PLANT BIOSECURITY
science foundation

Expanding environmental biosecurity capacity to protect our unique ecosystems

Final Report (PBSF012)

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1. Executive Summary

Exotic pests threaten cultural and environmental biodiversity values unique to Australia with prime topical examples being myrtle rust affecting Australian Myrtaceae and the more recent decline of Bunya pines in the Bunya Mountains National Park. For the last two years, the Queensland Department of Agriculture and Fisheries (DAF) has been working very closely with the traditional custodians of K'gari, the Butchulla People, the Fraser Island (K'gari) World Heritage Advisory Committees and the World Heritage Unit (WHU) within the Department of Environment and Science (DES). Knowledge sharing has focussed on forest health and biosecurity including the potential impacts of myrtle rust on species and ecosystems of significance to K'gari and the cultural values of these to the Butchulla people. This project developed and delivered training that has increased environmental biosecurity awareness, thereby increasing the capacity of the Butchulla, the traditional custodians of K'gari (Fraser Island), to detect, monitor and report on priority pests that may threaten culturally and environmentally significant species within the Fraser Island (K'gari) World Heritage Area. Six Butchulla Land and Sea Rangers (BLSR) completed a two-day training workshop consisting of theoretical and practical exercises in Brisbane and a myrtle rust study site in a subtropical rainforest ecosystem near Gondwana World Heritage areas. Since the training, Rangers have commenced surveys back on country. In August 2019, a joint survey to continue training was conducted on K'gari with myrtle rust identified in a range of different ecosystems.

2. Introduction

Exotic pests threaten cultural and environmental biodiversity values unique to Australia. Myrtle rust is the second most significant plant pathogen to invade the native environment in Australia and several reviews have highlighted serious gaps relating to Australia's environmental biosecurity. Under the World Heritage Convention, the Federal Government (with day-to-day management devolved to the State) has responsibility for identifying and protecting the Outstanding Universal Value (OUV) and ensure its conservation for current and future generations. Australia's World Heritage properties are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). World Heritage properties are recognised as a matter of national environmental significance under the EPBC Act's assessment and approval provisions. Therefore, ensuring biosecurity risks, including myrtle rust, are identified then managed effectively are paramount to fulfilling these obligations. This project addresses aspects of this by developing and delivering environmental biosecurity awareness and surveillance training, myrtle rust identification and assessment methods and reporting to protect the OUV of the Fraser Island (K'gari) World Heritage Area.

3. Aim

This project aims to increase the capacity of First Nations People to detect, monitor and report priority environmental exotic plant pest and disease threats in a World Heritage Area. Additionally, this project will be developing an environmental biosecurity awareness, surveillance and reporting training module that could be adopted nationally. Specific training to identify *Austropuccinia psidii* symptoms and assess impact of myrtle rust will be conducted.

4. Methods/Process

Training modules and programs developed in collaboration with Butchulla Land and Sea Rangers (BLSR), Department of Agriculture & Fisheries, Biosecurity Queensland and Department of Environment & Science. Training information focused on:

- Myrtle rust
    - What to look for – symptoms of myrtle rust
    - When to look – understanding factors influencing disease development and severity
    - Where to look – environments conducive to disease development
- Environmental (Forest) health and biosecurity awareness and reporting processes
    - What is biosecurity
        - Key message – Biosecurity is a shared responsibility
        - Key outcome – Increased awareness and capacity to detect and report on forest health and biosecurity threats

5. Achievements, Impacts and Outcomes

Biosecurity and myrtle rust identification training

In May 2019, a two-day training program was run for six BLSR including presentations from Suzy Perry, Janet McDonald, Louise Shuey and Geoff Pegg (Fig 1). The training focussed on:

- Providing a background on general biosecurity - Suzy Perry
- An overview of forest biosecurity and the shared responsibilities we all have when it comes to biosecurity awareness and reporting – Dr Geoff Pegg
- Introduction to Forest Priority Pests and Reporting – Janet McDonald
- Signs and symptoms and the disease triangle – Dr Louise Shuey
- Myrtle rust (*Austropuccinia psidii*) – what is it and how to identify it – Dr Geoff Pegg
- High risk site surveillance and sample collection – Janet McDonald

Field tours were also conducted as part of the training:

- Mt Coot-tha Botanic Gardens
    - General forest health awareness, sample collection, photography and myrtle rust symptoms
- Tallebudgera Valley
    - Myrtle rust symptom and host identification and impact assessment training
    - Disease impact monitoring plot design

Rangers learnt to identify myrtle rust and its potential to affect a range of ecologically and culturally significant plant species.

The team also learnt how to establish field-monitoring plots to check the ongoing health of K'gari's forests now included under the Queen's Commonwealth Canopy initiative.

Figure 1. Forest health and biosecurity training – Butchulla Land and Sea Rangers learning the skills in pests and disease symptom identification, photography and the impacts caused by myrtle rust in native ecosystems.

On-Country training

The second phase of training took place on K'gari during the first week of August 2019. During this time on Country, the team visited a number of areas and ecosystems. Sites included coastal heath and wetlands south of Dilli Village, rainforest ecosystems from Eurong to Central Station, culturally significant sites around Boorangoora (Lake Mckenzie), melaleuca paperbark around Eli Creek and fire affected stands of *Melaleuca quinquenervia* north of Orchid Beach. Sites around the tourist resort of Kingfisher Bay were also assessed. A range of Myrtaceae occur on K'gari as shown in Table 1 below.

Myrtle rust was detected on a range of Myrtaceae and in different areas assessed with the overall forest health at the different site also observed and recorded. Areas of rainforest affected by fire in November 2018 were assessed and *A. psidii* symptoms were detected on reshooting *Syzygium oleosum*. Rust impact assessments were also reported from *Melaleuca quinquenervia* and *Homoranthus virgatus* in vegetation surrounding Booroongora and in heath areas south of Dilli Village. Severe dieback of *Homoranthus virgatus* caused by myrtle rust was recorded around Kingfisher Bay. Symptoms were also detected on *Leptospermum polygalifolium* at the same site.

