



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

Rapid 'ōhi'a death (ROD), caused by two recently described fungus *Ceratocystis* species, *C. lukuohia* and *C. huliohia*, has resulted in widespread death of 'ōhi'a lehua (*Metrosideros polymorpha*) in Hawai'i. Aotearoa New Zealand *Metrosideros* species, such as the iconic pōhutukawa and rātā, are closely related to *M. polymorpha*. The pathogens are not currently present in Aotearoa New Zealand, but should either of these pathogens establish in this country, they could affect endemic and indigenous *Metrosideros* species and possibly expand their host range to other indigenous and exotic plants.

In 2021, a project team from across the Crown Research Institutes in Aotearoa New Zealand, in conjunction with mana whenua, forestry and horticulture end-user organisations, identified the need to better understand the risk that ROD poses to Aotearoa New Zealand and South Pacific nations. This newsletter aims to provide an update on the project's activities and to keep the science team, end-users and collaborators connected.

So welcome/haere mai to the second edition of "Te haere huihui taki" (journey gathering together).

ROD review

As part of a first-year milestone, we completed a review that examines the risks that ROD pathogens pose to the endemic Aotearoa New Zealand *Metrosideros* species. The review also defined a framework for preparedness against the possible arrival of ROD. It contains contributions from 15 researchers, including the project team, the Department of Conservation (DOC) and the Ministry for Primary Industries (MPI), and was reviewed by Dr Irene Barnes from the Forestry and Agriculture Biotechnology Institute (FABI, South Africa). There are still many unknowns in our understanding of the mechanisms involved in ROD spread, its potential host range, and the risk of specific entry pathways. Here we summarise the current understanding of the risks that *C. lukuohia* and *C. huliohia* pose to Aotearoa New Zealand.

Likelihood of entry: Low to medium. Based on biological aspects of the two ROD pathogens, their current known distribution, the low cargo volumes originating from Hawai'i and the strict border biosecurity measures in Aotearoa New Zealand, the overall risk of introduction of the pathogens through natural and human-assisted pathways is considered to be low. However, the risk of introduction through contaminated footwear, tramping, camping and sporting equipment was considered to be moderate, and in need of further study.

Conditions for establishment and spread: Moderate. Climate modelling showed that Aotearoa New Zealand has suitable conditions for the establishment of the ROD pathogens, particularly in the North Island. Spread within the country could be enabled by insect vectors and other vertebrates known to occur in Aotearoa New Zealand and Pacific nations, and by human activities.

Impact: High. Control inoculation experiments have confirmed that *C. lukuohia* can infect at least three other *Metrosideros* species, including *M. excelsa* (pōhutukawa).



Project leader Virginia Marroni presented a summary of the review "Rapid 'ōhi'a death: how substantial is the threat of this disease to Aotearoa New Zealand's endemic and indigenous *Metrosideros* species?" at the New Zealand Plant Protection Society Symposium on 8 August 2022, "Plant pathogens that keep us awake: past, present and future threats to native species".

If the pathogens were to establish in Aotearoa New Zealand or other South Pacific nations, they have the potential to cause unwanted impacts to endemic and indigenous *Metrosideros* species, and possibly expand their host range to other native and exotic plants.

In future editions of "Te haere huihui taki", we will provide more information on these pathogens' potential entry pathways, climatic suitability and some other aspects of our research. For a full copy of the review, please email: virginia.marroni@plantandfood.co.nz

How many *Ceratocystis* species occur in New Zealand forests?

The only *Ceratocystis* species recorded from New Zealand is *C. fimbriata* sensu stricto, a kumara-specialist pathogen. No species have been recorded from native forests (data from Biotanz, <https://biotanz.landcareresearch.co.nz/>). However, it has been estimated that more than two-thirds of the fungi present in New Zealand remain unknown, and as *Ceratocystis* requires specialised methods for detection in the field, some of these undetected species may belong in this genus. A better understanding of native *Ceratocystis* diversity in New Zealand is one of the key things needed to interpret and manage any future detection of the genus in New Zealand. Such data will enable better predictions about whether newly detected species are likely to be new introductions, or alternatively are species that have been here for many millions of years, but previously undetected. Based on the known diversity of the genus internationally, and the distribution of that diversity, we predict that undetected species will be present in New Zealand. DNA-based studies enable *Ceratocystis* to be divided broadly into four geographically specialised groups (known as clades): the North American clade, the Asian-Australian clade, the African clade, and the Latin American clade. The kumara pathogen *C. fimbriata* belongs in the Latin American clade, as does one of the Hawaiian 'ōhi'a pathogens, *C. lukuohia*. There are few (if any) examples of species occurring naturally in either tropical America or Aotearoa New Zealand. If more species from this clade were to be found in Aotearoa New Zealand, it is highly likely that they would have been introduced by humans. The second 'ōhi'a associated species, *C. huluohia*, belongs in the Asian-Australian clade. There are many examples of fungi shared between these regions and the native forests in Aotearoa New Zealand — if we do find native *Ceratocystis* species, they are likely to belong in this clade.

There are numerous international studies surveying for *Ceratocystis* using a baiting method where artificial wounds are used to attract the insects that disperse the spores of these fungi. Using this method, *Ceratocystis* species from Asia, Africa, South America and Australia have typically been successfully isolated from around half the trees and/or sites sampled. We plan to use this same method to sample for *Ceratocystis* in New Zealand; for practical reasons, we will focus on the Auckland region. At present we are negotiating access to suitable sites through Auckland Council, DOC, and relevant iwi authorities.

In addition, we have been given access to a set of historical cultures isolated from stained wood of native trees by Roberta Farrell (Waikato University). These have a *Ceratocystis*-like ecology, and their identity will be checked using DNA sequencing. Through these cultures, we may already have the answer as to whether *Ceratocystis* occurs naturally in New Zealand native forests.



Peter Johnston from Manaaki Whenua Landcare Research is leading the research on *Ceratocystis* species in Aotearoa New Zealand.

Metrosideros seed collection

Teresa Waiariki from Plant & Food Research (PFR) continues the engagement and efforts to source *Metrosideros* seed from different species and provenances within Aotearoa. We are very humbled and pleased with the response from people that want to be involved and help. The team has developed a flip book with information and photographs to help with training and identification of species. Teresa says that this material has been very valuable during her visits and training. A standardized seed collection pack is also distributed, which contains all the instructions and necessary items for plant marking, identification, collection and couriering.



Te Rarawa Iwi seed collection training with Teresa Waiariki, September 2022.



A population of *Metrosideros perforata* was located in the beautiful ngahere of Murray and Sue Lyon in Matata, and they helped us to collect seeds for the project, through previous consultation with the local Iwi Ngati Rangitahi. *M. perforata* is known by the Māori names aka, katea, katorotoro, torotoro, koro, akatoki, and whakapiopio, or by the English name of white rata. They are climbing woody vines. A differentiating feature is the presence of glandular spots, which are particularly visible on the undersides of the leaves.



Left, a climbing white rata on Matata; top right, Murray and Sue Lyon looking at seeds from *M. perforata*; bottom right, a close up of the capsules and released seeds. Photographs by Teresa Waiariki.



Top, the upper side (top) and underside (bottom) of *M. perforata* leaves. Note the glandular spots on the underside of the leaves. Photographs by Teresa Waiariki.



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