



Indigenous artistic and linguistic interpretation of myrtle rust and its impacts for community awareness

Research Impact Report/Progress Report (PBSF043)

March 2023

AUTHOR

Mark Temple

Copyright



The material in this publication is licensed under a Creative Commons Attribution 4.0 International license, with the exception of any:

- third party material;
- trade marks; and
- images and photographs.

Persons using all or part of this publication must include the following attribution:

© Mark Temple 2023.

Disclaimer

While care has been taken in the preparation of this publication, it is provided for general information only. It may not be accurate, complete or up-to-date. Persons rely upon this publication entirely at their own risk. Australian Plant Biosecurity Science Foundation and its members and stakeholders do not accept and expressly exclude, any liability (including liability for negligence, for any loss (howsoever caused), damage, injury, expense or cost) incurred by any person as a result of accessing, using or relying upon this publication, to the maximum extent permitted by law. No representation or warranty is made or given as to the currency, accuracy, reliability, merchantability, fitness for any purpose or completeness of this publication or any information which may appear on any linked websites, or in other linked information sources, and all such representations and warranties are excluded to the extent permitted by law.

Project Leader contact details

Name: Mark Temple

Address: School of Science, Western Sydney University, Narellan Rd & Gilchrist Dr, Campbelltown NSW 2560

P: (02) 4620 3329

M: 0412 600 712

E: m.temple@westernsydney.edu.au

Australian Plant Biosecurity Science Foundation

3/11 London Circuit, Canberra, ACT 2601

P: +61 (0)419992914

E: info@apbsf.org.au

www.apbsf.org.au

This document should be cited as:

Temple MD, Moffitt M, and Summerell B, 2023, APBSF Project Final Report, Indigenous artistic and linguistic interpretation of myrtle rust and its impacts for community awareness.

Contents

1. Executive Summary	4
2. Introduction	4
3. Aim	4
4. Methods/Process	5
5. Achievements, Impacts and Outcomes	6
National Science Week 2022	6
National Science Week 2023	7
The Art and Science of Myrtle Rust	7
Summary of artists and their works	8
Jenny Fraser	8
Graeme Walker	9
Graham Toomey	10
Charmaine Davis	11
Sharon Smith	12
Wanita Lowe	13
Dr. Bronwyn Bancroft	14
Darren Charlwood	16
Hayley Pigram	18
Kyra Kum-Sing	19
Brieanna Geary	20
Sonification and musification of Myrtle Rust DNA sequences	21
The use of audio for Myrtle Rust DNA sequence analyses	21
Turning science audio into art	22
Musification and science outreach	25
Generative music from the critically endangered Scrub Turpentine	25
Science Symposium	27
Archival Content from the Exhibition.	28
6. Discussion and Conclusion	28
7. Recommendations	29
8. Appendices, References, Publications	29

1. Executive Summary

An exhibition entitled “The art and science of Myrtle Rust” was held at Australian Plant Bank at the Australian Botanic Garden, 362 Narellan Road, Mount Annan 2567 from 2nd February to 12th February, 2023. The exhibition featured art works by 11 Aboriginal Artists from Boomalli Aboriginal Artists Co-operative. The works in this exhibition are each artists response to a call to protect Country from the devastating effects of Myrtle Rust.

In addition there were installations to demonstrate sonification and music made from Myrtle Rust genomic data, additionally generative music was made from critically endangered Australian Native Plants.

The exhibition featured an opening night on Thursday 2nd February, 5pm - 7pm. At this event representative artists attended to discuss their work and there was an ensemble performance of music inspired by sonification of the Myrtle Rust DNA sequence data.

As part of the exhibition there was also a Science Symposium on Myrtle Rust. For the entire exhibition period Dr Mark Temple acted as scientist-in-residence to introduce and discuss all aspects of the exhibition of members of the public. Archival content from the exhibition held at Plant Bank is documented at <https://myrtle-rust.com>.

2. Introduction

The Myrtle Rust fungus is silently killing our seedlings, saplings and established trees. Hundreds of Australian species in the Myrtaceae family are susceptible including bottlebrushes, eucalypts and tea trees with 16 species set to become extinct within a generation. It is caused by the fungus *Austropuccinia psidii*, and was first detected in Australia in 2010.

Myrtle rust causes yellow or orange pustules to appear on the leaves, stems, and flowers of infected plants. These pustules can lead to leaf loss, reduced growth and vigour and in severe cases, plant death. The fungus can also weaken the plant's natural defences, making it more susceptible to other diseases and pests. Scientists and land managers are working to understand the disease and develop strategies to mitigate its impacts on native plants.

3. Aim

The aim of this project was to use novel art and music to describe and draw attention in interesting ways to the Myrtle Rust problem facing Australia. Towards this end, new artworks were commissioned for exhibition by Aboriginal artists to describe the rust and its effects on country.

We also aimed to create new music that is inspired by both Myrtle Rust and the critically endangered plants.

4. Methods/Process

We would like to express our deepest thanks to the Boomalli Aboriginal Artists Co-operative for their invaluable assistance in commissioning the artwork for this exhibition. Boomalli Aboriginal Artists Co-operative was established in 1987 by ten founding member artists. They were Euphemia Bostock, Fiona Foley, Michael Riley (dec.), Tracey Moffatt, Jeffrey Samuels, Bronwyn Bancroft, Avril Quail, Fern Martens, Arone Meeks (dec.), and Brenda L. Croft. These ten artists were striving for recognition from the mainstream art society and their diversity was unparalleled. They challenged preconceptions around urban based Aboriginal Artists and created a unique space for themselves within the art world.

Methods to sonification the Myrtle Rust genomic data was devised by Mark Temple. To achieve this prior code was extensively modified to process the Myrtle Rust DNA sequences. To allow for musification of the sonified audio data, the code was re-written to include the ability to capture the audio in a MIDI file format. The MIDI data was imported into a Logic Pro, a digital Audio Workstation, that allowed the data to be manipulated as a musical instrument. This allowed the science audio data to be used in creative way for the creation of music. Additionally, generative music was made from critically endangered Australian native plants using a custom made Eurorack synthesiser.

5. Achievements, Impacts and Outcomes

National Science Week 2022

At National Science Week 2022 the event 'Science Meets Art: An evening of Sonification and music,' was held at Cell Block Theatre at National Art School. As part of this event, I discussed the effects of Myrtle Rust and performed three music tracks based on the DNA sequence of Myrtle Rust. The event was well attended and enthusiastically received. The audio display of the DNA sequence (sonification data) was used as the basis of these compositions.

