Good Gira (Cultural Fire Management) and Myrtle Rust

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Above: Photograph of the Butchulla Rangers conducting cultural fire management.

1 Contents

2 Introduction

The first Butchulla Lore is ‘minyang galangoor gu djaa, kalim baya-m’ (what is good for the land comes first). Like the countless generations of Butchulla people before us, we share the responsibility to honour this Lore. The Butchulla word for fire is ‘gira’. For many centuries, beautiful Butchulla country has been strategically and systematically burned by its custodians, the Butchulla people. Colonialism has disrupted such sacred land management strategies and introduced exotic weeds, pests, and pathogens, causing country to suffer greatly. With the extensive ecological knowledge and traditional sciences passed on from our old people, we understand that good gira (cultural fire management) is an integral part of practising cultural custodianship and healing country. The phrase ‘healing country’ can be defined as restoring and maintaining the health of the natural environment.

Galangoor nyin (thank you) to Aunty Josey Bonner, Butchulla Community Linguist, for the translation.

More information: Cultural Burns Return to K’gari « FINIA

2 Objective

This report examines the effectiveness of Butchulla led burning as a management strategy for myrtle rust on K’gari (Fraser Island). The objective of this report is to support the Butchulla Aboriginal Corporation’s aspirations for more Butchulla led fire management on K’gari.

3 Myrtle Rust

Austropuccinia psidii (myrtle rust) is a rust fungus native to South America. The pathogen arrived in New South Wales in 2010 and began attacking species of the Myrtaceae family all along Eastern Australia. The first confirmed rust detection made in 2013 by Dr. Geoff Pegg and Dr. Fiona Giblin (Department of Agriculture and Fisheries). However, myrtle rust was likely on K'gari before then. In 2013, Dr. Geoff Pegg and Dr. Fiona Giblin identified rust on five species: Austromyrtus dulcis, *Backhousia myrtifolia* (cinnamon myrtle), *Homoranthus virgatus* (twiggy homoranthus), *Melaleuca quinquenervia* (Broad-leaved Paperbark), and *Rhodamnia acuminata* (Cooloola ironwood). Forest pathologists, Dr. Geoff Pegg and Dr. Louise Shuey, from the Department of Agriculture and Fisheries) and the Butchulla Aboriginal Corporation's Land and Sea Rangers have since identified myrtle rust on more species, including *Eucalyptus pilularis* (blackbutt) and *Syncapia hillii* (satinay). The mature foliage of infected hosts is resistant to rust symptoms; however, the new growth is highly susceptible. Symptoms typical of myrtle rust include red-purple leaf spots with yellow pustules. The pathogen can cause blighting, leaf deformity, dieback, and tree death.

3.1 Myrtle Rust and Cultural Values

The Myrtaceae family is ecologically, culturally, and economically significant.
Many key tree species throughout the continent belong to this family, therefore, the health of Myrtaceae correlates with health of the natural environment and native wildlife. The Butchulla people value the Myrtaceae family greatly as many Myrtaceae species are edible, medicinal and/or cultural resources. Such resources could be utilised for ceremony, constructing shelters, utensils, tools, and weapons. Some Myrtaceae species also serve as seasonal indicators, and/or contain spiritual connections to sacred stories. Myrtle rust often prevents the flowering and fruiting of infected hosts. This has devastating impacts on country and can impede our ability to practise culture, as many of the fruits are edible and the flowers often serve as seasonal indictors.

3.2 Myrtle Rust and Fire

Wildfires have high, hot flames that destroy the forest's foliage and canopy. The green foliage contains oils and when burned they produce thick, dark smoke. Forests recovering from hot burns become 'upside down country', where the burnt canopies become brown or bare and the ground becomes green with recovering grasses and ground-dwelling plants. 'Upside down country' indicates that the forest is stressed. The affected forest produces an abundance of epicormic growth (new growth) which is highly susceptible to myrtle rust infection. Therefore, hot burns, like wildfires, accelerate myrtle rust infection and severity rates significantly. Forest pathologists, Dr. Geoff Pegg and Dr. Louise Shuey, have worked with the Butchulla Aboriginal Corporation's Land and Sea Rangers to collect data in post-fire sites on K'gari. The data collected on K'gari and compiled by Dr. Geoff Pegg and Dr. Louise Shuey, can be used to support our observations.