During this time on K'gari, the group also met with Fraser Island Defenders Organisation (FIDO) representatives at their nursey at Eurong. This was a positive opportunity for shared learning and to commence discussions on potential future collaborations, particularly around capture and storage of germplasm and the use of local plants for regeneration to reduce the risk of pests and weeds spreading from the mainland. Discussion around myrtle rust and ways that the nursery can select out individuals showing symptoms and destroy these rather than treat them and plant them may help to increase levels of tolerance or resistance within any future regeneration-planting program.

Table 1. Myrtaceae recorded on K'gari and their susceptibility to *Austropuccinia psidii*.

Botanical Name	Common Name	Myrtle rust susceptibility	Myrtle rust detected on K'gari
Acmena hemilampra	broad-leaved lilly pilly	Low-Moderate	

Acmena hemilampra ssp. hemilampra	blush satinash	Low	
Acmena smithii	lillypilly satinash	Resistant-High	
Angophora leiocarpa	rusty gum	Unknown	
Austromyrtus dulcis	midgen berry	Resistant-High	Yes
Backhousia myrtifolia	grey myrtle	Resistant-Low	Yes
Baeckea frutescens	weeping wallum baeckea	Resistant-Moderate	
Corymbia gummifera	red bloodwood	Unknown	
Corymbia intermedia	pink bloodwood	Unknown	
Corymbia tessellaris	Moreton Bay ash	Unknown	
Decaspermum humile	silky myrtle	High-Extreme	
Eucalyptus hallii	Goodwood gum	Unknown	
Eucalyptus latisinensis	white mahogany	Unknown	
Eucalyptus microcorys	tallowwood	Unknown	
Eucalyptus pilularis	blackbutt	Resistant-High	
Eucalyptus racemosa ssp. racemosa	scribbly gum	Unknown	
Eucalyptus resinifera	red mahogany	Resistant-High	
Eucalyptus robusta	swamp mahogany	Unknown	
Eucalyptus siderophloia	northern grey ironbark	Unknown	
Eucalyptus tereticornis	Queensland blue gum	Unknown	
Homoranthus virgatus	twiggy homoranthus	Moderate	Yes
Leptospermum juniperinum	prickly tea-tree	Unknown	
Leptospermum liversidgei	lemon-scented tea tree	Resistant-High	Yes
Leptospermum polygalifolium	Tantoon	Resistant-High	Yes
Leptospermum semibaccatum	wallum tea-tree	Resistant - Moderate	
Leptospermum speciosum	showy tea tree	Unknown	
Leptospermum trinervium	woolly tea-tree	Resistant-High	
Lophostemon confertus	brush box	Resistant	
Lophostemon suaveolens	swamp box	Resistant-Low	
Melaleuca dealbata	swamp tea-tree	Unknown	
Melaleuca nodosa	prickly-leaved paperbark	Moderate - Extreme	
Melaleuca pachyphylla	wallum bottlebrush	Resistant-Low	
Melaleuca quinquenervia	swamp paperbark	Resistant-Extreme	Yes
Melaleuca sieberi	Sieber's paperbark	Unknown	
Melaleuca thymifolia	thyme honey myrtle	Unknown	
Ochrosperma lineare	Scraggly baeckea	Unknown	
Osbornia octodonta	myrtle mangrove	Low	
Pilidiostigma glabrum	plum myrtle	Low-Moderate	
Rhodamnia acuminata	Cooloola ironwood	Low	Yes
Rhodamnia dumicola	rib-fruited malletwood	High	
Syncarpia hillii	Fraser Island satinay	Low	

Syzygium francisii	giant watergum	Resistant	
Syzygium johnsonii	Johnson's satinash	Resistant	
Syzygium luehmannii	riberry	Moderate	
Syzygium oleosum	blue lillypilly	Resistant-High	Yes

Figure 2. Surveys across different environment. Left to right – Eli Creek Melaleuca dieback, Orchid Beach post wildfire tree death, Central Station rainforest area affected by fire.

Figure 3. Detection of myrtle rust symptoms on fire affected rainforest species, *Syzygium oleosum* detected by Senior Ranger Corey Currie.

Figure 4. LHS – Dieback on *Corymbia tesselaris* caused by the endemic fungus *Quambalaria pitereka*, Middle – myrtle rust on *Leptospermum polygalifolium*, RHS – Dieback caused by myrtle rust on *Homoranthus virgatus*.

COVID 19 delayed the second training/survey trip until the 17th of August 2020 with the Island closed to all visitors for an extended period. As such this trip overlapped with the commencement of **PBSF025 project** – Part 2 Expanding Environmental Biosecurity. Along with the BLSR, Aunty Joyce Bonner and Aunty Rachel Killer from the Butchulla Aboriginal Corporation (BAC) and Rhett Butler from World heritage also joined the trip. Field surveys focused on bushfire affected areas. A bushfire ignited by a lightning strike in November 2019 burnt large areas of coastal heath and woodland in the southern part of the island.

Six monitoring plots were established in fire affected *Melaleuca quinquenervia* wetlands. Plots consisted of 50 trees per site with disease incidence and severity levels recorded along with impact data including dieback and death or reshoots/epicormic regrowth. No site had more than 35% of trees free of disease at the time of assessment. Sites 2 and 6 only had 24% of trees with no evidence of disease. However, there was also variability in levels of severity and the impact of rust at these different levels over time is unknown and will be monitored. The long-term effects on sites is also unknown, as is recovery without need to assist with regeneration. The good news is that there appears to be some trees that were free of disease and these may provide seed for future regeneration. Monitoring of these sites will continue as part of PBSF025 project.

Seedling assessment plots were also established with myrtle rust identified on *M. quinquenervia* and *Leptospermum liversidgei*. Other species identified with rust in fire affected areas included *L. trinervium* and *Austromyrtus dulcis*.

