel diagnostic markers differentiate lineages of the highly invasive myrtle rust pathogen *Austropuccinia psidii*

Zhenyan Luo, Jinghang Feng, Austin Bird, Mareike Moeller, Rita Tam, Luc Shepherd, Lydia Murphy, Lavi Singh, Abigail Graetz, Lilian Amorim, Nelson Sidnei Massola Júnior, M. Asaduzzaman Prodhan, Louise S. Shuey, Douglas Beattie, Alejandro Trujillo Gonzalez, Peri Tobias, Amanda Padovan, Rohan Benjamin Essex Kimber, A. R. McTaggart, Monica Kehoe, Benjamin Schwessinger ✉ and Thais Regina Boufleur ✉

Applied in Biosecurity settings for exotic strain diagnosis

Strain variant tool – reports first to CPPO

Project activities, data outputs and engagement - website

Visit ..

www.sporetracker.com.au
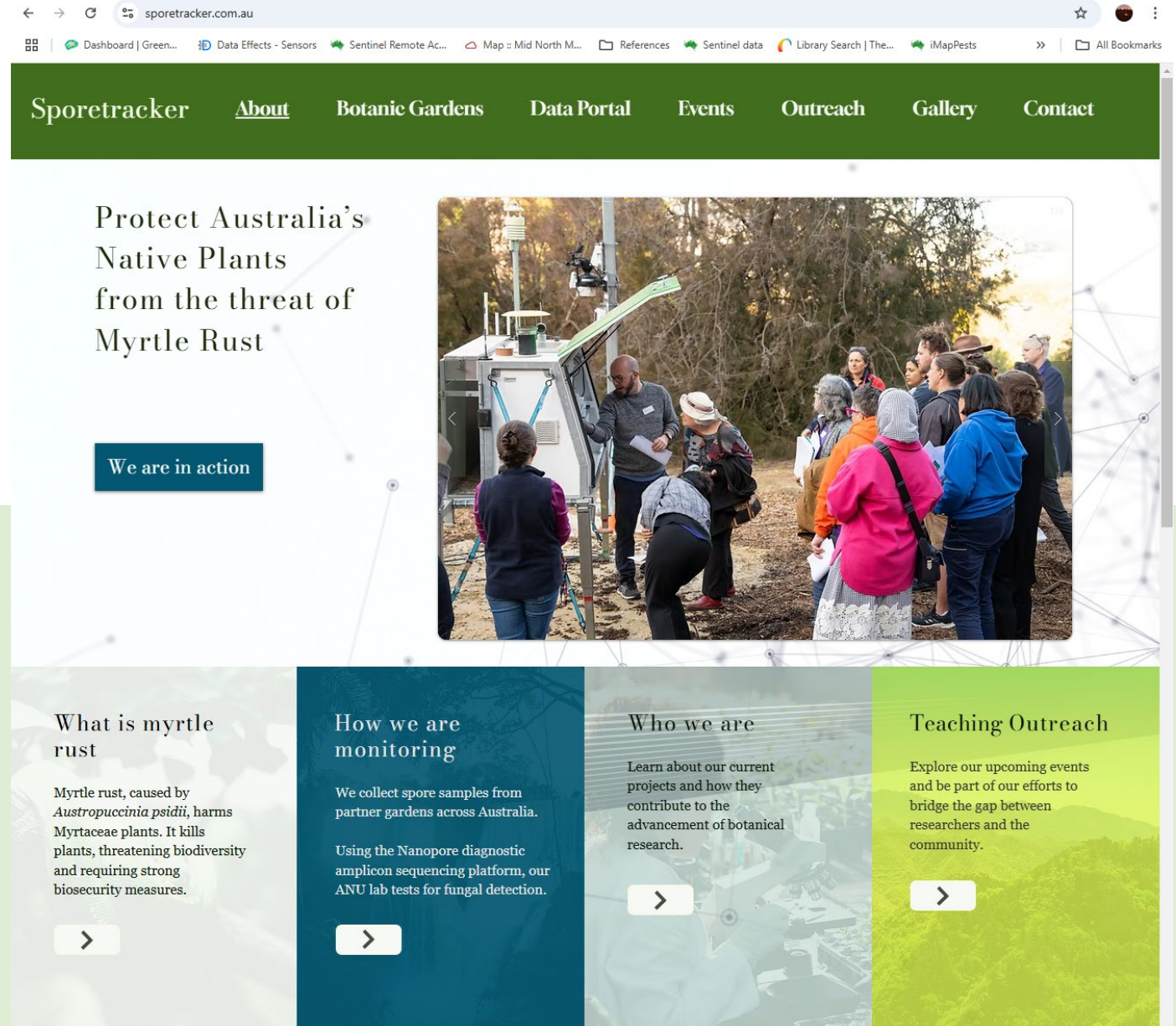
Canberra - ANBG
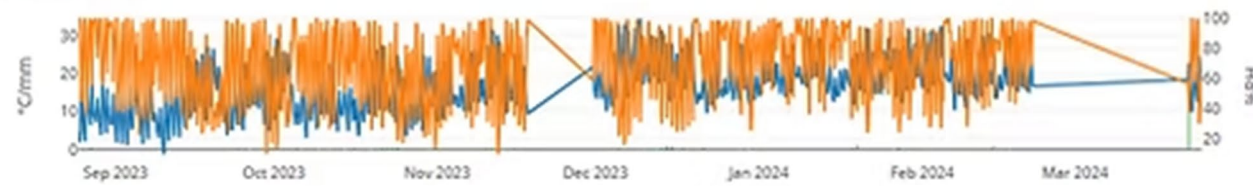
Adelaide Botanic Gardens
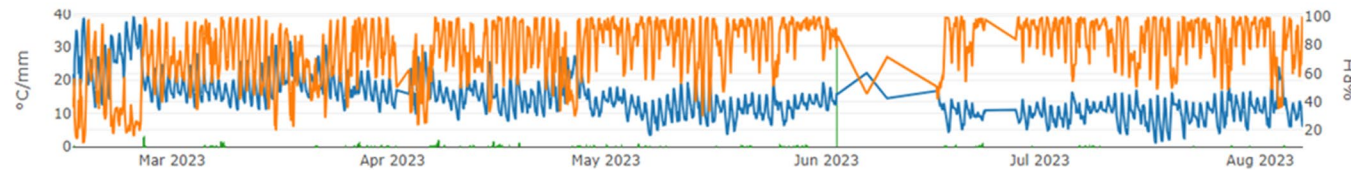
Strategic Surveillance Plan for Myrtle Rust
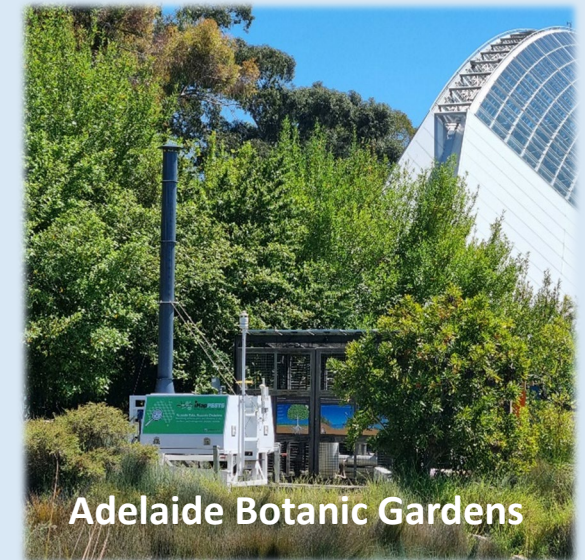
Thank you …