3.3 Myrtle Rust and Good Gira (Cultural Fire Management)

Butchulla fire practitioners observe country, wildlife and the seasons and apply regular cool burns accordingly, this is called 'cultural fire management'. Cultural fire management is integral to restoring and maintaining the health of country (healing country) and is only implemented in vegetation communities that benefit from fire. Butchulla fire practitioners apply cool, low flames to 'thin out' the forest where necessary and burn the debris on the ground, this significantly reduces the risk of wildfires and encourages new growth among grasses and ground-dwelling vegetation. This new growth provides plentiful food for wildlife and cultural resources for the Butchulla people. The cool, low flames minimise any disturbance to the mature trees or 'parent trees.' The cool burning method protects the mature foliage and minimises stress-induced epicormic growth, significantly reducing the rate and severity of myrtle rust infections in some species. Therefore, it is understood that cultural burning can be a successful and sustainable strategy for myrtle rust management. The data collected on K'gari and compiled by Dr. Geoff Pegg and Dr. Louise Shuey, can be used to support this theory and the Butchulla Aboriginal Corporation's aspirations for more cultural fire management on K'gari.

4 Acknowledgements

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Chantel Van Wamelen, Butchulla Aboriginal Corporation's Land and Sea Program Coordinator

Myles Broome, Butchulla Aboriginal Corporation's Land and Sea Ranger

Jodie Rainbow, Butchulla Aboriginal Corporation's Land and Sea Ranger

Blayde Foley, Butchulla Aboriginal Corporation's Land and Sea Ranger

Myrtle rust on K’gari

Geoff Pegg, Louise Shuey, Tilly Davis, Blayde Foley, Myles Broome, Jodie Rainbow, Chantel Van Wamelen

Photos – Nicolas Rakotopare (Threatened Species Recovery Hub), Geoff Pegg (DAF, Queensland)

Introduction

Austropuccinia psidii, commonly known as myrtle rust, has long been considered a significant threat to Australian plant industries and ecosystems. In April 2010, *A. psidii* was detected for the first time in Australia on the central coast of New South Wales (Carnegie et al, 2010). The geographic distribution of *A. psidii* in Australia continues to expand with detections now extending from Tasmania, along the entire east coast of Australia as far north as Bamaga at the tip of Cape York Peninsula and west to the Northern Territory including the Tiwi Islands and west of Darwin.

Austropuccinia psidii affects plants in the Myrtaceae family, which includes many Australian natives including eucalypt, paperbark, bottlebrush, tea tree and lilly pilly. The impact of *A. psidii* on individual trees and shrubs has ranged from minor leaf spots, foliage, stem and branch dieback to reduced fecundity. Tree death, because of repeated infection, has been recorded for a number of species and some are now disappearing and considered critically endangered such as the native guava *Rhodomyrtus psidioides*. The host range in Australia currently exceeds 380 species from 57 different genera.

The threat to some of Australia's unique ecosystems are only now being realised. Significant decline of Myrtaceae species have been recorded in lowland wet sclerophyll forests in south-east Queensland and northern NSW (Pegg et al. 2017). In the short time that *A. psidii* has been established in Australian natural ecosystems, we have observed significant damage and tree mortality. There are few exotic diseases in Australia that threaten such a wide range of Australian flora.

Austropuccinia psidii was first reported on K'gari in 2013 (Giblin & Pegg,unpublished) with limited surveys identifying disease on *Austromyrtus dulcis*, *Backhousia myrtifolia*, *Homoranthus virgatus*, *Melaleuca quinquenervia* and *Rhodamnia acuminata*. However, little information on impacts were gathered during these surveys.

This study aimed to determine the susceptibility to and impact of myrtle rust on Myrtaceae species on K'gari, particularly following wildfire. Data used in this report has been compiled as part of overlapping projects funded through PBSF and ANPC (Threatened Species Recovery Hub). Full reports of these projects can be found at (Fire and Rust | Australian Network for Plant Conservation (anpc.asn.au); Expanding environmental biosecurity capacity to protect unique ecosystems on K'gari (Fraser Island) (PBSF025) – Plant Biosecurity Science Foundation (apbsf.org.au); Expanding environmental biosecurity capacity to protect our unique ecosystems (PBSF012 COMPLETE) – Plant Biosecurity Science Foundation (apbsf.org.au)).

Materials and methods

Fire affected areas

In November 2019, a wildfire was initiated following a lightning strike in the southern end of the island affected areas of coastal heath, melaleuca wetlands and woodland and eucalyptus woodlands. In October 2020, a more extensive wildfire was initiated by an illegal campfire and burned for more than two months affecting approx. 80,000ha (Figure 1).

Given that myrtle rust is known to impact on regenerating Myrtaceae, seedlings and reshoots, much of the survey work focussed on fire affected ecosystems. This included coastal heath and woodland, paper bark wetlands, wet sclerophyll forests and rainforest areas.