Figure 5. Myrtle rust identification and assessment training on K'gari – post fire seedling assessment and impacts on *Melaleuca quinquenervia*, including newly appointed BLSR Forest health and Biosecurity Ranger, Tilly Davis. Dr Louise Shuey doing surveys with Butchulla women in a women's only area near Central Station, Woongoolba Creek.

Figure 6. Impacts of myrtle rust on post fire regeneration of *Melaleuca quinquenervia* on K'gari.

Additional activities

- During the World Heritage Forum held in Canberra during September, Senior BLSR Corey Currie, Dr Geoff Pegg (DAF) and Alana Hazel (WHU) jointly presented the project. It was received with high praise and hopefully will encourage further collaborations within other World Heritage properties across Australia.

- Further positive outcomes have included the opportunities for Senior BLSR Corey Currie and Butchulla Elder Aunty Gayle Minniecon to attend a three-day International Indigenous Biosecurity workshop in New Zealand. This included opportunities to share indigenous knowledge and values on Biosecurity, as well as discussing Indigenous solutions for a changing world. First Nations groups came from all corners of the world including Africa, South Pacific, North and Central America.

- In November 2019, two BLSR Rangers, Chantel Van Wamelen and Myles Broome, also took the opportunity to attend and present the project work at the 7th National NRM Knowledge Conference in Wodonga, Victoria in collaboration with Dr Louise Shuey.

- The partnership between DAF, DES and the BLSR recently received a $400,000 National Heritage grant allowing for the employment of a Forest health and Biosecurity Ranger. Matilda (Tilly) Davis was the successful candidate and commenced working with the BLSR in late July 2020. This will allow a focus on biosecurity and myrtle rust on K'gari, extending training to Queensland Parks and Wildlife Service (QPWS) Rangers and Community Rangers. This will be integrated into the aims of project PBSF025 of developing a train-the-trainer program. A focus will be developing a better understanding of the cultural values of plant species and ecosystem in which they exist, including Myrtaceae threatened by myrtle rust.

Outcomes

- Increased environmental biosecurity awareness, detection and reporting capacity through training of BLSR staff
    - Additional training will be developed and provided in a train-the-trainer program as part of PBSF025
    - Increased capacity to report on forest health and biosecurity issues impacting species and ecosystems on K'gari
    - Shared Traditional Owner knowledge through on-going gathering of information on the cultural significance of plant species and environments on K'gari
- Contribution to reporting species and community impact – Theme 3 MR Action Plan
    - Surveys of Myrtaceae on K'gari identifying eight species showing infection and varying levels of impact
    - Establishment of impact monitoring plots, particularly focussed on fire impacted area
        - Links with PBSF032 and NESP/ANPC national fire and rust project work
    - Identified the potential to examine the use of traditional burning regimes and how this might the influence myrtle rust impacts
- On-going commitment to forest health and biosecurity through:
    - National Heritage Grant to employ a Forest health and Biosecurity Ranger
    - Continuation of collaborative activities with BLSR, DAF and DES with on-going PBSF funding
    - Environmental Biosecurity Risk Assessment for K'gari (Fraser Island). The project is supported by the Australian Government's Chief Environmental Biosecurity Officer (CEBO) and led by the University of Melbourne's Centre of Excellence for Biosecurity Risk Analysis (CEBRA). The aim of the project is to develop tools and strategies for minimising the risks of new priority pests, weeds and pathogens establishing on K'gari.

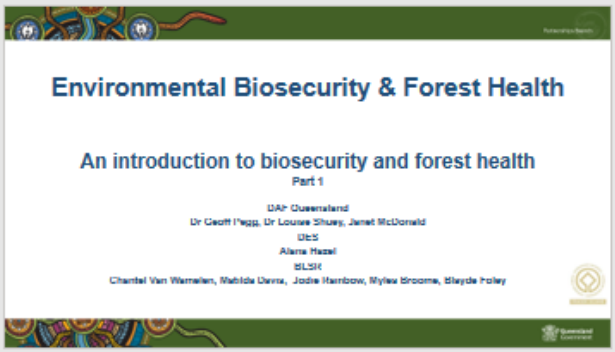
6. Discussion and Conclusion

Training modules developed as part of this project have increased environmental biosecurity awareness from a forest pest and disease perspective, detection and reporting capacity through training of BLSR staff. However, there is a need for further development that incorporates the social, cultural and ecological values of trees and the threats exotic pests and diseases pose. Development of training that targets a range of audiences including indigenous communities, tourists, school groups and Parks and Wildlife Rangers. Clearly identifying what we are trying to protect is essential.

Training the BLSR will help contribution to the reporting and collation of impact data on Myrtaceae species and associated environments on K'gari and further contribute to a national program. Like other sites, disturbance events appear to be a significant factor in incidence and severity of myrtle rust. While *A. psidii* has been detected in a range of ecosystems on K'gari, impact has been greatest in disturbed areas, including areas affected by wildfire. Continued monitoring and more extensive surveys are planned as part of PBSF025.

Through the additional funding from PBSF and a National Heritage grant, on-going commitment to forest health and biosecurity will be the focus of Tilly Davis. Funding for a specific ranger will allow for more a focussed approach to further development of a forest health and biosecurity program for K'gari and extension of training to a wide range of stakeholders. Extending networks to other Land and Sea Ranger programs and other Indigenous environment groups will hopefully occur as part of this new role. More importantly promoting what it is we are trying to protect, and the cultural values of the native plants and associated environments, will be a priority for on-going work.

7. Modules



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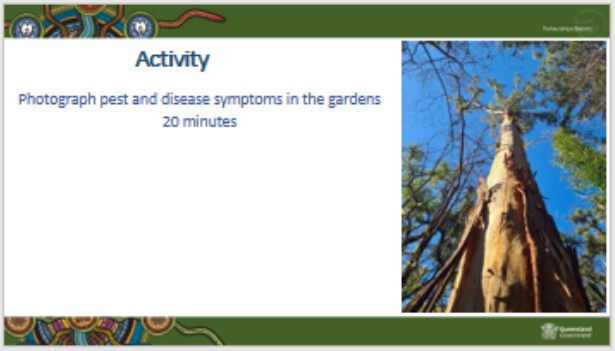

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6

What is environmental biosecurity?