Throughout each track the sequence of Myrtle Rust was clearly audible underpinning the musical performance. Before the performance, a question-and-answer session was moderated by Sunanda Creagh, an award-winning journalist and a Senior Editor at The Conversation. The devastating effects of Myrtle Rust were explained to the audience. The event was filmed, and footage was featured in a short story on the ABC TV show called ArtWorks.

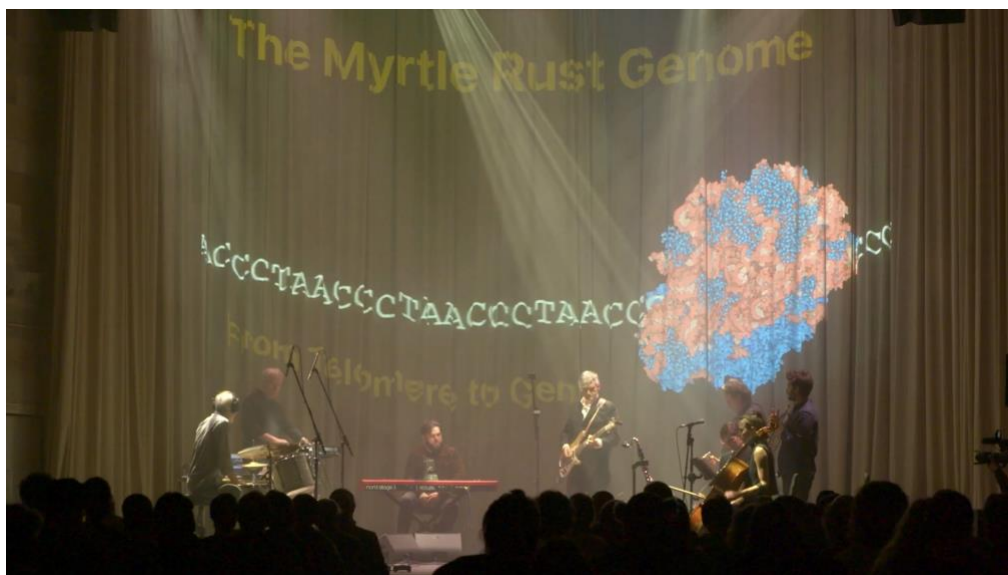


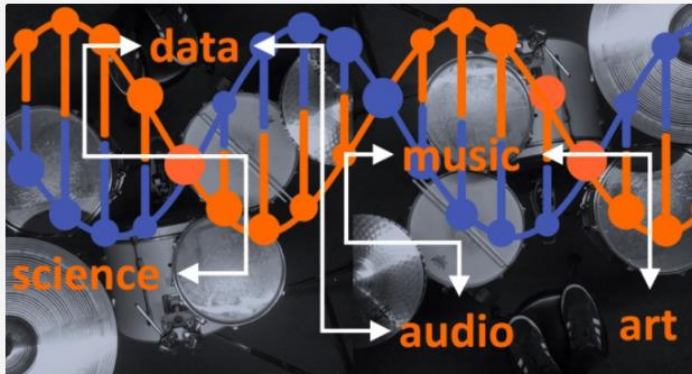
Photo shows the ensemble performance of music to accompany the science audio, derived from the Myrtle Rust DNA sequence.

This was performed by Dr Mark Temple-Drums and biological sequences, Dr Michael Bain (UNSW)-Synthesiser, Dr Tim Byron (UOW)-Keyboards, Dr Julian Knowles-Guitar, Paul Scott-Bass, Freya Schack-Arnott-Cello, Phillippa Murphy-Haste-Clarinet/Viola, Nick Calligeros-Trumpet

Artworks (Episode 28): <https://iview.abc.net.au/show/art-works/series/2>

YouTube link for additional footage: https://youtu.be/n_3edKbfmbg

THE SOUND OF SCIENCE



This Thursday (18th of August), Molecular Biologist **Dr. Mark Temple** is performing an ensemble with a group of musicians and scientists at the **National Science Week** event 'Science Meets Art: An evening of Sonification and music,' preparing a piece accompanied by an audio derived from the **Coronavirus genome** and the **Myrtle Rust genome** (a serious disease affecting Australia's flora). Mark will play the drums and be in control of the audio from the DNA sequences. Joined by special guests, such as **Freva Schack-Arnott** (cello), **Professor Julian Knowles** (guitar), **Dr Tim Burton** (keyboard), and many more from various ensembles and bands. Combining a world of science and music, the use of sonification by Mark is a fascinating and insightful approach to generated music.

Sonification of DNA sequences including Myrtle Rust DNA and musification of this data was discussed on 2SER radio. This interview was re-broadcast in December 2022 as part of the yearly highlights of the Drive show.

<https://2ser.com/the-sound-of-science/>

National Science Week 2023

The musical compositions initiated during this grant are a work in progress that will extend beyond the scope of this grant. The Myrtle Rust compositions will feature in National Science Week events in 2023 to be held at the Powerhouse Museum (MAAS). Negotiations are in progress for this. Additionally, these tracks will be released on Streaming Services e.g., Spotify etc) as part of the promotion for this event.

The Art and Science of Myrtle Rust

A major component of this project was to commission artwork to speak to the devastating effects of Myrtle Rust. Towards this end, 11 Aboriginal Artists from Boomalli Aboriginal Artists Co-operative responded to a call to protect Country from the devastating effects of Myrtle Rust. In addition to the painting and mixed media artworks a short film was made by Jenny Fraser. These works were exhibited at Australian Plant Bank at The Australian Botanic Garden, Mount Annan during the period 2nd February to 12th February.

Summary of artists and their works

Jenny Fraser



Too Ancient to Die Young (2022)

by Dr Jenny Fraser

Film shot by Jenny Fraser on

Bundjalung Country

Edited by Jenny Fraser and Mark Temple

Length: 5:29 mins

NFS

YouTube link to Video:

<https://youtu.be/6gT3yNxAknQ>

If you think you've got it bad
Spare a thought for the Trees
What about Plant Rights, for all our Human Wrongs?
Spare a thought for the Trees
Red Coats, Timber Getters, Squatters and Takers
Spare a thought for the Trees
Bloodletting sap breaking songlines
Spare a thought for the Trees
With plant rust that turns them to dust
Spare a thought for the Trees
Chime in with the birdsong hertz now
Spare a thought for the Trees
The healthiest forests are located on protected
Indigenous lands
Spare a thought for the Trees
Too ancient to die young
Spare a thought for the Trees



Jenny Fraser is a digital native working within a fluid screen-based practice, celebrated internationally. Her old people hail from Migunberri Yugambeh Country in the Scenic Rim, Far Northern Bundjalung, on the border district between South East Queensland and the NSW Northern Rivers region. Her current focus is healing work with Bush Foods, Plant Medicine, Flower Essences and other Body Work, using the raw energy of plants, helping people to help themselves and revitalizing ancient practices. Dr Jenny Fraser has a professional background in Art and Media Education spanning over three decades. She also runs Solid Screen Retreats and maintains a creative practice alongside lecturing and publishing.