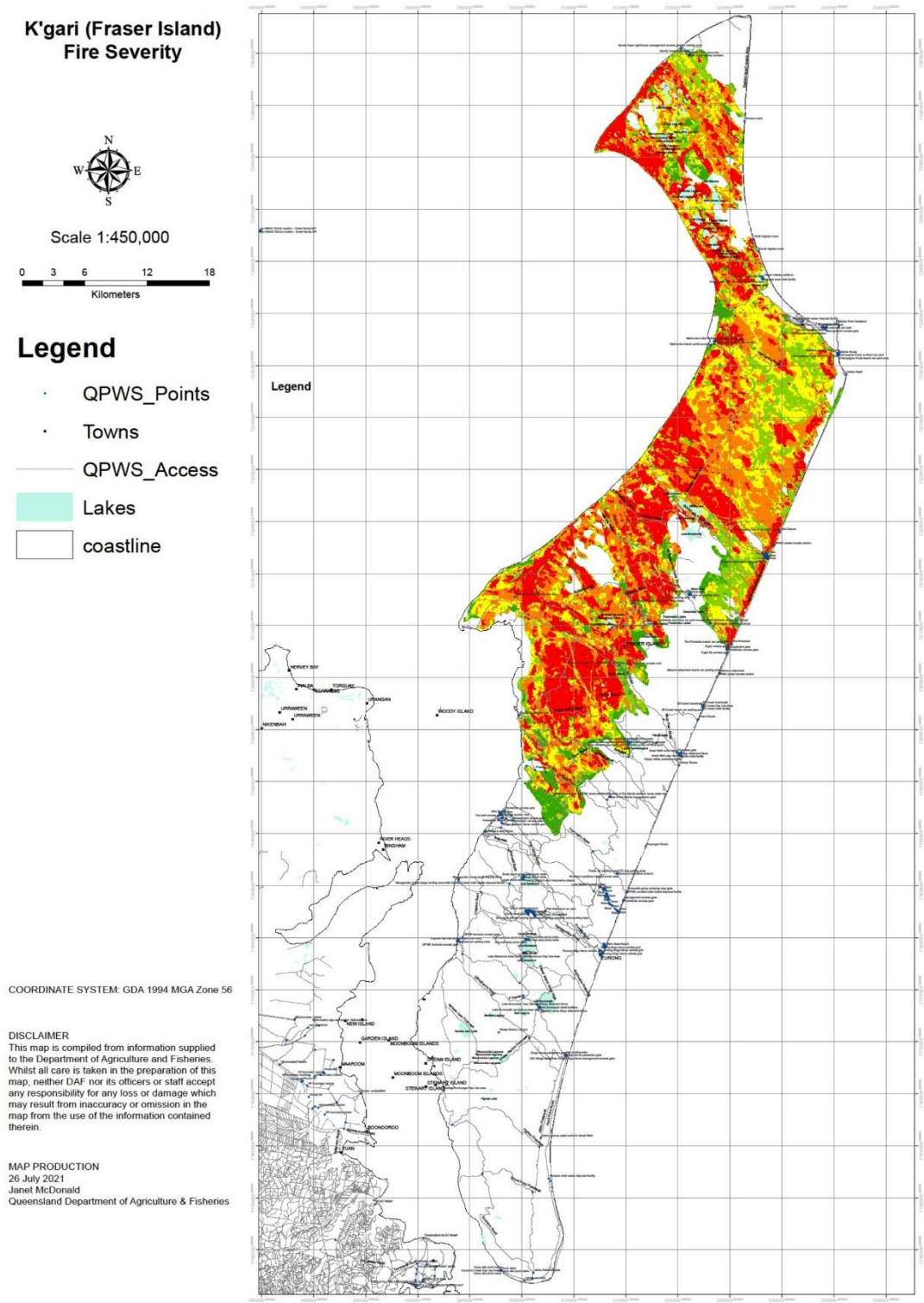

Figure 1 K'gari 2020 fire map showing fire intensity levels, red being the most intense fire ratings

Surveys and assessments

Walk through and transect surveys were conducted at a range of sites in areas affected by fire with evidence of seedling regeneration and/or reshooting occurring. These surveys were designed to determine the presence of myrtle rust in different environments and on different species.

Surveys were conducted in wildfire-affected areas where Myrtaceae species were present. Surveys methods were dependent on the site conditions and the distribution of Myrtaceae or presence of specific species of interest. Locations within environments were selected at random and walk-through surveys to assess multiple species impacts carried out by assessing all trees along a transect. The length of the transect was dependent on the site circumstances.

