

# Te haere huihui tahi

03

August 23

## B3 project update: Assessing the risk of rapid 'ōhi'a death (ROD) to Aotearoa New Zealand and the South Pacific

Kia ora koutou,

Much has happened since our last newsletter in November 2022, and we can't help but acknowledge how eventful and dynamic it has been for us. Some of the team travelled to the Hawai'i Big Island in November 2022, and in this issue, and in upcoming ones, we will share some of the highlights. The purpose was to learn about rapid 'ōhi'a death (ROD) and its ecological, social, cultural, and economic impacts in Hawai'i, establish partnerships, and include cultural perspectives in biosecurity research. The International Congress of Biological Invasions 2023 (ICBI2023) was held in Christchurch from 1 to 4 May 2023, providing a platform for experts from around the world to come together and share their knowledge and experiences. There was strong participation from various Pacific Nations who shared their expertise and experiences, contributing to a greater understanding of the challenges, common threats, and opportunities within the region. During the Congress, a special session dedicated to rapid 'ōhi'a death brought together international experts and collaborators from South Africa and Hawai'i, and New Zealand researchers. We share highlights of this session below, offering you a glimpse into the valuable learnings from these interactions.

### Trip to Hawai'i

A project team delegation including Teresa Waiariki (PFR, Indigenous Engagement/Research Associate), Waipaina Awarau-Morris (AgResearch, Indigenous Engagement/Scientist), Mark McNeill (AgResearch/Entomologist) and Virginia Marroni (PFR, Project Leader/Plant Pathology) was hosted by Dr Lisa Keith (USDA ARS) in Hilo, Hawai'i from 13 to 27 November 2022. Lisa Keith led the rapid 'ōhi'a death (ROD) research in Hawai'i from the very beginning, when trees were dying and not much was known about this new disease. Lisa developed a great plan of activities for our visit. We had the opportunity to meet with local experts, including researchers, park rangers, conservationists, cultural leaders and community who shared their knowledge and experiences in dealing with ROD. We participated in fieldwork, collecting samples from affected trees and monitoring the spread of the disease. We learned about the cultural significance of 'ōhi'a trees and their importance in Hawai'iian folklore and traditions. The visit provided valuable insights into ROD's impact on Hawai'i's ecosystems and the challenges faced by conservationists in preserving the unique biodiversity. During our trip, we became aware of the significant cultural connections between the Māori of Aotearoa New Zealand and the Kanaka Maoli of Hawai'i. By acknowledging and honoring this connection, we are committed to respecting the values of both communities and upholding their rich cultural heritage. We returned to Aotearoa New Zealand with a greater understanding of the importance of collaboration, community engagement, and ongoing research in safeguarding Hawai'i's natural resources. For a full copy of the travel report, please email: [virginia.marroni@plantandfood.co.nz](mailto:virginia.marroni@plantandfood.co.nz)



*Metrosideros polymorpha*, 'ōhi'a lehua.

More highlights of the trip in the next issue. For a full copy of the travel report, please email: [virginia.marroni@plantandfood.co.nz](mailto:virginia.marroni@plantandfood.co.nz)

## Connecting with researchers at USDA Forest and Wildlife Service

We met Dr Marc Hughes, Dr Brian Tucker and Ryan Belcher at USDA Forest Service. Brian Tucker presented the work carried out to survey and monitor 'ōhi'a health across Hawai'i. The main tool used for surveying is Digital Mobile Sketch Mapping (DmSM). DmSM is a method used in geospatial data collection that involves collecting spatial data using digital sketches made on a mobile device, such as a tablet. It is often used in areas where traditional surveying methods are impractical or unavailable and is particularly useful for field data collection in challenging environments. In the case of ROD, trained aerial surveyors from the Big Island Invasive Species Committee (BIISC) carry out regular surveys by helicopter to record the occurrence of recent 'ōhi'a tree death. The team is part of the ROD Early Detection/Rapid Response (EDRR) group, formed by the BIISC to actively monitor and manage the spread of ROD in high priority areas. Drone surveys follow the helicopter observations, to obtain accurate GPS coordinates of potentially infected trees. The drone work is supported by a collaboration with the University of Hawai'i Spatial Data, Analysis and Visualization (SDAV) Lab (Dr Ryan Perroy's lab, afternoon visit). A ground team then uses the GPS coordinates to collect samples from the suspected ROD-infected trees. Samples are subsequently sent to USDA ARS (Lisa Keith's lab) for diagnostics (presence/absence of the ROD pathogens) and the information contributes to produce up-to-date maps to show the progression of the disease and help with management efforts.