Graeme Walker



Destruction from another foreigner - Myrtle Rust

by Graeme Walker

Acrylic on canvas

91 x 91 cm

\$1,500

Centre of painting: Example of what Myrtle Rust looks like and its deadly impact on our unique native flora. It is surrounded by plants that have died, with them being covered by the colours this disease looks like.

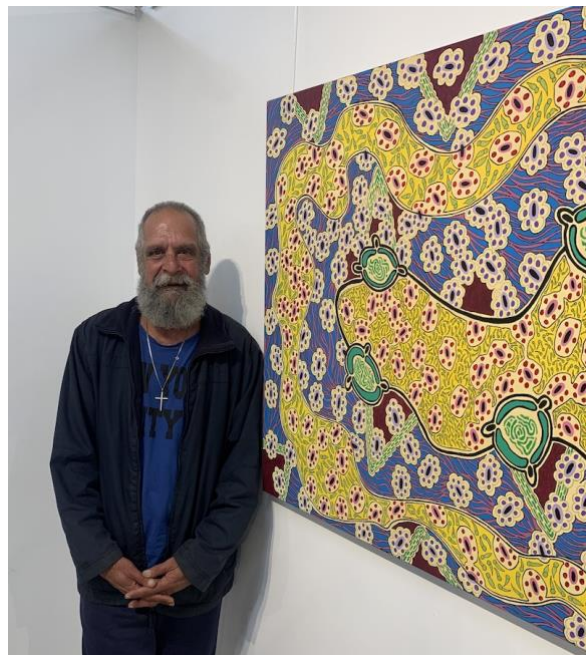
The grey background also represents Myrtle Rust from a microscopic point of view and developments from spores to above. The variety of leaves represent the various plants which have been impacted on and I replaced the grey background to blue sky that you can see through in the bush. This needs to be protected.

Graeme Walker is a Bundjalung/Yuin (Goorie/Koori) man, born in Casino - North Coast of New South Wales, and a self-taught artist. He has been painting since the mid 1980's and considers his works of art to be contemporary abstract/design. Graeme paints on canvas and various soft materials like linen, paper and clothing.

Graeme's art focuses on the various aspects of life, including that of the humankind with the emotions and feelings that are attached. Art has and always will be therapeutic for Graeme. As a sufferer of PTSD for many years, art has helped him cope.

Some abstractions and designs Graeme creates are simply pleasing to his eye, but every viewer sees things differently. Graeme encourages this and it makes him happy when people say this to me.

Graeme continues to learn as an artist, with his inspiration coming first and foremost from his enjoyment of painting. To see a scribble turn into something amazing – this is what captures Graeme and where all his artwork comes from.



Graham Toomey



Soul by Graham Toomey
Metallic and mounting on 6mm
Acrylic float frame
69 x 92 cm
\$2,300

Some years ago I wanted to do a body of work that takes me further into a world that is me. I like to find new ways of feeling and being with Country. Country is embedded in my DNA which entails the environment which is old, precious and fragile. I feel I

am the plants, the earth, its dust, the trees, the wind, the darkness, the light and all mother nature's gifts. Using microscopes provided by Sydney University, I journeyed into the fascinating world of science, time and beauty. This artwork shares not only the beautiful conformation of the plant, but a message that reminds us all that Country, (mother nature) needs to be cared for and in turn Country will care for us.

The Correa alba or White Correa is an Australian native plant used by our people, for tea.

I am a 'freshwater man' of the 'Wurramunga' clan of the Wiradjuri nation and also of the Wongaibon nation of Western N.S.W.

My art practice involves creating paintings, ceramics, word work, public art and installations. I like to create works about the landscape of Country, Spirituality, Culture, History, Movement and about stories and images of 'Country'.



I like to explore and find new creative ideas and put those into practice. Creating also is healing for me and it helps me find the light on dark days, due to the embedded trauma and injustices of our people and our history.

While I create, my mind, heart and spirit are strongly connected with my ancestors and with my 'Country'.

My art practice also involves creative and cultural advisory roles; to which I work in collaboration with agencies and organisations on creative or cultural projects.

Charmaine Davis



Fatal Beauty by Charmaine Davis
Acrylic on canvas
61 x 61 cm
\$1200

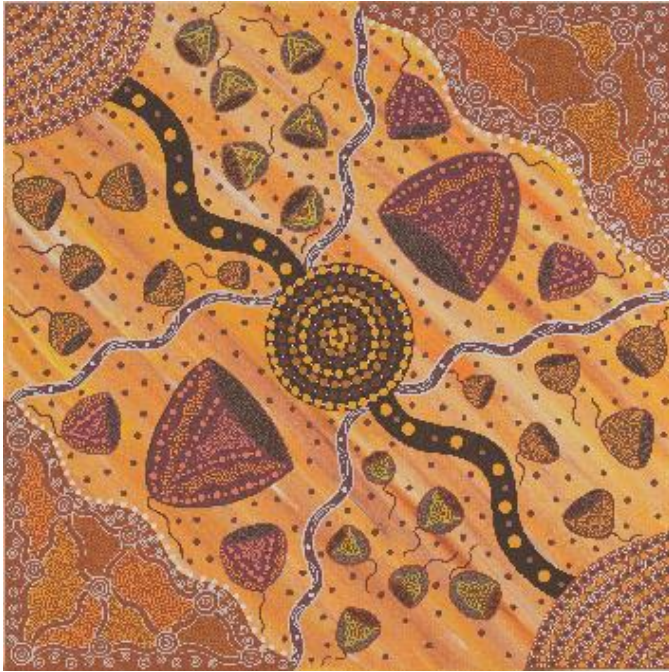
I've painted the leaves of the paperbark tree. Personally I've used the paperbark for artwork and also for cooking and carrying things. The spray of golden dust on the leaves hides an ominous story. Paperbarks and other Myrtaceae species have an important place in the landscape of this country which has a knock on effect with flora and fauna. They are being threatened by this fatal beauty that is called Myrtle Rust.

Charmaine Davis is a Goori Woman who is descended from the Gumbaynggir and Bundjalung Nations. Charmaine paints landscapes in acrylic and recently is exploring 3D mediums. Her artistic creations are attributed to her Culture, homelands and family. There is a spiritual connection to



Country, through Ancestral links, family, identity and community. Charmaine creates visual portals that allow the viewer to connect with her Art and Cultural visions. Charmaine has always been a creative soul and states "It's in my blood to create". She is compelled to tell the history of this Country through an Aboriginal lens.