Where species of known susceptibility, ecological and/or conservation significance were identified more targeted assessments were undertaken to capture information on as many individuals as possible. This consisted of assessments in multiple sites selected randomly or the establishment of plots.

Location of surveys and targeted species were recorded using Garmin InReach handheld GPS.

Assessment methods

At each site information on the site characteristics were gathered including:

- GPS location
- General site description
- Vegetation type
- Fire intensity - low severity (burnt understory, unburnt canopy), moderate severity (partial canopy scorch), high severity (complete canopy scorch, partial canopy consumption), severe (full canopy consumption)
- Presence/absence of susceptible growth – new shoots, expanding foliage, green stems

Assessment methods have been adapted from previous work done by Pegg et al. (2014), Carnegie et al. (2016), Pegg et al. (2017) and Pegg et al. (2020). Ratings were simplified to be applicable across a range of species and for the use by people less familiar with the disease and array of symptoms and impacts on the different host species. Disease incidence on susceptible new growth and severity of infection based on a scale of low, moderate, high and severe was collected. Due to the variability in hosts and their response to infection, shoots and foliage were rated separately to juvenile stems. Where possible information on the levels of dieback caused by rust was also recorded as was presence of any flower or fruiting structures and evidence of infection.

Monitoring plots

50 tree plots were established in selected sites and focused on *Melaleuca quinquenervia* (paperbark) to assess impact of repeated infection of myrtle rust on post-fire plant regeneration. Trees were selected at random but only trees with evidence of reshoots were included.

One meter radius plots were established in areas where seedlings of *Eucalyptus pilularis*, *M. quinquenervia* and *Syncarpia hillii* seedlings were regenerating. Plots were randomly selected, and the number of plots assessed was dependant on the total area of seedlings.

Results

2019 fire - myrtle rust impact assessments

The main surveys on K'gari focused on southern parts of the island affected by wildfire in November 2019. Vegetation types included coastal heath and woodland ecosystems with some encroachment into wet sclerophyll and rainforest vegetation.

Table 1 Species and susceptibility to *Austropuccinia psidii* in fire affected sites within fire affected sites on K'gari (Fraser Island) National Park in November 2019

Species	*Regeneration type*	*Rust identified*	*Infection level*
Syncarpia hillii	S	N	
Austromyrtus dulcis	R	N	
Acmena smithii	R	N	
Eucalyptus pilularis	S/R	N	
Leptospermum liversidgei	R	Y	L-M
Leptospermum semibaccatum	R	N	
Leptospermum polygalifolium	R	N	
Leptospermum trinervium	R	Y	L-M
Homoranthus virgatus	S	Y	L-M
Baeckea frutescens	R	N	
Melaleuca quinquenervia	S/R	Y	L-S

S=Seedling; R=Reshoot; L=Low, M=Moderate, H=High, S= Severe

Surveys across various sites failed to identify myrtle rust occurring on seedling or epicormic regrowth of the iconic and ecologically significant satinay, *Syncarpia hillii* (Table 1), despite it being a known susceptible species in glasshouse studies (Pegg unpublished). Similarly, no infection was found on *Eucalyptus pilularis* despite high levels of infection recorded in other fire affected areas assessed in New South Wales.

Myrtle rust was detected on regenerating *Homoranthus virgatus* (twiggy Homoranthus) but there were also high numbers of individuals free of symptoms and producing flower buds at the time of assessment. Reports of significant levels of impacts on this species have been made previously, including sites around Boorangoora (Lake McKenzie), Dilli Village and Kingfisher Resort (Pegg et al. unpublished).

Table 2 *Melaleuca quinquenervia* plot assessments for myrtle rust impact at different sites across fire affected areas on K'gari

Site	***% Trees infected***	***% Infected trees with dieback***
Sheep Station fire break	76	26
Broken Bridge	66	45
Garry's Anchorage	68	38
Inskip	68	41
Jabiru	76	36

Myrtle rust symptoms and dieback was found on both seedlings and reshoots of *M. quinquenervia* (Fig. 2, 3). Five monitoring plots were established in different locations at the southern end of the island. Fire impact levels were rated as high in all sites and 50 trees at each site, selected at random, were assessed for disease incidence, severity and impact of infection (dieback of reshoots). All sites had greater than 60% of trees showing some evidence of infection (Table 2). Dieback levels were low at the time of assessment, but it was considered that the stage of infection was reasonably recent. There is a need to reassess these sites to better capture impact levels, particularly in relation to repeat infection events and the impact on flowering rates within the different sites over time.