Data Effects - Andrew Baker, Paul Coldrey, Gerard O'Connor,

ANU - Benjamin Schwessinger, Mareike Moeller, Yapeng Lang, Zhenyan Luo, Sonja Brodersen, Ashley Jones

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Adelaide Botanic Garden

Australian National Botanic Garden

Royal Botanic Garden Sydney

Royal Botanic Garden Melbourne

Kings Park and Botanic Garden
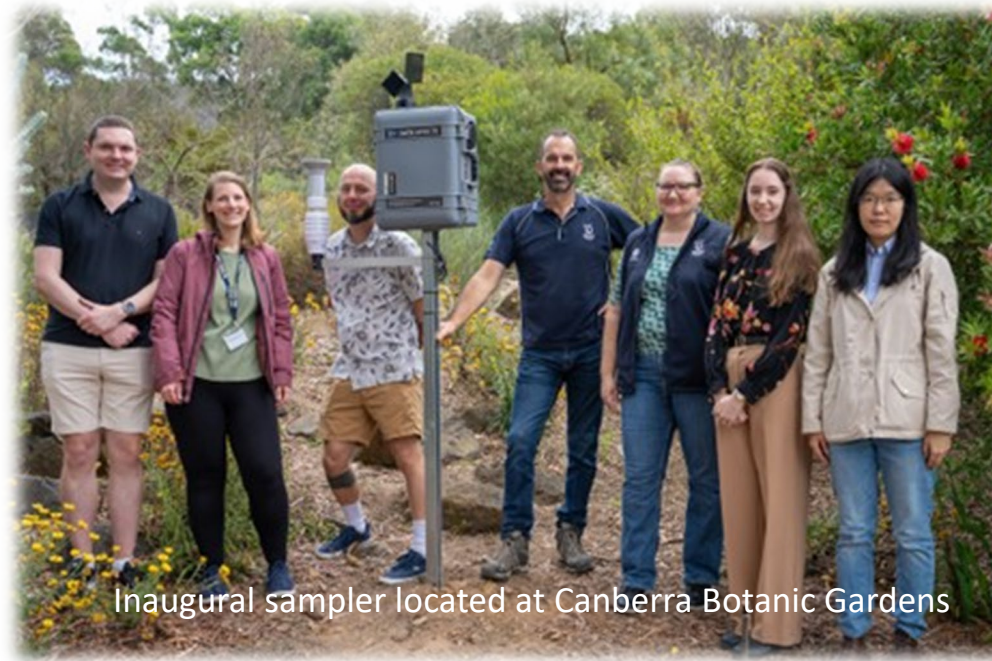
Lismore Rainforest Botanic Gardens

Royal Tasmanian Botanical Garden

George Brown Darwin Botanic Garden

Cairns Botanic Gardens

Australian Network for Plant Conservation

Previous pilot study project partners University of Canberra and University of Sydney

Inaugural sampler located at Canberra Botanic Gardens