USDA Forest Service Nursery. Upper row, Ryan Belcher (left) and Marc Hughes (right) showed us recently sown 'ōhi'a seeds on trays. Bottom row, Ryan Belcher holding a 1-year-old 'ōhi'a plant.



The group at USDA Forest Service. Dr Bryan Tucker presents.

## Visit to the plant nursery at USDA Forest and Wildlife Service

Dr Marc Hughes, a research plant pathologist at the USDA Forest Service, and Ryan Belcher the Nursery Manager along with Nainoa Goo, both from Akaka Foundation, gave us a tour of the facilities. The nursery produces 'ōhi'a plants for the 'Ōhi'a Disease Resistance Program (ODRP), established in 2018. The objective of the programme is to identify disease-resistant 'ōhi'a trees, with the objective of growing and using them to restore native forests, landscapes, and preserve 'ōhi'a in the cultural and biological landscapes.

## ROD and ungulate damage

We met with Dr Flint Hughes and his team at USDA Forest Service. and visited two sites to observe ungulate impacts/ROD in fenced and unfenced areas of the forest. Research in Hawai'i has shown increased mortality of trees in stands where ungulates are present compared with areas where ungulates are excluded from 'ōhi'a. Feral pigs, through their activities, can damage the root system and trunk, providing a route for ROD to enter the tree.



Our first stop, at a fenced area of native 'ōhi'a forest, with no feral pig damage. Flint Hughes (standing against the trunk of a healthy 'ōhi'a tree) explained what a healthy native forest understory looked like, with plenty of vegetation and the undisturbed soil is covered in plant debris.



Our second stop at an 'ōhi'a forest site with high incidence of ROD. (Flint Hughes now leaning against a dead 'ōhi'a tree). Note the soil, lacking plant debris cover, while most understory plants are invasive species. At the back there are several dead "skeletons" of 'ōhi'a trees. Sometimes these sites are colloquially called "graveyards".

At this second site we were able to observe ROD symptoms of black staining on trunks and we took samples



Kyson Dunn removes part of the bark of an 'ōhi'a tree to expose the xylem where we can see characteristic black staining, one of the characteristics symptoms of ROD.



With the help of a drill, Joseph Rocco obtains wood shavings from the exposed xylem area. The shavings are collected in sterile plastic bags identified with tree number, date, collector, and type of sample (in this case wood shavings). All samples are sent to USDA ARS (Lisa Keith's lab) for diagnosis.

### ROD at Lisa's lab USDA ARS

We met in the morning at USDA ARS with Dr Lisa Keith and her team.



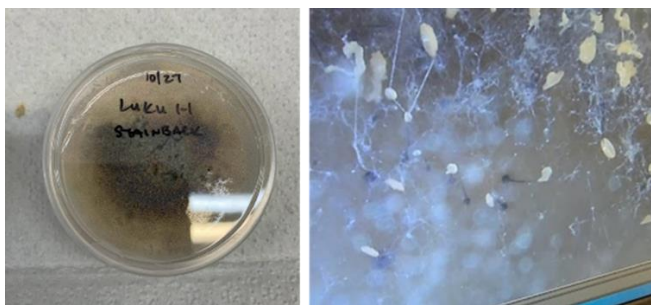
Visit to USDA Agriculture Research Service. Front row, left to right, Lionel Sugiyama, Lisa Keith, Virginia Marroni, MaryAnn Villalun and Waipaina Awarau-Morris. At the back, left to right, Blaine Luiz, Eva Brill, Teresa Waiariki and Mark McNeill.