Sharon Smith



Gumnuts by Sharon Smith

Acrylic on canvas

76 x 76 cm

\$1,700

Gumnuts and how they come from the eucalyptus tree. The eucalyptus leaf was used for healing and for many other things that were associated with healing and sickness that were in our tribes. It wasn't until after I had done a painting about gumnuts that I was told of Myrtle Rust disease attacking the eucalyptus leaves and many other plants.

My great great grandmother used the eucalyptus leaf and gumnuts to make medicine so I feel I have a connection with her when I paint about gumnuts and eucalyptus leaves.

Sharon Smith is a descendant of the Wiradjuri tribe of western New South Wales. An emerging artist, Sharon's paintings reflect her love of the natural world. Through her depictions of landscapes, trees and animals, Sharon explores her own personal connection with, and her people's age-old relationship to, the earth. Sharon's paintings thematically express her heritage and culture and work as an affirmation of her identity.

Along with her exhibitions at Eora, Sharon began exhibiting with Boomalli in 2010 in the "Amnesty Impressions" exhibition. She became a member of the Boomalli Aboriginal Artists Cooperative and a regular volunteer. In 2012 she exhibited in "The Graduates", at The Limelight Gallery NSW and Kerrie Lowes Gallery NSW. Sharon continues to exhibit regularly at Boomalli. Sharon was a finalist in the Parliament House Art Awards 2014 and a finalist in the Fishers Ghost Awards 2015.

As well as being a means of connecting with the wider society, Sharon's art has also played a major role in her personal journey towards gaining understanding and insight into where she comes from.



Wanita Lowe

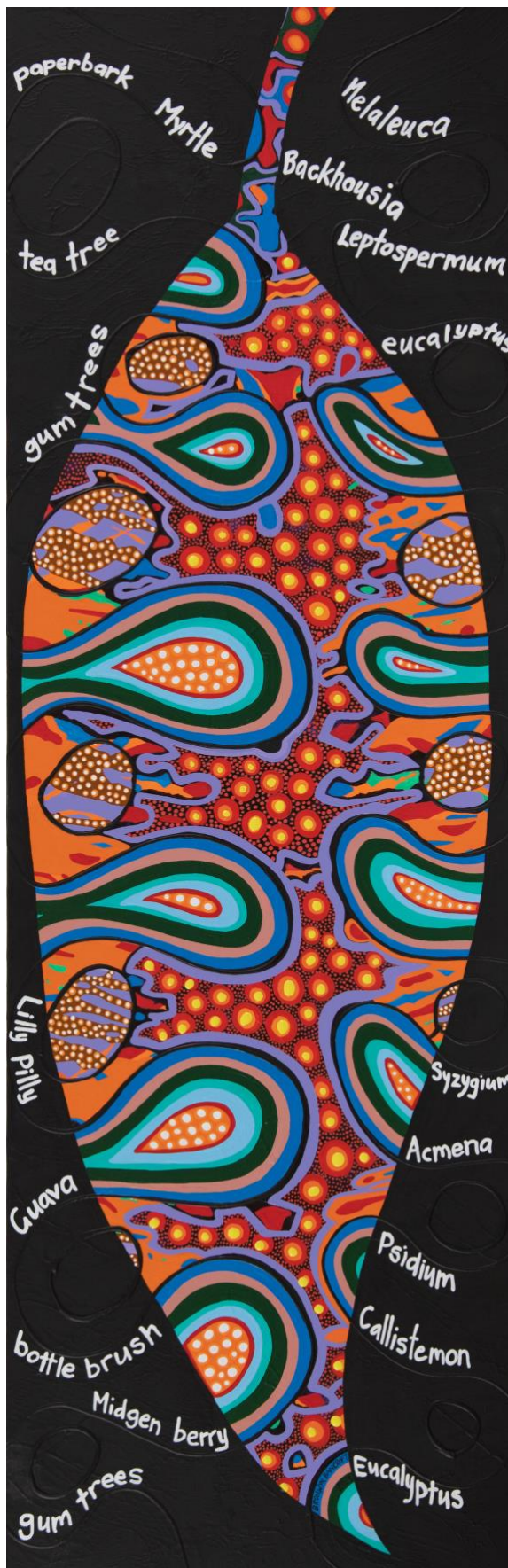


Myrtle Rust Alert! by
Wanita Lowe
Acrylic on canvas
91 x 91 cm
\$1,500

When thinking about the effect Myrtle Rust has on our environment, I wanted to raise awareness of the damage it has on our natives and the Australian unique biodiversity. Stop!! Alert!! is my message' We need to act now!

I am a Dunghutti woman who grew up on Wiradjuri land and have two beautiful daughters of Gamilaraay descent. I was born on Dunghutti Country Burnt Bridge/Kempsey but grew up as a foster child on Wiradjuri Country Leeton where I am accepted within the community, later finding and reuniting with my family and mob in Kempsey. My work conveys contemporary storytelling of my culture, using elements of tradition mixed with visual urban techniques. My Indigenous heritage is reflected in my work drawing inspiration from my culture through significant storytelling using ceramics, basket weaving, painting, drawing and printing.





Myrtle Rust Be Gone! by Dr Bronwyn Bancroft

Acrylic on canvas

136.5 x 44.5 cm

POA

The definition of Myrtle is 'an evergreen shrub which has glossy aromatic foliage and white flowers followed by purple black oval berries'. Sounds delightful! The definition of rust is 'a reddish- or yellowish-brown flaking coating of iron oxide that is formed on iron or steel by oxidation, especially in the presence of moisture'. Not so delightful an image. A fungus that has now been identified as Myrtle Rust and is native to South America has migrated to Australia and is creating havoc. It looks like diseased skin that is being ravaged by the fungus on actively growing leaves that belong to many of our native trees, gum trees, bottle brush, tea tree, lilly pilly, paperbark, myrtle, guava and midgen berry. I created my painting to increase awareness and hopefully the eradication of this fungus that decimates the food sources that native animals rely on.

When our natural world is out of balance then our environment is weakened and as a result attacked in its most vulnerable areas.

If you are walking around and can identify Myrtle Rust on a leaf, then take a specimen, log where it is and send it to the local conservation mob. There are so many ways we can combat it collectively.

Dr. Bronwyn Bancroft is a proud Bundjalung Woman and Artist.

Bronwyn started creating from the age of 7, growing up in Tenterfield in Northern NSW. Her professional career as an artist began following her graduation from the Canberra School of Arts in 1980.