Figure 2 Assessing paperbark regeneration on K'gari for myrtle rust on reshoots following 2019 wildfire.

Melaleuca plot revisit - 2021

Three of the five plots were revisited in 2021.

Plot 1 – Broken Bridge

Five trees, all assessed as being highly susceptible to *A. psidii* at the first assessment in 2020, were dead at this assessment. However, without more regular monitoring it is difficult to determine if this is due to myrtle rust only or a combination of factors. At the time of the first assessment 17 of the 50 trees were found to be disease free. All but two of the trees were again assessed as disease free.

Plot 2 - Sheep Station Rd

Trees initially rated as being free of disease (24%), and possibly resistant to rust, were again free of disease symptoms. Conversely, the majority of those rated as highly susceptible at the initial assessment (44%) rated similarly for disease incidence and severity. No tree deaths were recorded.

Plot 3 – Gary's Anchorage

Twelve trees were found to be dead at the second assessment. This included three that were previously assessed as being free of myrtle rust. Of the remaining nine trees, seven had moderate to high (≥50% foliage infected) disease incidence on the reshoots in 2020. Disease incidence levels on the other two dead trees were 10% and 25% with disease severity ratings of low and low-moderate respectively.

Of those assessed as free from rust in 2020 (16 trees), nine trees were assessed as being free of myrtle rust symptoms in 2021.

Figure 3 Myrtle rust symptoms on reshoots of fire damaged paperbark trees on K'gari

2020 fire myrtle rust impact assessments

In late 2020 a wildfire affected more than 87, 000ha of bushland on K'gari. Affected ecosystems ranged from inland lake wetlands, woodlands and fringing rainforest environments. Species assessed within fire affected environments are listed in Table 3.

Table 3 Myrtaceae species assessed for *Austropuccinia psidii* infection in fire affected areas on K'gari (Fraser Island) in May 2021

Species	*Regeneration type*	*Rust identified*	*Infection severity range*
Angophora leiocarpa	R	N	
Austromyrtus dulcis	R	Y	L-M
Backhousia myrtifolia	R	Y	L-H
Corymbia intermedia	R	N	
Corymbia tesselaris	R	N	
Eucalyptus pilularis	S/R	Y	L-S
Melaleuca quinquenervia	S/R	Y	L-S
Leptospermum trinervium	R	Y	L-M
Syncarpia hillii	S/R	Y	L-S

S=Seedling; R=Reshoot; L=Low, M=Moderate, H=High, S= Severe

No evidence of myrtle rust was detected on reshoots of *Angophora leiocarpa*, *Corymbia intermedia* or *C. tesselaris*.

Deepwater Lake

May 2021

The 2020 fire affected two key species around Deepwater Lake, *E. pilularis* and *M. quinquenervia*. Additionally, myrtle rust symptoms were identified on *Austromyrtus dulcis*, but only at low levels. The fire severity at this site ranged from moderate, with partial canopy scorch, to severe in pockets with full canopy scorch and canopy consumption. *Melaleuca quinquenervia* trees were damaged severely

along with pockets of *E. pilularis*. Reshoots and seedlings of both species were present and assessed for levels of *A. psidii* infection and impact.

Eucalyptus pilularis – black butt

Twenty five percent of *E. pilularis* trees with reshoots had myrtle rust symptoms, ranging from 10 to 80% of susceptible foliage affected. Of the 104 *E. pilularis* seedlings assessed, 40.38% had various levels of infection on susceptible foliage. Fifty percent of affected seedlings had disease incidence levels on >50% of susceptible foliage. Disease severity levels ranged from low, with small lesions, to severe with foliage and shoot dieback occurring.

Melaleuca quinquenervia – paper bark

Forty-eight percent of reshooting *Melaleuca quinquenervia* trees had evidence of rust. Disease severity levels varied but the majority (35.9%) of trees only had low levels of rust pustules present. A higher percentage (60.98%) of *M. quinquenervia* seedlings were identified with infection, most (42.68%) having a high disease incidence level (75-100% susceptible foliage with infection). Twenty-six percent of the affected seedlings were rated as severe with large numbers of pustules per leaf and associated dieback of susceptible foliage, shoots and juvenile stems. This would suggest a more significant impact on recruitment with low levels of resistance within the population. However, on-going monitoring would be required to fully understand impacts on recruitment.

September 2021 – site re-visit

Melaleuca quinquenervia – paper bark

Seventy-one percent of reshooting *M. quinquenervia* trees had evidence of rust with 21% of the total trees assessed having some level of rust related dieback. Fifty percent of trees infected had moderate or above levels of disease. Of the seedlings assessed, 43.33% were infected, a 17.65% reduction from assessments back in May 2021.