Eva Brill demonstrated the sample processing procedure. Samples arrive from a diverse range of sources, including researchers and homeowners, and are in various forms, including drill shavings, chips, and branches. Each sample is accompanied by a form with information about its location, date of collection, and sender. Shavings are placed directly into plastic zip-lock bags containing carrot baits. Branches and wood chips are drilled to produce shavings, which are subsequently processed in the same manner. Once the shavings are obtained, they are placed into 2-mL cryotubes containing the white beads for DNA extraction.



Sample processing procedure at Lisa's lab USDA ARS

Afterward, we prepared a microscope slide by scraping the surface of a *Ceratocystis lukuohia* culture and observing it under the stereomicroscope, where we were able to see the perithecia (specialised fungal structures) with their long black necks.



Left, *Ceratocystis lukuohia* growing on an agar plate. Right, black fungal structures called perithecia with long necks can be observed under the stereomicroscope.

With the guidance of Blaine, Virginia then inoculated two 'ōhi'a plants with *C. lukuohia*. To do this, Virginia made a flat wound at the base of each plant and placed a filter paper disc with *C. lukuohia* mycelium facing the sapwood. She then covered the disc back with the flap and secured it in place with tape.



An 'ōhi'a plant after being inoculated with *Ceratocystis lukuohia*. Note the plastic wrapping at the base of the plant.

After a lunch break, we had a look at symptoms on the trunks of plants that had been inoculated about a year before. Blaine peeled the bark on a young stem to demonstrate the procedure, which required using a considerable amount of pressure to get into the sap wood. Blaine explained that sometimes you see decolouration and if you peel deeper a very clear necrosis appears on the sap wood.



Necrotic tissue is exposed in the sap wood of a *Ceratocystis lukuohia*-inoculated 'ōhi'a plant.

### Ōhi'a from the air

Teresa and Virginia met at the airport at 0730 h with Dustin Swan (BIISC) and our helicopter pilot, for take-off at 0830 h. Seeing ROD from the air allowed us to gain a new perspective on the impact of the disease on the forest ecosystem. From high above, we could clearly see the devastating effects of ROD, with numerous brown skeleton trees dotting the landscape.



Rapid 'ōhi'a death from the air in Puna District, Hawai'i, ground zero of the outbreak. The once-vibrant green canopy of the forest is now dominated by grey 'ōhi'a skeletons.

More highlights of the trip in the next issue. For a full copy of the travel report, please email: [virginia.marroni@plantandfood.co.nz](mailto:virginia.marroni@plantandfood.co.nz)

## Ceratocystis and rapid 'ōhi 'a death (ROD) at the International Congress of Biological Invasions (ICBI2023) in Christchurch, 1–4 May 2023

A special session organised and chaired by Virginia Marroni brought together international experts and collaborators from South Africa, Hawai'i and New Zealand. Researchers from Hawai'i, who hosted a delegation of four ROD team members in November 2022, presented at this session. The conference helped to strengthen links with international experts working on *Ceratocystis* invasive species and their impact on native ecosystems.

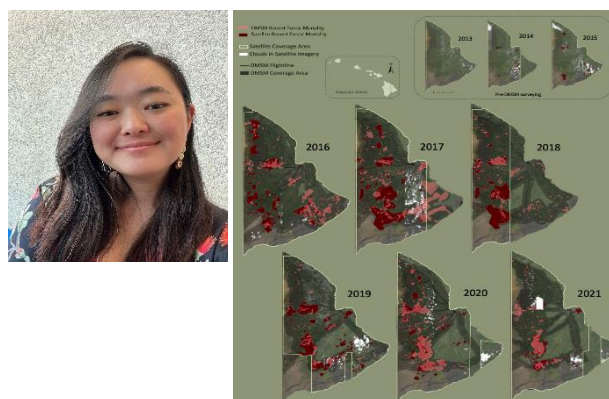
**Professor Irene Barnes** from the Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Research Institute (FABI), University of Pretoria, South Africa, was the session keynote speaker. Irene presented "Ceratocystis diseases rising in South Africa – and elsewhere in the world."