- Protection of the environment from weeds, pests and diseases entering, emerging, establishing or spreading in Australia:
  - Ecosystems – Terrestrial, Freshwater, Marine
  - Social amenity
    - human health and wellbeing,
    - cultural values,
    - dependent industries (tourism);
- Environmental Biosecurity is distinct from Agricultural Biosecurity, which focuses on pests and diseases that could have an economic impact on agricultural industries, including forestry.

7

New Zealand

- **Māori Biosecurity, protecting our taonga for future generations**
  - Our place, our taonga, Our unique land, waters, and the life they sustain are New Zealand's taonga (treasures).
  - The country's prosperity and sustainability depend on its premium biosecurity status and the relatively unspoiled state of its natural environment. Free from many of the pests and diseases that afflict other places, these assets are New Zealand's great enablers – helping grow our economy, enhancing our lifestyle and strengthening our sense of national identity.

8

Environmental biosecurity pest list – things not present in Australia

Aquatic animal diseases	Fresh water invertebrates	Marine pests	Native animal diseases & their pathogens
Bonamiosis	Asian clam	Asian green mussel	Duck viral enteritis
Crayfish plague	Chinese mystery snail	Black-striped false mussel	Exotic West Nile virus
Megalocytivirus	Japanese mystery snail	Carpet sea squirt	Pacheco's disease
White spot syndrome virus	Golden apple snail	Chinese mitten crab	Proventricular dilatation disease
Yellow head disease	Quagga mussel	Lady crab / Asian paddle crab	White nose syndrome of bats
	Quilted melania		

https://www.agriculture.gov.au/biosecurity/environmental/priority-list

9

Environmental biosecurity pest list – things not present in Australia

Plant diseases & their pathogens	Terrestrial invertebrates	Vertebrates	Weeds & freshwater algae
Ceratocystis wilt	Asian gypsy moth	Asian black-spined toad	Didymo
Exotic strains of myrtle rust	Formosan subterranean termite	Boa constrictor	Manchurian wildrice
Polyphagous shot hole borer associated fusarium wilt	Giant African snail	Climbing perch	Mikania
Ramorum shoot dieback and leaf blight	Harlequin lady beetle	Corn snake	Mouse-ear hawkweed
Teratosphaeria leaf blight and canker	Invasive artic red imported fire ant, electric ant	Red-eared slider turtle	Spiked pepper
Xylella		Silver carp	

https://www.agriculture.gov.au/biosecurity/environmental/priority-list

10

How do they get here?

11

What can happen if exotic pests establish?

	Environment	Amenity	Agriculture
Weeds	• Transform ecosystems • Eliminate/replace native species – competition • Reduce the ecological values of natural areas	• Reduce access to amenity and scenic values of natural areas • Cause health issues • Reduce function and values of community open space areas	• Reduce productivity • Increase costs of production • Contribute to loss of production/income
Feral animals	• Displace and/or prey on native species • Degrade natural ecosystems	• Destroy infrastructure • Cause traffic hazards • Prey on native and domestic animal species	• Outcompete livestock • Contribute to loss of production • Prey on and threaten livestock • Carry diseases and parasites that can impact on livestock
Insect pests and diseases	• Transform ecosystems • Eliminate native species • Reduce the ecological values of natural areas	• Cause health issues • Reduce function and values of community open space areas	• Production losses and associated financial impact • Market access – international and interstate

12

What is being done to reduce the risk?

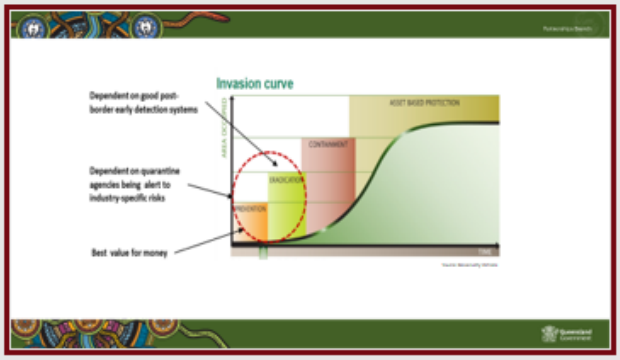
- **Prevent arrival and establishment**
  - ***Pre-border*** – identify risk pathways to prevent arrival or introduce treatments to eliminate the threat
  - ***At border*** – Inspection/treatment of goods, aircraft, ships and people arriving into Australia
  - ***Post border*** – High risk site surveillance activities and incursion response
    - Detection triggers a biosecurity response

13

What happens when things do arrive?

- **Detection**
  - Eradication
    - Biosecurity response to a detection or report and activities implemented where eradication is seen as being feasible
  - Contain
    - Restrict the spread of the pest/disease/weed
    - Interstate/regional movement restrictions – e.g. myrtle rust – no Myrtaceae allowed into WA; Red Imported Fire Ant; European House Borer
  - Manage
    - Long term strategies to reduce the impact

14



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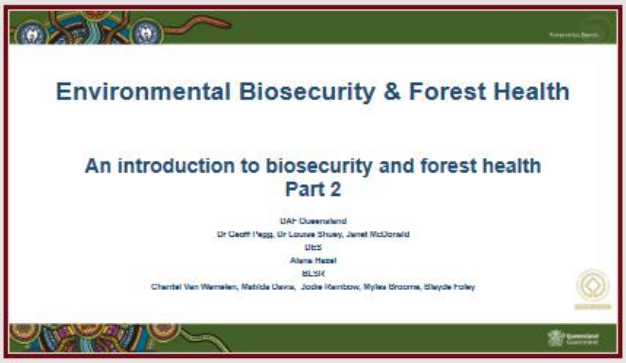

Environmental Biosecurity & Forest Health
An introduction to biosecurity and forest health
Part 2