Bronwyn's career has included both national and international exhibitions. Her work has been acquired by all major Australian galleries, state libraries and private collections.

Bronwyn's contribution to Indigenous children's literature has been immense and has included the publication of 45 books.



Bronwyn is a Founding Member of Boomalli Aboriginal Artists Co-operative (est. 1987) and has been the Co-operative's volunteer senior strategist since 2009. Bronwyn also offers her extensive expertise as a Board member/Director of Australian Indigenous Mentoring Experience (AIME), Australian Society of Authors, and the Commonwealth Bank Indigenous Advisory Council.

Bronwyn has a Diploma of Visual Arts from Canberra School of Art , 2 Masters degrees (Studio Practice and Visual Art) and a Doctor of Philosophy from the University of Sydney. Bronwyn received the University of Sydney's Alison Bush Graduate Medal for her contribution to the Indigenous Community and is the recipient of the inaugural NSW Aboriginal Creative Fellowship at the State Library of New South Wales.

Darren Charlwood



Change by Darren Charlwood

Acrylic on canvas

51 x 41 cm

\$500

I used a repeating leaf pattern in this painting in the traditions of Aboriginal cultural art where generations of artists use the designs of their ancestors.

In repeating these patterns we reaffirm these traditions, honouring our ancestors, becoming conduits for our shared identity and expressing our identity through art. But it's changed and I represented this change by putting red throughout the pattern on the leaves, the rust.

The leaves are also like skeletons, hollow

representations of what once was.

On a background of surrounding green they subtly stand out.

Change is constant, in fact the one consistent rule that can be applied to science as well as the natural world but these changes are slow and consistent allowing for adaptation.

When change occurs rapidly it has devastating consequences.



Like a thief in the night

Like a thief in the night by Darren Charlwood

Acrylic on canvas

31 x 61 cm

\$500

I wanted this piece to talk about the complexity of reactions, relationships and mechanisms taking place continuously all around us without us even realising.

These reactions, partnerships, chains of events and the symptoms of these cycles and the outcomes of this array of complexities are the foundations of our natural environment.

It's extremely complex but surprisingly simple all at the same moment in time.

Each environment is different, yet each ecosystem shares components, actors and mechanisms within it, a commonality.

These actors are sometimes interchangeable on occasion but these interchangeable characteristics do not ensure balance, in fact they bring about an imbalance and with that comes rapid change.

These foreign interchangeable actors have devastating impacts "like a thief in the night"



Darren was born in Sydney's Inner West and grew up in Redfern surrounded by the newly empowered Aboriginal community in the 1980s. He is a Wiradjuri man from the *yabaay wagaan* (wedge tail eagle and crow) mob in Wellington.

Darren began painting at a young age; however, it was not until 10 years ago that he began painting full time. Darren's art is deeply rooted in his experience as a Wiradjuri man, a father, a son and a member of the urban Aboriginal community of Sydney's Inner West. He also draws heavily from his cultural knowledge of the environment and the Wiradjuri use of lines and patterns.

Within the urban context, Darren produces pieces which reflect his environment. He makes use of recycled materials which come from the

environment, something which is based on the Aboriginal tradition of using only what is needed from the environment.

Darren's work is his expression of Aboriginality and reflects his political perspectives in the resistance of Aboriginal people against colonial oppression and dispossession. His art reflects the survival and adaptation of his people when faced with invasion and the sudden and violent change to their environment which came with it. The continuation of cultural practice is a protest in itself, as reflected in the endurance of the voices of Aboriginal people in Australia.

Hayley Pigram



wiyanga (Mother)
by Hayley Pigram
Watercolour on cotton paper
(framed)
57 x 76 cm
\$700

Myrtle rust is a pervasive yet strangling beautiful blight on the plants it affects. It is dangerous and disgusting. Watching over all of this, giving us hope and also affecting all, are our Ancestors. They hold our collective

knowledge and love for our Country. Together with our Ancestors we can override Myrtle rust and protect our Country.

I am a Darug woman from the Sydney area. I was born and raised on my traditional homelands in the southwest of Sydney and have always had a close connection to my culture and Country.

As an urban Aboriginal Artist, my art takes many forms to reflect my culture. While I often enjoy utilising a dot style of painting, I pair this with bright colours and unusual mediums. I feel this pairing represents myself as an Artist who has a deep traditional spirituality, yet lives a modern lifestyle. My art tells the story of a modern woman with an ancient heritage.

Much of my art practice is a reflection of my journey towards an understanding of healing and hope. It also allows me a way to express my deep connection to my family, their stories, their pain and our anger. Art gives a visual language for stories too complex for words to ever represent.

In 2015 and 2016 I completed my certificate III and IV in Aboriginal Cultural Arts at Eora TAFE. In 2018 I completed a Bachelor of Visual Arts at Sydney College of the Arts. In 2019 I completed my certificate in Aboriginal Mentoring.

In the past year I have conducted a Recycled Weaving workshop, spoke on a NAVA panel about artist led initiatives and exhibited in the Hobiennale at Moonah Arts Centre in Hobart, Tasmania. My artwork 'Three Boys' is currently on a billboard on the M4 as part of an NRMA campaign connecting road signs to Country.



Kyra Kum-Sing



Another takeover!
by Kyra Kum-Sing
Acrylic on canvas
34 x 62 cm
\$2,500

Creating awareness
into reducing and
eradicating the
spread of Myrtle
Rust before another
take over.

A depiction of my country as if myrtle rust had taken over. This would have a devastating affect towards our native plants, foods, peoples and our homelands.

Our mountains are special to us, they hold cultural and spiritual significance.

Over the many generations since colonialism, Our Elders have taught us stories about our dreaming.

Through maintaining our continual connection to our cultural and traditional practices in looking after country.

We are meant to protect our peoples and homelands.

Kyra is from the Malera Bandjalan and Mitakoodi language groups. Kyra currently works for Boomalli Aboriginal Artists Co-operative as a Curator/Artist. As an artist her practice is diverse and her works have been exhibited at Boomalli, Lone Goat Gallery, and the Red Rattler Theatre. Kyra received a Fellowship with the National Museum Australia in 2019 and was a participant for the National Gallery Australia and Wesfarmers Indigenous Art Leadership Program in 2021.



Kyra has curated a number of acclaimed exhibitions such as Shell It (2021) at the La Perouse Museum and 'Future is Here' at Carriageworks, July 2021. Other curated exhibitions include Power (February 2021) at Blacktown Arts Centre, Dyarra Murruma Guwing - The Sun Setting Red (2020) at Gallery Lane Cove + Creative Studios and Boomalli's 35th Anniversary exhibition "Duration", alongside Founding Member Artist, Dr. Bronwyn Bancroft, in 2022/23.