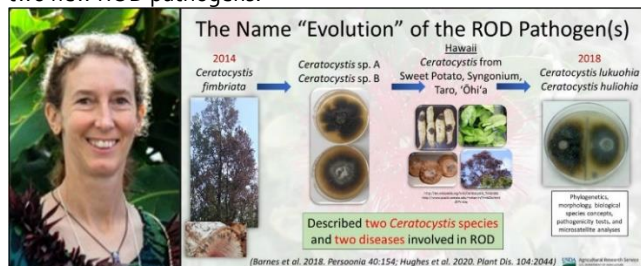
**Dr James B. Friday** (Extension forester for the University of Hawai'i), presented initiatives aimed at preserving the health of Hawai'i's forests.



**PhD candidate Nai'a Odachi** from The University of Hawai'i presented a poster titled "A comparative analysis of monitoring methods for Rapid 'Ōhi'a Death in Hawai'i: high-resolution satellite imagery and digital mobile sketch mapping surveys"



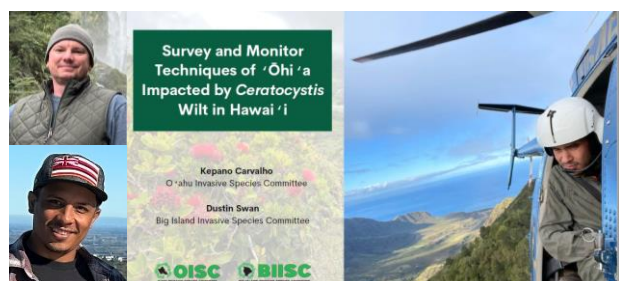
**Dr Lisa Keith** from USDA ARS presented "Rapid 'Ōhi'a Death: Ongoing research to protect native forests in Hawai'i and the Pacific". Lisa and her team have been involved in ROD research from the early days, being instrumental in the identification of the two new ROD pathogens.



**Professor Ryan Perroy**, Chair of the Department of Geography & Environmental Science at the University of Hawai'i at Hilo presented: "Hawai'i an Forest Mortality Trajectories associated with Ceratocystis Wilt of 'Ōhi'a".

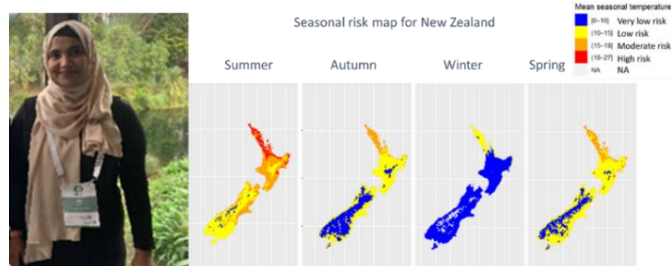


**Dustin Swan** from the Big Island Invasive Species Committee and **Kepano Carvalho** from the O'ahu Invasive Species Committee discussed essential tools to detect and respond to Rapid 'Ōhi'a Death across the islands.

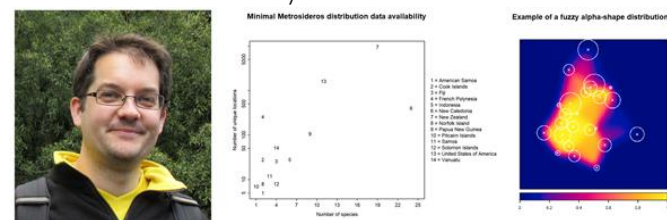


**Our B3 ROD project team shared four oral presentations and a poster:**

**Luna Hasna** (PFR) presented: "Assessing the Risk of Establishment of Rapid 'Ōhi'a Death: Using Knowledge of Ceratocystis species in New Zealand".