1


Workshop outline
Part 1 - Biosecurity overview
Environmental biosecurity priority lists
Significance of biosecurity
How do things get here
Reducing the risk & what happens when they do arrive
Part 2 – What are we protecting?
K'gari
Part 3 – Forest health & biosecurity
plant pests and pathogens
Part 4 – What can I do to help?
Surveillance & reporting
Symptoms and signs

2


Ngabang K'gari (Mother K'gari)
The Butchulla people are the children of our country and our culture honours our first Lore, what is good for the land comes first, so our commUNITY has a shared responsibility to care for country as we care for our own mothers.
Combining the ancient ecological knowledge of our ancestors and the contemporary ecological knowledge that you share, may we all yan gambay (walk together) to protect and preserve our precious island, K'gari, and our beautiful Butchulla country on the mainland.
Painting and words by Matilda (Tilly) Davis.
Galangoor nyin (thank you) Aunty Joyce Bonner for the translation.
The sea of blue dots surrounding K'gari was inspired by the Aboriginal artists of Warumpi (Papunya) in the Northern Territory, where the art of dot-painting originated.

3


What are we protecting - K'Gari World Heritage Area
BUTCHULLA
Land and Sea Rangers

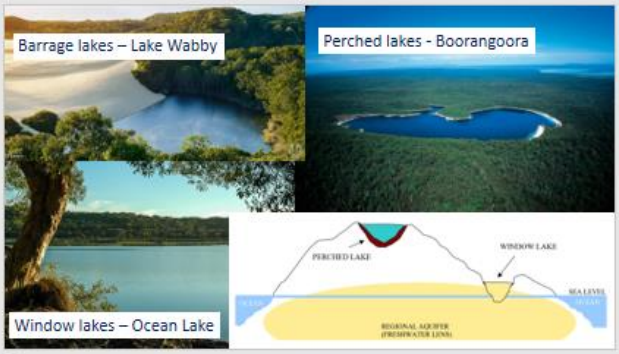
4


Sand and dunes

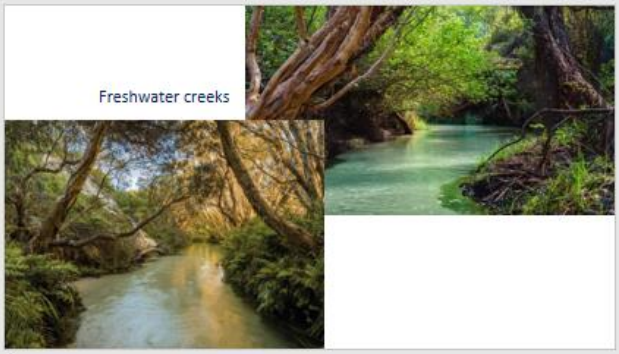
5


Coloured sands

6


Barrage lakes – Lake Wabby
Perched lakes - Boorangoora
Window lakes – Ocean Lake
PERCHED LAKE
WINDOW LAKE
SEA LEVEL

7


Freshwater creeks

8


Forests on sand
So many different habitats!

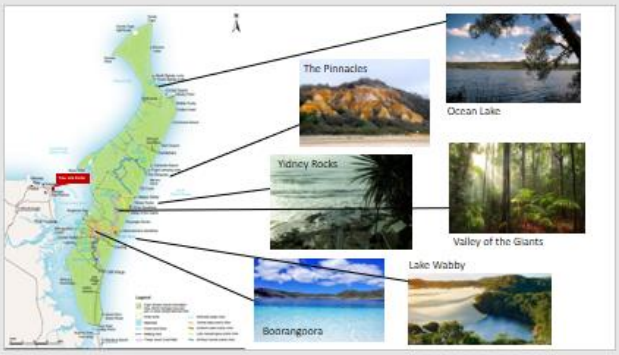
9


Animals of K'gari

10


Birds of K'gari

11


The Pinnacles
Ocean Lake
Yidney Rocks
Valley of the Giants
Lake Wabby
Boorangoora

12

Environmental Biosecurity & Forest Health

An introduction to biosecurity and forest health

Part 3

DAF Queensland
Dr Geoff Pegg, Dr Louise Shuey, Janet McDonald
DES
Alana Hazel
BLSK
Chantel Van Wamelen, Matilda Dana, Jodie Rainbow, Rylee Broome, Blayde Foley

1

Workshop outline

- **Part 1 - Biosecurity overview**
  - Environmental biosecurity priority lists
  - Significance of biosecurity
    - How do things get here
    - Reducing the risk & what happens when they do arrive
- **Part 2 – What are we protecting?**
  - K'gari
- **Part 3 – Forest health & biosecurity**
  - plant pests and pathogens
- **Part 4 – What can I do to help?**
  - Surveillance & reporting
  - Symptoms and signs



2

Forest health and Biosecurity – plant pests and diseases






3

What is a tree?

- **Cultural** - blue
- **Ecological** - green
- **Social** - yellow

4

What is a tree – cultural importance

- Spiritual
  - Family connections
- Scar trees
  - Navigation
  - Historically significant
- Edible and medicinal
  - Paper bark
  - Pandanus – fertility
  - *Austromyrtus dulcis* – midyim berry


5

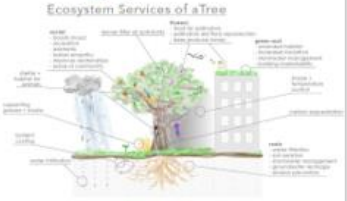
What is a tree – cultural importance

- Canoes
- Shelter
- Cooking
- Indicator – dreaming links
  - Food
  - Festival
- Totems & family connections
- Tools & weapons
  - Spear
- Ceremonial
  - Blue gum
  - Small leaved gum
  - Paper bark
  - Clap sticks
- Weaving


6

What is a tree – ecological/social

- Regulate temperature and provide shade
- Filter air pollutants
- Sequester carbon
- Manage and filter rainwater
- Stabilize soils
- Maintain soil health
- Provide food and shelter for living organisms
- Improve occupant's mental, physical, and well-being
- Improve recreation and aesthetics