Eucalyptus pilularis – black butt

Twenty-two percent of reshooting *E. pilularis* trees had myrtle rust symptoms, similar to that observed in May 2021. Only 16.22% of trees had evidence of myrtle rust associated dieback. The number of seedlings assessed with myrtle rust symptoms dropped in comparison to assessments made in May 2021 with on 22.37% of seedlings assessed with myrtle rust symptoms.

Cornwells Break Rd

Fire severity levels were considered low with the understory burnt and little or no evidence of impact in the tree canopies. *Eucalyptus pilularis* and *Syncarpia hillii* were the dominant Myrtaceae at the site. Fire was absent from areas across the fire break with the same species present (Fig. 4). However, the lack of seedling and reshoot regeneration in the unburnt areas meant that myrtle rust impact comparisons between burnt and unburnt areas were not possible. It does demonstrate the role disturbance events can play in myrtle rust development and impact.

Figure 4 Cornwells Break Road burn site – low intensity fire stimulated regeneration of the understory including *Syncarpia hillii* and *Eucalyptus pilularis*. Fire was absent on the southern side of the track as was any evidence of seedlings or reshoots to allow comparison studies.

May 2021

Seedlings of both species were assessed at the site, along with reshoots of *S. hillii*. This report is the first record of myrtle rust affecting *S. hillii* outside of glasshouse studies and the first report of impact on this culturally and ecologically significant species on World Heritage (K'gari) Fraser Island. However, the number of seedlings with infection as of May 2021 were low, with 17% showing symptoms ranging from one or two spots (38.57% of infected seedlings) on leaves to severe blighting on new leaves and juvenile stems (15.71% of infected seedlings) (Fig. 5). Of the 61 reshoots assessed, only seven had symptoms of myrtle rust.

Figure 5 Satinay seedlings regenerating after the 2020 fires with symptoms of myrtle rust on foliage and juvenile stems

September 2021

A similar level of disease incidence was found with 18.26% of seedlings showing symptoms of active *A. psidii* and/or dieback caused by infection (Fig. 6, 7). During this assessment it was noted that a high percentage of seedling were appearing to wilt due to an extended dry period. These dry conditions will also impact on disease levels.

Figure 6 Satinay seedling assessments for myrtle rust in September 2021. Conditions were dry and seedlings germinating post fire were wilting.

Figure 7 Myrtle rust symptoms on Satinay seedlings in fire affected areas on K'gari in September 2021

November 2021

The same site was again assessed in November 2021 following periods of rainfall. Disease was again detected on a range of seedling sizes. However, of the 495 seedlings assessed, only 11.49% had symptoms at the time of assessment. However, disease incidence levels were considered high (≥50%) on 64% of infected seedlings and moderate or higher disease severity levels recorded on 54.9% of seedlings. Some of these seedlings were considered well established with relatively recent infection occurring on the newest shoots (Fig. 8, 9).

Figure 8 Established Satinay seedlings with myrtle rust infection on the newest growing shoots and leaves

Figure 9 Dieback of Satinay seedling caused by myrtle rust affecting the new shoots and young foliage

Moon Point – Happy Valley Rd

May 2021

Reshoots of *Leptospermum trinervium*, growing in severely burnt woodland areas east of Moon Point, were found with rust infection on the newest growth flush. However, only 10% of plants assessed had evidence of infection at the time. Disease severity levels on infected trees were low and unlikely to impact on regeneration unless disease levels increase over time.

Further east along the Happy Valley Road, where the vegetation transitions from woodland to fringing rainforest, fire affected *Backhousia myrtifolia* (reshoot), *E. pilularis* (seedlings), *S. hillii* (seedlings) and *Syzygium oleosum* (reshoot) were assessed for *A. psidii* infection and impact. Forty percent of *B. myrtifolia* reshoots were identified with active *A. psidii* infection and/or associated dieback. No seedlings of this species were identified at the site.

Austropuccinia psidii infection was also detected on seedlings of *S. hillii*. However, only 5% of the 100 seedlings assessed had symptoms. These ranged from single spots to moderate levels of infection on new foliage.

September 2021 – site re-visit

Syncarpia hillii seedlings were severely wilting and no evidence of myrtle rust symptoms were observed. Myrtle rust was however, identified on *Syzygium oleosum* and *Backhousia myrtifolia* reshoots.