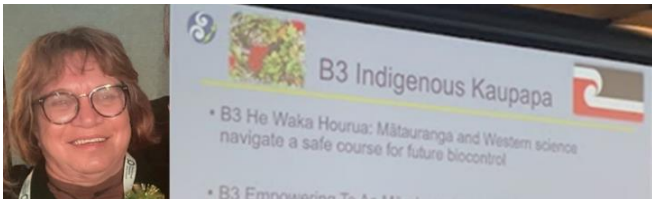
**Tom Etherington** (Manaaki Whenua) presented: "Mapping Pan-Pacific Distributions of *Metrosideros* species as Potential Ceratocystis Hosts: A Fuzzy Geographic Approach given Occurrence Data Uncertainty".



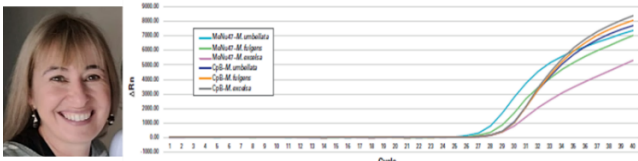
**Teresa Waiariki** (PFR) presented "Bringing Tikanga Māori (Māori values) into Biosecurity Research: Te Haere Huihui Tahī (A journey gathering together). Māori mana whenua Aotearoa and Kanaka Maoli Hawaiian indigenous peoples joining together for the ROD project.



**Waipaina Awarau-Morris** presented "Kaitiekitanga, Science and Better, Border, Biosecurity", with the ROD project being one of her case studies.



**Virginia Marroni et al.**, presented a poster "Validation of a real-time PCR protocol to detect *Ceratocystis lukuohia* and *C. huliohia* from Aotearoa New Zealand *Metrosideros* species



## Metrosideros seed collection update

### In the field, North Island

Cyclone Gabriel and continual heavy downpours in the last 6 months have affected many of the mana whenua in rohe (areas), i.e. Northland and the Bay of Plenty, where seed is being collected. Respectfully we stepped back in collections to allow for the recovery of these whanau and communities. Rivers and streams became unpredictable for crossing to go further inland in the ngahere (bush). Also, a lot of the hills became unstable with many slips, and sourcing some of the more elusive rātā species in these areas became difficult. The seasonal flowering and seed ripening was sporadic, but we were still able to collect many samples of pōhutakawa and rātā from Te Whanau-A-Apanui. Some sound recordings from early morning to late afternoon of the awa (streams), moana (ocean) and manu (birds) from where pōhutakawa and rātā species live were sent to Hawai'i to play in the nursery during propagation of our taonga, giving them the sounds of home.

### South Island West Coast

We received seed from *M. parkinsonii*, Parkinson's rātā or shrubby rātā. In the South Island, the species is limited to the western side, where it is common from Mt Burnett (near Collingwood) to just north of Hokitika.

Seeds were collected by nursery staff at Bathurst Resources, which runs a very small nursery focused on growing plants for restoration on some of their mine sites in the Buller Region. This includes some rare or threatened plants, including *M. parkinsonii*.



*M. parkinsonii*, Parkinson's rātā or shrubby rātā grown at the Bathurst Resources nursery.

### In the lab

Rachael Warren has taken over from Shirley Thompson (who has retired), working on seed processing and conditioning to send to Hawai'i.



Rachael has been busy with seed received over the last few months. Closed mature capsules received are first dried. Once they open, seed is extracted. Seed is then surface sterilised to meet phytosanitary requirements to import into Hawai'i. Dried seed is sent to Hawai'i (Lisa Keith's lab) for germination and testing for susceptibility to ROD pathogens.

### In Hawai'i



*Metrosideros fulgens*, the scarlet rātā, growing at USDA ARS in Hilo Hawai'i

### Postscript

Sending our thoughts to the people of Hawai'i in the aftermath of the wildfires.