Kyra also works on protecting Aboriginal sites and cultural heritage on Bundjalung Country and is a passionate advocate for Aboriginal rights and self-determination, and Aboriginal arts, and holds a Bachelor of Media from Southern Cross University.

Brieanna Geary



Falling Leaves by Brieanna Geary

Mixed Media

35 x 60 cm

\$600

This depicts the insensitivity of an invasive plant species that destroys our native plants. The effects of this devastating species can kill off the plants that provide tucker for humans. Also causing sickness to our koalas, kangaroos & emus that are native to "OUR COUNTRY" Australia.

We as The Custodians of this land need to work together to find a traditional solution to fight the – Myrtle Rust...



Born in Ipswich QLD, I am a proud Aboriginal woman of the Githabul and Ugarapul nations with Bundjalung descent. I grew up living a sustained cultural life, learning about my people and our traditional ways of living and who we are as Indigenous people.

I am very passionate about my art. This is my journey and I would like you to take a step into my paintings to see a world from my point of view. I hope you enjoy.

Sonification and musification of Myrtle Rust DNA sequences

The use of audio for Myrtle Rust DNA sequence analyses

DNA carries genetic information for the development and function of organism such as humans, plants and fungi. A DNA sequence is a long, continuous chain made up of only four chemical bases referred to as G, A, T, or C. They repeat in various defined patterns to make up a gene. Many genes are identical from person to person, plant to plant or from fungus to fungus. But sometimes one of the chemical bases in the sequence is different from the usual pattern, this could be a mutation. These changes could create advantages so that the fungus can infect other plant species.

Australian scientists have made significant progress in understanding the biology of Myrtle Rust, the fungal disease caused by *Austropuccinia psidii*. Sydney scientists such as Dr Peri Tobias and her team have built an entire genetic map of the fungus responsible for Myrtle Rust. The result is the world's largest assembled fungal genome, taking up a billion letters of DNA genetic code. If you printed the genome it would take up more than 400,000 A4 pages. This discovery marks an important step towards unlocking genetic features of the genome which drives the disease.

Studies have identified several genes that are important for the fungus to cause disease in plants. For example, researchers have identified a gene involved in the recognition of host plants and is essential for pathogenicity. Other studies have identified genes that allow the fungus to break down plant cell walls and penetrate host tissue. This knowledge will be important for the development of strategies to mitigate the impacts of the disease on native plant communities.

The process of gene expression from the Myrtle Rust genome has been simulated by a computer algorithm. The output of this analysis is both a visual and audio display as shown below. The use of audio for DNA sequence analysis is a process called Sonification.

The visual display of the tool in translation mode shows a sliding window of DNA/RNA sequence. Key features of the animated display are the translated peptide sequences displayed using one letter Amino Acid codes. The frame in which they occur is also indicated on the left-hand side. The presence of start (ATG) and stop codons (such as TAG) are highlighted in green and red, respectively. The location of the audio play-head is represented to coincide with the peptidyl-transferase centre of the ribosome. As the Myrtle Rust genome sequence passes through the play-head the sonified audio is generated. An example of the animated display and audio output is available on YouTube.

Sonification of the Myrtle Rust genome

Frame1 0011|

Frame2 0000|

Frame3 0000|

RNA + 00019|

1bp Translation ▶▶ Play ▶▶ Switch ◀◀ 1053bp Transcription Biological Proces - Translation

Audio controls and note display of the sonified audio.

Mute	Feature	Motif	Note
<input checked="" type="checkbox"/>	Nucleotide	T	Db2
<input checked="" type="checkbox"/>	Di-Nucleotide	TT	Eb1
<input checked="" type="checkbox"/>	GC Content over 10 bp	0.3	Ab3
<input checked="" type="checkbox"/>	GC Content over 100 bp	0.3	Ab3
<input checked="" type="checkbox"/>	Peptide Frame 1 Peptide Frame 2 Peptide Frame 3	Leu - -	Bb3 - -
<input checked="" type="checkbox"/>	Three base repeat:	-	-

YouTube link: <https://youtu.be/61y40SNz8JA>

In this recent sonification work, I made the effort to make the audio tuneful and harmonious so that it could be listened /analyses for longer periods of time without fatigue. The audio is systematically generated each time the tool is run and it is identical on repeated use of the tool since it is directly reflects the DNA sequence. This is not generative music.

Turning science audio into art

On reflection, I was quite taken with the musicality of the audio, and this has taking me down a new research path to think about the science of music. How does music work, how do some things stand out and how do others blend into the overall sound? I thought about this whilst I was writing computer code to convert the DNA sequences into audio. It turns out that musical thinking improves the outcomes of the science research, and this allowed me to blend multiple layers of audio (and therefore more layers of data) into a single audio track.

The science audio can also be mapped to a variety of other instrument sounds. These sounds are not ideal for analyses, but they serve a function in the arts domain. As part of the Myrtle Rust project, I modified my prior code to not only play the audio in the browser but also to write the music data to a MIDI file. This MIDI audio format provides a much greater degree of flexibility and creativity when working with the science audio. The MIDI data can be imported into any standard Digital Audio Workstation.

In this environment many post-production techniques can be applied such as changing the tempo and assigning different instruments to individual layers of sequence data. Additionally, the audio output is of a higher fidelity than was previously possible.

The following table summarises 6 examples of Myrtle Rust genes that have been sonified, exported as MIDI and processed in Logic Pro (a Digital Audio Workstation). Each of these tracks has been assigned to a different tempo, measured in beats per minute (BPM). Additionally varied instrumentation has been assigned to each layer of sonified audio. I find that adding drums to the audio is a good first step towards making music from sonified audio. This gives a clear guide for composition since it helps define the barebones of a song structure for other instrumentation. On occasion, changes in the drum patterns are also synchronised to coincide with changes in the functionality of the DNA regions.

DNA sequence¹	BPM²	Description
APSI_hap2_scaffold_15	90	The gene sequence is preceded by an extended telomeric repeat. The absence of start codons in the telomeric sequence reduces the complexity of the sonified audio since open reading frames are not sonified. Additionally, the 6 bp repeat of the telomere sequence produce a repetitive two-bar musical swing in three-four time. The transition into the exon sequence switches to a more complex sequence pattern (less melodic) with an undefined swing.
APSI_P064	120	Predicted virulence (effector) coding sequences. These are small, secreted proteins that provided interesting sequences to sonify.
APSI_P065	150	
APSI_P065	78	This sequence was sonified with the “transcription” algorithm. All other sequence were sonified with the “translation” algorithm.