7

8

Australian Forests

- 123 million hectares (98%) of native forests and 2 million hectares (2%) of plantation forests
- Due to Australia's geographic isolation we have relatively few of the pests and diseases that affect forests overseas
  - Success of Australian tree species in plantation forests globally has created an increased risk
    - *Eucalyptus*
      - *Myrtle rust*
    - *Acacia*
      - *Ceratocystis* wilt disease

9

Definitions

- **Forest Health** refers to the status of key ecological and physiological processes of the forest species
  - growth, photosynthesis, respiration, nutrition, water uptake
- In a healthy forest these processes are operating within their normal bounds
- In an unhealthy forest these processes are abnormal and may lead to decline
- Factors influencing forest health include:
  - biotic (e.g. pests and pathogens)
  - abiotic (e.g. nutrients, climatic) agents
  - human activities

10

Plant pest and pathogen threats to the environment

- **Plant pest and pathogen threats not in Australia**
  - Pests or pathogens that have been identified as a potential significant risk to Australia
  - Have been detected at the border but have not established
- **Plant pests and pathogens in Australia**
  - **Introduced plant pest and/or species**
    - Occurring beyond its natural range
  - **Native plant pests & pathogen**
    - Species occurring naturally in Australia
      - Impacts may change due to disturbance, change in distribution
        - Emerging threat

11

What happens when pests or pathogens get introduced into a new area?

- Extinction of a plant species
  - Naive hosts – have no or limited inherited resistance to the introduced pests or pathogen
  - No natural checks
    - e.g. biocontrol agents
- Reduced distribution of a plant species
  - Change in population structure
- Reduced ecological function of a plant species
  - Flow on effects – e.g. pollinators
- Loss of culturally significant species/individual trees

12

Chestnut blight

- ***Cryphonectria parasitica*** – fungal pathogen
  - Native to East Asia and South East Asia
  - Introduced into Europe and North America in the 1900s
  - Affects the American Chestnut and American chinquapin
- **Impact**
  - Devastating economic and social impact in eastern United States.
    - Killed an estimated four billion trees & virtually eliminated American chestnut as a canopy species in 8.8 million acres of forest
  - Flow on effects the loss of these species had:
    - The chestnut fruit was a major food source for animals in the low elevation Appalachian forests.
    - Drastic decrease of the squirrel population
    - Extinction of seven native moth species
    - Linked to a decrease in the abundance of cavity-nesting birds
    - Decrease in river water quality

13

Sudden Oak death

- ***Phytophthora ramorum*** – fungal pathogen
- The disease kills oak and other species of trees
  - devastating effects on the oak populations in California and Oregon
- First reported in 1995
  - introduced as an exotic species to Europe and North America
- **Impacts**
  - Cultural
    - loss of tanoak acorn as one of the most important traditional and ceremonial foods still used in Northern California
      - Yurok, Hupa, Miwok, and Karuk peoples
  - Ecological
    - loss of keystone species

14

Phytophthora dieback – Western Australia

- *Phytophthora cinnamomi*
  - Kills susceptible plants
    - banksias, jarrah and grass trees, by attacking their root systems
  - More than 40% of Western Australian native plants are susceptible
- > 1 million hectares affected in Western Australia
- Impacts of dieback
  - Loss of biodiversity
    - extinctions of threatened plants
    - extinction of animal species relying susceptible plants for food and habitat
      - dibblers, western ground parrots and honey possums.
    - reduced variety of native plants
  - Loss of key understorey species
  - Disruption to woodland vegetation structure
  - The increased dominance of resistant plants such as grasses, rushes and sedges, or introduced weeds

15

Bunya Pine

- Chantel – story from a Butchulla perspective
- Louise – Phytophthora dieback story

16

Myrtle rust

- Rust fungus *Austropuccinia psidii*
  - Native to South America
    - limited/no impact in native ecosystems
  - Detected in Australia in 2010
  - Host range – Myrtaceae (eucalypts, bottle brush, lilly pilly)
- Impact
  - >350 species from 57 genera – seedlings to 100 year old trees
    - Localised extinction
      - Native guava – *Rhodomyrtus psidioides*
    - Changes in plant community composition
    - Impact on regeneration following disturbance
      - E.g. fire

17

Myrtle rust on K'gari

- Fire damage sites – southern K'gari
  - Five *Melaleuca quinquenervia* impact monitoring sites assessed
  - High percentage of susceptible trees at all sites
- Seedling regeneration demonstration plot
- Myrtaceae species transect

18

19

Environmental Biosecurity & Forest Health

An introduction to biosecurity and forest health

Part 4

DAF Queensland
Dr Geoff Pegg, Dr Louise Shuey, Janet McDonald
DES
Alana Hazel
BL 8R
Chantel Van Wamelen, Matilda Davis, Jodie Rainbow, Myles Broome, Elayde Foley

1

Workshop outline

- **Part 1 - Biosecurity overview**
  - Environmental biosecurity priority lists
  - Significance of biosecurity
    - How do things get here
    - Reducing the risk & what happens when they do arrive
- **Part 2 – What are we protecting?**
  - K'gari
- **Part 3 – Forest health & biosecurity**
  - plant pests and pathogens
- **Part 4 – What can I do to help?**
  - Surveillance & reporting
  - Symptoms and signs



2

What can I do to help?

- **Create Awareness**
  - **Increasing awareness and knowledge of biosecurity** in the environments we work/live in
  - **Familiarise yourself with your surroundings**
    - Look for changes – pest detective
  - **Educate**
    - Increase capacity to detect and report
      - Make biosecurity and forest health a part of normal activities
    - Get the message out there
      - Come clean go clean
      - Develop communication strategies
      - Develop networks
        - Landcare & garden groups
        - Schools

3

What can I do to help?