Garawongera Road – September 2021

Myrtle rust levels were compared in a burnt and unburnt section on forest along Garawongera Rd. *Backhousia myrtifolia* is a dominant understory species and in the unburnt section 25.71% of trees assessed had some level of infection and/or myrtle rust associated dieback. In the burnt section (moderate intensity fire) 29.41% of reshoots were found with disease, indicating little difference between fire affected and unaffected trees for this species.

Boorangora – September 2021

Homoranthus virgatus shrubs were assessed for myrtle rust symptoms and levels of dieback. Thirty-two plants were assessed in total with six trees showing low levels of active myrtle rust. Seventeen trees had varying levels of myrtle rust associated dieback.

November 2021 surveys

Surveys in November 2021 aimed to assess for myrtle rust in areas not previously assessed and included burnt and unburnt areas. This included areas along Cornwells Break Road (heath woodland, wet eucalypt), Postens Cul-de-sac (burnt and unburnt wet eucalypt), Ocean Lake (burnt heath/woodland), Wathumba (burnt woodland, heathland), Lake Allum (unburnt wet eucalypt, hoop pine), Central Station (unburnt wet eucalypt/rainforest).

Table 4 November 2021 myrtle rust assessments on K'gari

Location	Forest type	Fire status	Species	Myrtle Rust identified	Severity Range
Cornwells Break Road (western)	Woodland/heath	Burnt	*Leptospermum trinervium*	Y	M-H
			Homoranthus virgatus	N	
			Austromyrtus dulcis	N	
	Rainforest	Unburnt	*Backhousia myrtifolia*	N	
			Decaspermum humile	Y	L-M
			Rhodamnia acuminata	Y	L
			Syzygium oleosum	Y	L
Postans Rd	Dry eucalypt	Unburnt	*Backhousia myrtifolia*	Y	L-M
		Burnt	*Backhousia myrtifolia*	Y	L-H
Ocean Lake	Woodland	Burnt	*Austromyrtus dulcis*	Y	L-S
			Melaleuca quinquenervia	Y	L-S
Wathumba	Woodland/heath	Burnt	*Austromyrtus dulcis*	N	
			Leptospermum trinervium	N	
			Melaleuca quinquenervia	N	
Lake Allum	Wet eucalypt/hoop pine	Unburnt	*Austromyrtus dulcis*	N	
			Backhousia myrtifolia	Y	L-S
Central Station	Wet eucalypt	Unburnt	Austromyrtus dulcis	N	
			Backhousia myrtifolia	Y	L-M

Symptoms of myrtle rust infection were found in burnt and unburnt sites on a range of species and in a range of ecotypes (Table).

Decaspermum humile – silky myrtle

This survey recorded myrtle rust on *Decaspermum humile* for the first time on K'gari. Symptoms were identified on regenerating saplings along the road edge with high disease incidence on new shoots (Fig. 10).

Figure 10 *Rhodamnia acuminata* (Cooloola ironwood) and *Decaspermum humile* (Silky myrtle) affected by myrtle rust on K'gari

Austromyrtus dulcis

Surveys across K'gari have generally found *A. dulcis* to be free of myrtle rust. However, assessments in fire affected areas around Ocean Lake identified myrtle rust on 28% of plants assessed. Of those infected, all had infection on the immature fruit and/or flowers (Fig. 11, 12). At the same location 70% of *M. quinquenervia* reshoots had infection, with severity levels ranging from low to severe. This same area was assessed back in 2018 pre fire, with no evidence of myrtle rust identified.

Figure 11 Healthy (RHS) and myrtle rust affected *Austromyrtus dulcis* (midyim) – shoots and juvenile fruits at Ocean Lake, K',gari

Figure 12 Myrtle rust on juvenile fruits of *Austromyrtus dulcis* (midyim) at Ocean Lake, K'gari

Backhousia myrtifolia

Backhousia myrtifolia was assessed in several locations, both burnt and unburnt, with myrtle rust identified at all but one site (Fig. 13, 14). At a site on Postans Rd, unburnt and fire affected trees were assessed. Twenty-five percent of trees were infected in the unburnt site compared to 56% of trees recovering from fire damage.

Figure 13 *Backhousia myrtifolia* (cinnamon myrtle) on K'gari with myrtle rust on juvenile stems and foliage

Diseased trees (saplings and mature trees) were also identified around the banks of Lake Allum. Several mature trees had significant crown dieback with epicormic reshoots occurring at the tree base. The cause of the dieback is unknown. It was however, in a location where significant dieback of mature hoop pine was evident. Soil samples have been collected to test for *Phytophthora* root rot. Of the trees assessed 42.6% had some level of myrtle rust infection identified with severity levels ranging from low to high.