CACRXL010000050	124	Taken from the raw sequence read of contig50 which was only 2,136 bp long and it could be sonified in its entirety in a short musical timeframe.
Rhodosporidium_toruloides DNA polymerase II subunit A	110	Taken from a highly annotated fungal genome assumed to be highly conserved with <i>A. psidii</i> . The long promoter sequence is unaccompanied by drums which begin as the exon sequence is translated.

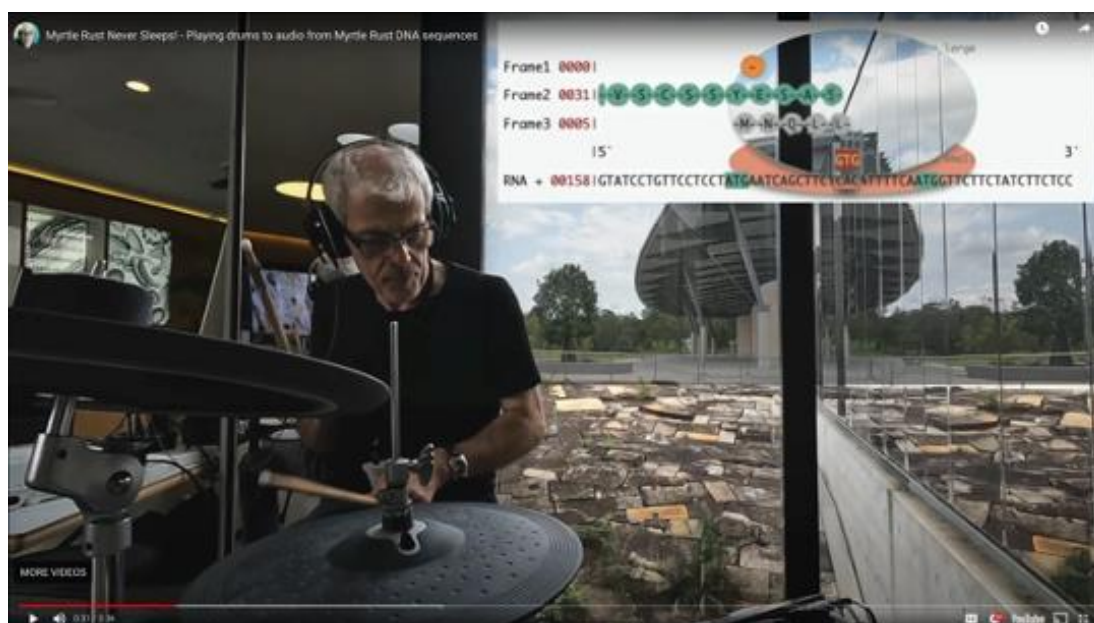
¹Sequence data kindly provided by Peri Tobias (except where noted)

² Beats per minute, the original tempo of the MIDI file is 164 BPM and this was adjusted in the Digital Audio Workstation

All tracks available on DropBox:

https://www.dropbox.com/sh/mmgxhz3bd6wx8id/AACJdJPF5g7Zk4H_bfgqfzpa?dl=0

The figure below shows drums being added to a new Myrtle Rust audio sequence that was generated and performed at Plant Bank during the exhibition period. Everything except the drums were derived directly from the MIDI file from of the Myrtle Rust DNA sequence.



YouTube link: <https://youtu.be/kCFYbySEr7o>

As you can hear in this example the initial attempts as playing to the sequence are a little chaotic since there are competing accents within the audio data which can be disorienting for the musician. As an end point in this process, I think it is important that the music has merit on its own, and it is engaging musically without knowledge of the scientific content. Once people engage with the music they can then (if they wish) further inquire as to why it sounds like it does. This is a novel approach to engage people in science.

Musification and science outreach

The outcome of the musification has been the ability for ensemble performances based on sonification of the Myrtle Rust genome. When I started generating sounds from biological sequences, I was very clear to point out that sonification was producing “audio” for data analysis rather than “music” as artistic expression. In this current project I have used the raw computer-generated science audio as if it were music made by a guest musician in a rehearsal room. The challenge for live musicians is to play along to the computer-generated audio.

The science audio itself has a shifting sense of rhythm, it often has non-repeating melodies, and it obviously lacks traditional song structure. As musicians our goal was to make it more musical. We added compositional elements such as introductions, verse like sections, bridges and various musical dynamics to match the beginning and end of genes as well other sequence motifs in the data. In addition to the previously described performance at National Art School during National Science Week 2022, there was also a short music performance to accompany the Myrtle Rust DNA sequence at Plant Bank.



Ensemble performance at Plant Bank to accompany Myrtle Rust DNA sequence.

This was performed by Dr Mark Temple-Drums and biological sequences, Dr Michael Bain (UNSW)-Synthesiser, Freya Schack-Arnott-Cello, Philippa Murphy-Haste-Clarinet/Viola, Nick Calligeros-Trumpet

Four music tracks were performed at the opening of night of the exhibition.

YouTube link: <https://youtu.be/zuob5UvJAVk>

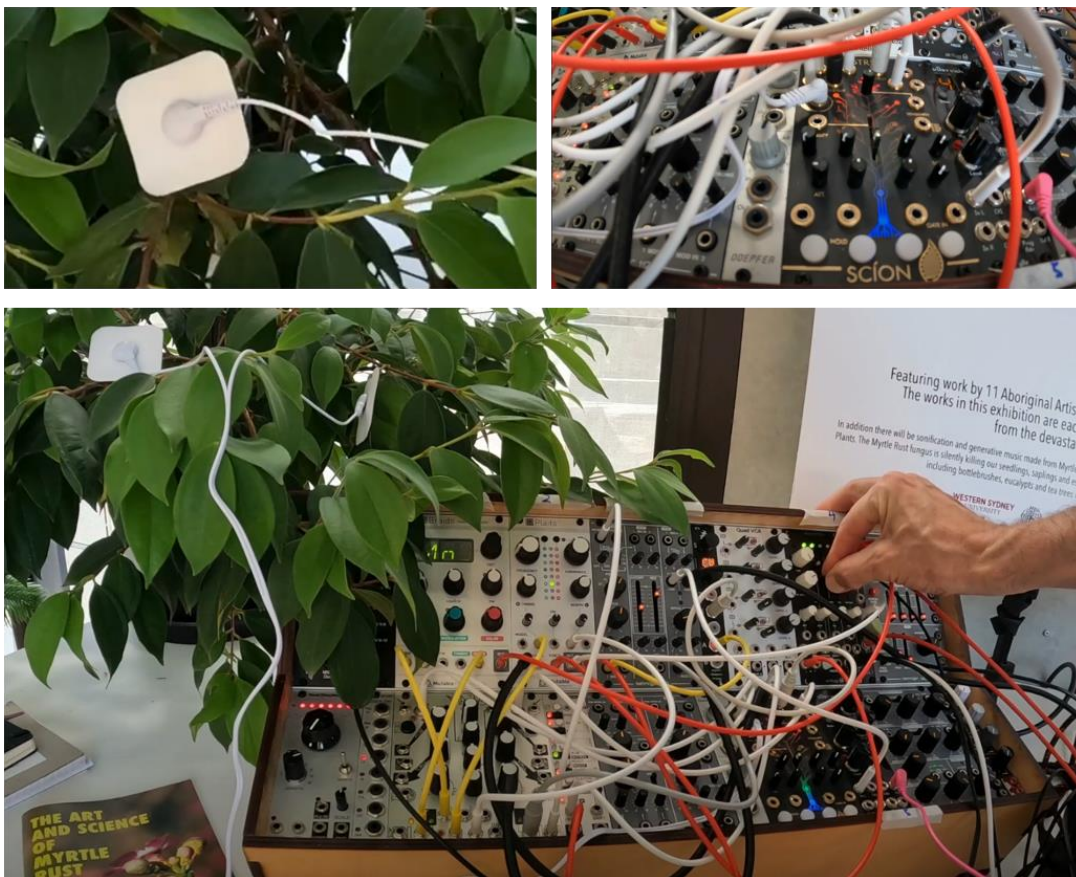
Generative music from the critically endangered Scrub Turpentine