- **Surveillance**
  - Active surveillance
    - Planned/structured activities looking for specifics
      - Aerial
      - Drive/walk-through
      - Trapping
  - Passive surveillance
    - Observations of pests and diseases during routine activities
      - Adhoc/irregular
- **Reporting**
  - **Suspected exotic pest or disease – EXOTIC PLANT PEST HOTLINE**
  - Local Government Department
    - Diagnosis of the issue
  - MyTreePest app – in development
    - Information on native pests and pathogens

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE
1800 084 881

4

Benefits of forest health surveillance

- Assess the health of the forests and develop baseline information on the status of the forest and what pests and diseases are already present
  - Easier to identify change and emerging pest and disease threats
    - Timely implementation of management processes
    - Timely reporting in the case of exotic/new pests and disease threats
  - Provide timely advice for land managers/owners
  - Provide baseline information to inform management of pest & disease issues
  - Provide information for reporting requirements
    - World Heritage OUV's on K'gari; State of the Forest/Environment
- FHS is effective in detecting a number of new and emerging pests, evaluating their potential impact and assisting in focusing future research efforts.

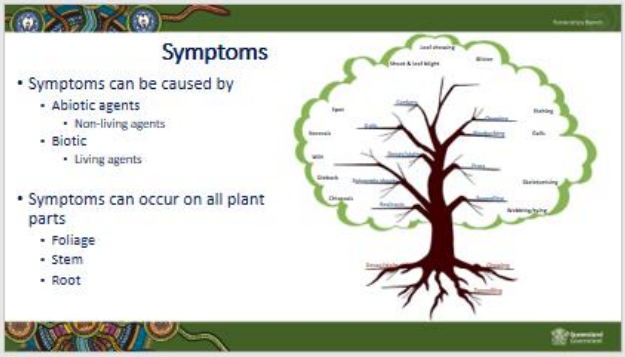
5

What am I looking for?

- **Symptoms**
  - The visible response of a plant to a causal agent over time
- **Signs**
  - Structures produced by the causal agent of that disease that are more specific than symptoms and are more useful in the accurate diagnosis of a disease



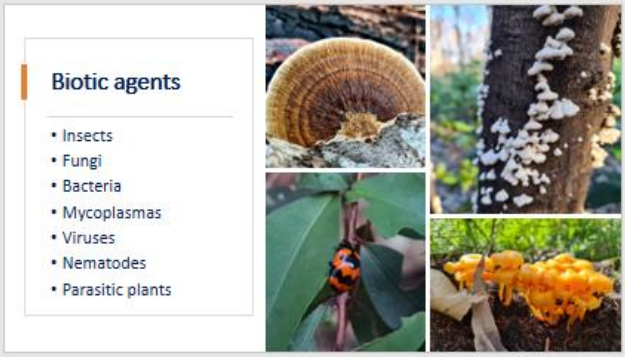
6


Symptoms
• Symptoms can be caused by
• Abiotic agents
• Non-living agents
• Biotic
• Living agents
• Symptoms can occur on all plant parts
• Foliage
• Stem
• Root

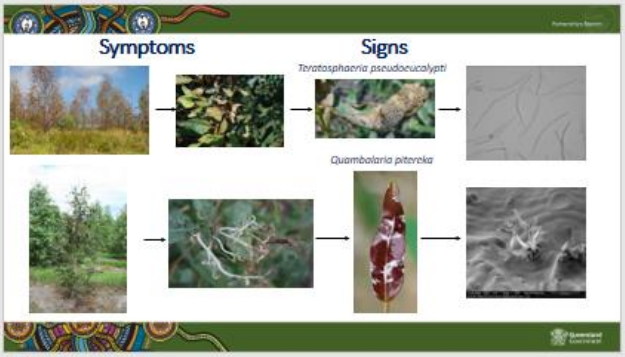
7


Abiotic Agents
• Environmental
• Drought
• Frost
• Lightning
• Water-logging
• Fire
• Chemical
• Herbicide application
• Salinity
• Nutritional
• Toxicity
• Deficiency

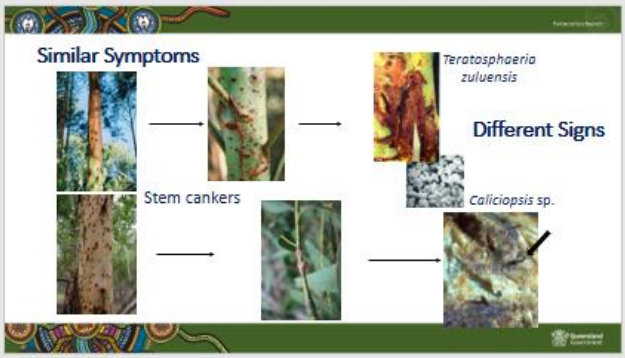
8


Biotic agents
• Insects
• Fungi
• Bacteria
• Mycoplasmas
• Viruses
• Nematodes
• Parasitic plants

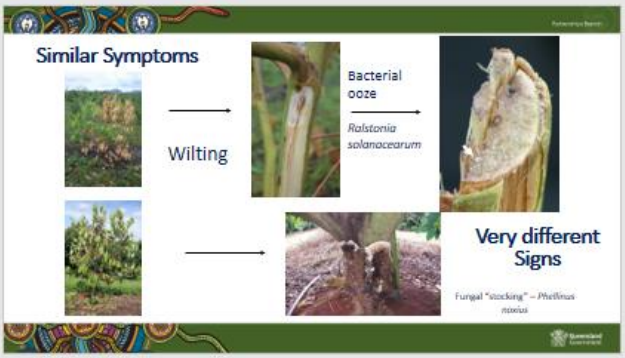
9


Symptoms
Signs
Teratosphaeria pseudoeucalypti
Quambalaria pitereka

10


Similar Symptoms
Teratosphaeria zuluensis
Different Signs
Stem cankers
Caliciopsis sp.

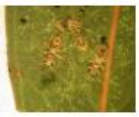
11


Similar Symptoms
Wilting
Bacterial ooze
Ralstonia solanacearum
Very different Signs

12

Similar Symptoms

Very different Signs



13

Symptoms – leaf & shoot blight/blotch

- Leaf blight refers to the parts of leaves that become discoloured, dried out, or dead in response to a pathogen infection.
- Shoot blight is the distortion and death of young shoots and leaves caused by fungal pathogens.