Figure 14 Symptoms of myrtle rust on *Backhousia myrtifolia* (cinnamon myrtle) on K'gari

Thirty *B. myrtifolia* trees were assessed for myrtle rust near the Central Station camping ground. Twenty percent of trees were found with symptoms ranging from low to moderate severity levels. This same area was assessed back in September 2021, but no disease was identified then.

Table 5 Summary of all Myrtaceae species assessed for *Austropuccinia psidii* infection in fire affected areas on K'gari (Fraser Island)

Species	*Regeneration type*	*Rust identified*	*Infection severity range*
Angophora leiocarpa	R	N	
Acmena smithii	R	N	
Austromyrtus dulcis	R	Y	L-M
Backhousia myrtifolia	R	Y	L-H
Baeckea frutescens	R	N	
Corymbia intermedia	R	N	
Corymbia tesselaris	R	N	
Decaspermum humile	R	Y	L-M
Eucalyptus pilularis	S/R	Y	L-S
Homoranthus virgatus	S	Y	L-M
Leptospermum liversidgei	R	Y	L-M
Leptospermum polygalifolium	R	N	

Leptospermum semibaccatum	R	N	
Leptospermum trinervium	R	Y	L-M
Melaleuca quinquenervia	S/R	Y	L-S
Rhodamnia acuminata	R	Y	L
Syncarpia hillii	S	Y	L-S
Syzygium oleosum	R	Y	L

S=Seedling; R=Reshoot; L=Low, M=Moderate, H=High, S= Severe

Discussion

Myrtle rust, caused by the fungus *Austropuccinia psidii*, has been identified from a range of species and sites on K'gari (Table 5). Detections have been identified on seedlings and reshoots as plant species attempt to recovery from the effects of wildfire. However, impacts are not restricted to disturbed sites, with infection being identified on cinnamon myrtle, *B. myrtifolia*, which is a dominant understory species in some of the wet-sclerophyll forests found on K'gari. The incidence of infection on this species appeared to be at its highest during the final survey in November and may be the result of a return to wetter and more favourable conditions for the rust fungus following years of below average rainfall. That said, data collated as part of these studies did identify higher levels of infection, both incidence and severity, on fire affected *B. myrtifolia* trees than trees in the unburnt sites.

These studies have been the first to identify myrtle rust on *S. hillii* (Satinay) outside of glasshouse studies. The 2020/21 fires resulted in mass seedling germination events, with myrtle rust causing infection of new shoots and leaves causing dieback of seedlings. However, to date the incidence of disease within the populations remains low with <20% of seedlings assessed being impacted. However, it is recommended that continued monitoring is done, particularly with a return to wet weather predicted.

The impact of myrtle rust on *Melaleuca quinquenervia* recovery (seedlings and reshoots) has been documented across fire affected sites in NSW and Queensland including K'gari. Repeated myrtle rust infection has shown to cause dieback of reshoots and in some cases tree death. It has also been shown to prevent flowering. While there is evidence of resistance to myrtle rust within populations of this plant species, the long-term consequences to this species are unknown. The impacts from a cultural perspective are poorly understood but with impacts on tree survival and flowering means that it is likely to be significant. Studies across the fire sites in Queensland and NSW importantly indicated a possible link between fire intensity and myrtle rust impacts. In areas where fire didn't impact on the tree crown, disease levels were comparatively low suggesting that traditional cooler burning could be a useful management tool for this, and other species.

Surveys of midyim berry (*Austromyrtus dulcis*) on K'gari have generally found little or no evidence of impact. While reported previously in other regions, the most recent surveys in November 2021 were the first where rust was identified affecting the fruit of midyim on K'gari. Whether or not this was entirely because of fire and the masses of susceptible regeneration are unknown but worthy of further investigation. Ideally, more detailed assessment of fruiting across many sites would be required to better understand this.

The influence of fire on myrtle rust development and severity has been demonstrated in studies across Queensland and New South Wales. While fire is considered an important selection agent in the development of Australia's native flora, the development of new epicormic and young seedlings en-

masse are ideal for the development and spread of myrtle rust. Juvenile leaf and stem tissues are much more susceptible to the rust than older suberized tissue. The recent fires on K'gari have seen impacts in a range of ecosystems and myrtle rust impacting on a range of species. More work is required to better understand the influence of fire, but the fact that cooler traditional burns reduce the level of epicormic reshooting and mass seedling regeneration is likely to reduce the effects of myrtle rust for some species. However, this will not protect all species from myrtle rust with records of the decline of many species in undisturbed sites. A strategic plan to ensure species conservation and disease management is required.

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