As a departure from the sonification of Myrtle Rust DNA sequences I thought it be interesting to make audio directly from a living plant. This was achieved through two padded

electrodes attached from the leaves of a plant and patched to the biofeedback sensor input of the Scion module of a custom made Eurorack synthesiser.

A Eurorack synthesizer consists of specialised audio devices which together generate and control sound in a customised ways. The audio and controls signals are passed between units using 3.5mm mono jacks. This allows for the interconnection of different modules from different manufacturers. Common modules found in a Eurorack system include oscillators, filters, envelopes, sequencers, effects, and more to create sounds that are difficult or impossible to achieve with traditional instruments. A key module in this setup was the Scion module, this was used to make generative music from the critically endangered Scrub Turpentine (*Rhodamnia rubescens*). Tiny fluctuations in surface conductance of the plant leaves were amplified by the module to generate random control voltage (CV) and gate signals. Each CV signal was quantised to the pitches of the C minor scale at 1 Volt/octave.

The quantised signals were used to trigger the Braids, Plaits, and Behringer 112 voltage-controlled oscillators to generate musical notes. These audios were patched into effects modules to add echo, delay, and reverb. The sensitivity of the biofeedback sensor, the modulation of the oscillators and the audio effects processing was adjusted to achieve a continuous real-time generative music patch as shown below.



In the first example I talk about the process and demonstrate how the Eurorack can be manipulated to affect the generative music from the plant.

Talking about how to make Generative Music from Australian Native Plants

YouTube link: <https://youtu.be/qgwmqUJ-AM4>

In this edited example, the music is more tonal, and the audio was run without intervention.

Generative Music made from a Critically Endangered Australian Native Plant (Short Version).

YouTube link: <https://youtu.be/TtPBWLrsqe8>

This is the same as the above example without editing, the generative music runs for over twenty minutes without intervention.

Generative Music made from a Critically Endangered Australian Native Plant (Long Version)

YouTube link: <https://youtu.be/oTha-DBgc4Y>

Science Symposium

As part of the exhibition there was a Science Symposium on Myrtle Rust held on Wednesday 8th February (10 - 1 pm) at Australian PlantBank.

Time	Presenter	Title
10:00	Brett Summerell	An introduction to the conservation impacts of Myrtle Rust in Australia
10:20	Karen Sommerville	Ex situ collections for research and recovery
10:40	Michelle Moffitt	Metabolomics for the identification of resistant plants
11:00	Peri Tobias	Developing tools to manage myrtle rust with remote monitoring and strain diagnostics
11:40	Jason Bragg	Conserving plants that are impacted by myrtle rust: preserving diversity and promoting resistance
12:00	Amelia Yenson	Safe Custody for Native Guava – a pilot project for capturing and sharing plant material
12:20	Alyssa Martino	Gum Tree Guardians; monitoring the spread of myrtle rust in Australia
12:40	Robert Makinson	More than the sum of the parts – some thoughts on national needs and strategy

Archival Content from the Exhibition.

Archival content from the exhibition held at Plant Bank is documented at <https://myrtle-rust.com>. Furthermore the event was widely promoted on social media including Facebook, Twitter and LinkedIn.

Twitter

The screenshot shows a series of tweets from Mark Temple (@marktempl) and The Australian Botanic Garden (@AustralianBG). The tweets discuss the exhibition 'The Art and Science of Myrtle Rust' and include images of Myrtle Rust on plants and artwork. One tweet features a video of Mark Temple playing music, and another shows a poster for the exhibition opening night.

LinkedIn

The screenshot shows LinkedIn posts from Mark Temple. The main post is titled 'The Art and Science of Myrtle Rust' and discusses the use of sound to represent data in biology. It includes a video of Mark Temple speaking and a poster for the exhibition. The post also mentions a Science Symposium and provides information about the exhibition website.

Facebook

The screenshot shows a Facebook post from Mark Temple. The post is titled 'Making music from the sonification of Myrtle Rust DNA' and includes a video of Mark Temple speaking. The text of the post describes the project and the exhibition.

The screenshot shows another Facebook post from Mark Temple. The post is titled 'Live Music made to accompany the Myrtle Rust genome' and includes a video of Mark Temple playing music. The text of the post describes the project and the exhibition.

6. Discussion and Conclusion

This project has produced a range of art and music activities that have been instrumental in promoting the devastating effects of Myrtle Rust to the wider population. Whilst this project is now complete, I will continue to run science outreach events in 2023 and beyond that

address concerns raised by the spread of Myrtle Rust in Australia. The tools that I have developed for sonification and musification of the Myrtle Rust DNA sequences are important in this regard for the creative process.

7. Recommendations

N/A

8. Appendices, References, Publications

Links to all online content are embedded in the main body text.

Additional material is available at this YouTube playlist:

<https://www.youtube.com/playlist?list=PL1k1ADIKRpMfENfzlef9w0nwd6-tS9Fu>

Additionally, the exhibition catalogue is available at:

<https://www.dropbox.com/s/ma4phv8eq6j6uir/The%20Art%20and%20Science%20of%20Myrtle%20Rust.pdf?dl=0>