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Symptoms – leaf spot

Characterized by discoloured often circular spots on the leaves

Aulographina eucalypti on *Eucalyptus cloeziana*

Austropuccinia psidii on *Syzygium wilsonii* & *Eucalyptus grandis*

Austropuccinia psidii & *Mirid* leaf spots on *Melaleuca quinquenervia*

15

Symptoms - Dieback

Characterised by progressive death of twigs, branches, shoots, or roots, starting at the tips.

Stag-head is a slow **dieback** of the upper branches of a **tree**; the dead, leafless limbs superficially resemble a stag's head.

16

Symptoms - Dieback

Photo: Stuart Johnson QPWS

Photo: G Pegg DAF

17

Symptom – Dieback & Epicormic shoots

- Occur on the tree's branches and trunk
  - Triggered by stress fire, drought and continual defoliation or pests and disease attack
  - Can also be more susceptible to pests and disease attack.

Fire induced epicormic

Fire induced epicormic impacted by myrtle rust *Melaleuca quinquenervia, Eucalyptus pilularis*

Epicormic induced growth due to myrtle rust *Syzygium corynanthum*

18

Symptom - Galls



Galls are a kind of swelling growth on the external tissues of plants, fungi, or animals. Plant galls are abnormal outgrowths of plant tissues. They can be caused by various parasites - viruses, fungi and bacteria – as well as other plants, insects or mites.

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Symptom - Galls

- **Insect** galls occur in different shapes and colours on stems, branches, twigs and foliage.
- They are abnormal growths of plant tissue.
- Galls act as both the habitat and food source for the maker of the gall.
- Galls can be characteristic of different agents (mostly flies and wasps) which allows field identification.

20

Symptom - Galls


Rust gall on a branch


Rust galls on *Acacia* sp. foliage

- **Fungal** galls can be rust coloured, rough textured and larger than insect galls
- Can occur on branches, twigs and foliage
- Many of these fungal galls are formed by a specific class of fungi known as rusts.

21

Symptoms - Canker


- Localized, sunken, slightly discoloured, brown to reddish lesions on trunks and branches, or smaller twigs.
- Formed by the interaction between the host and pathogen - the host tree tries to contain the growth.
- Can take months or years to enlarge enough to girdle twigs, branches, or trunks.

22

Symptoms - Wilt



Affected parts lose their turgidity and droop

A **wilt disease** is any number of diseases that affect the vascular system of plants.

Wilt can be caused by root and crown rots, stem cankers, insect injuries, drought or excess water, soil compaction etc.

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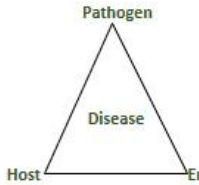
Activity

- Hervey Bay Botanic gardens – pest and pathogen symptoms
  - Photograph pest and pathogen symptoms
  - Collect samples and describe

24

Surveillance - Disease triangle



Four factors needed for a disease to occur

1. Host or susceptible plant
2. Environment – rainfall/humidity
3. Pathogen or disease causing agent
4. Time for disease to occur

25

Disease triangle – myrtle rust example

Pathogen - *A. psidii* urediniospores

- Host or susceptible plant
  - actively growing Myrtaceae – seedling – mature tree
- Environment
  - rainfall & high humidity – minimum 8hrs leaf wetness for spore germination
- Pathogen or disease causing agent
  - high number of spores to increase chance of finding and infection a susceptible host
- Time for disease to occur
  - 7 to 14 days from infection to completion of the disease cycle and production of new spores

26

Where to look?

- **Nurseries**
  - Frequent watering
  - High density of susceptible species
  - Active growth
- **Revegetation plantings/landscaping**
  - High density plantings
- **Botanic gardens**
  - Target known susceptible species
- **Waterways – swamps, creek banks**
- **Fire recovery sites**
  - Areas of mass regeneration
    - Seedlings/epicormic regrowth
- **Valley ecosystems**
  - High humidity – year round suitable conditions

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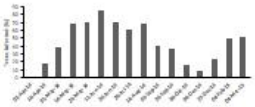
When to look?

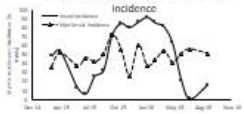
- Optimum times in subtropical conditions appears to be autumn – early spring
  - Variable with some sites being all year round
  - In some cases more host driven than climatic
    - *Melaleuca quinquenervia*

Fire regeneration – disease incidence



Peak in disease incidence in Autumn/Winter

Melaleuca swamp – disease and insect incidence



Fluctuations independent of climatic variables

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What to look for?

Seedlings, saplings.....100 year old mature trees

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Symptoms

- Wide range of symptoms
  - Infects new growth, fruit and flowers
    - Old growth is resistant to infection
- Restricted leaf spots to blighting
- Red-purple spots associated with pustules
- "Glowing" yellow pustules to "scorched" appearance with no obvious pustules
- Significant dieback to tree death
  - Rate of decline is variable

30

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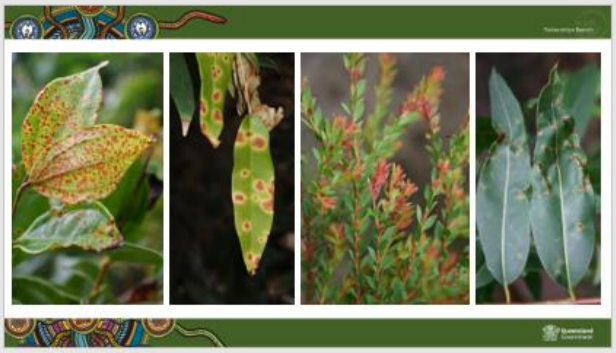

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38


What is biosecurity & why is it important
• What does the term "biosecurity" mean to you?
• Why is it important?
• Revisit Group activity – 4 tables of 5 with Rangers helping lead discussions on tables
• 15 minutes

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35

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Australian Plant Biosecurity Science Foundation

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