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Fire and Rust – impact of myrtle rust on regeneration of fire damaged Myrtaceae and associated ecosystems

Progress Report (PBSF029)

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Contents

1. Executive Summary

The impact *A. psidii* might have on regeneration following disturbance such as fire has long been considered a risk this pathogen posed prior to arrival in Australia, with detrimental consequences for forest structure and survival of dependent fauna and understory plants. Assessments in Australia since detection have identified significant detrimental impacts due to the fungus, including adverse effects on regeneration following disturbance events. Recent extreme fire events have resulted in significant impacts on a range of different ecosystems, with widespread epicormic and seedling regeneration now occurring or about to commence, creating ideal conditions for spread and impact of rust. This project aims to determine the impact myrtle rust is having on species and ecosystem regeneration. Monitoring plots have been established in Queensland and New South Wales in coastal heath and woodland environments. Plots have been monitored monthly, with species affected by rust recorded along with incidence of disease over time and severity and impact of infection. Assessments been primarily on reshooting tissue, including epicormic regrowth and root suckering but seedling regeneration has been assessed where possible. Disease has been detected on a range of *Eucalyptus*, *Leptospermum* and *Melaleuca* species. *Melaleuca quinquenervia* and *M. nodosa* are two species where regeneration has been significantly affected by myrtle rust.

2. Introduction

While fire is considered an important selection agent in the development of Australia's native flora (Gill 1975), the development of new epicormic and young seedlings en-masse are ideal for the development and spread of *A. psidii*. The impact *A. psidii* might have on regeneration following disturbance such as fire has long been considered a risk this pathogen posed prior to arrival in Australia, due to infections by this fungus occurring exclusively on young tissue. Detrimental consequences for forest structure and survival of dependent fauna and understory plants were expected (Grgurinovic et al. 2006). Assessments in Australia since detection have identified significant impacts, including regeneration following disturbance events (Carnegie & Pegg 2018). Recent extreme fire events have resulted in significant impacts on a range of different ecosystems, with widespread epicormic and seedling regeneration now occurring or about to commence, creating ideal conditions for spread and impact of rust.

3. Aim

This project aims to determine the impact myrtle rust is having on species and ecosystem regeneration.

4. Methods/Process

Sites in New South Wales and Queensland have been selected based on fire intensity mapping (Fig 1) and surveys conducted to assess regenerating reshoots and seedlings of Myrtaceae across these sites.

- In NSW three sites have been selected
    - Yarringully Nature Reserve – Melaleuca woodland – two 50 tree plots and four seedling regeneration plots
        - Species assessed – *Melaleuca quinquenervia*, *M. nodosa*, *Eucalyptus pilularis*
    - Double Duke State Forest – Woodland dominated by *Eucalyptus pilularis* and *Eucalyptus pyrocarpa* – 3 x 50 transect mixed species plots; 3 x 50 tree species plots; 1 seedling regeneration plot
        - Species assessed – *Eucalyptus pilularis*, *Eucalyptus pyrocarpa*, *Melaleuca nodosa*, *Leptospermum trinervium*, *Leptospermum polygalifolium*, *Austromyrtus dulcis*.
    - Bundjalung National Park (Fig 2) – coastal heath, melaleuca wetland and coastal woodland – 3 x 50m transect (Fig 3) mixed species plots; 8 x 50 tree species plots; 4 x seedling regeneration plots
        - Species assessed - *Melaleuca quinquenervia, M. nodosa, M. sieberi, Leptospermum trinervium, L. polygalifolium, L. speciosum, Baeckea frutescens, Eucalyptus pilularis, E. planchoniana, E. tindaliae, Corymbia henryi, C. intermedia*.
- In Queensland sites have been established in Noosa and Cooloola National Park – coastal heath
    - Noosa National Park- Peregian and Emu Swamp, 4 x 50-meter multispecies plots and two transects in unburnt vegetation; 2 x 50 tree species plots and one seedling regeneration plot in coastal heath and coastal woodland
        - Species assessed – *Melaleuca quinquenervia, M. thymifolia*, *M. pachyphylla*, *M. nodosa*, *Leptospermum liversidgei*, *Baeckea frutescens*, *Ochrosperma lineare*, *Homoranthus virgatus* and *Austromyrtus dulcis*
    - Cooloola – 4 x 50 meter mixed species transects and 3 x 50 tree species plots in low. moderate and high fire impact areas – coastal fringing rainforest, coastal heath and coastal woodland
        - Species assessed - *Lophostomon confertus, Corymbia intermedia, Eucalyptus robusta, Acmena smithii, Syzygium oleosum, L. polygalifolium, L. semibaccatum, B. frutescens, L. liversidgei and H. virgatus*

A new assessment form was designed and implemented to assess impact of myrtle rust on post fire regeneration. Data collected included:

- Regeneration type – reshoot/seedling

- Presence/absence of susceptible flush
- Disease incidence on foliage -%
- Disease severity on foliage – Low, moderate, high, extreme
- Disease incidence on juvenile stems - %
- Disease severity on juvenile stems - Low, moderate, high, extreme
- Dieback caused by myrtle rust - %
- Death caused by myrtle rust -%
- Flowering – 0 to 4 scale
- Flower/fruit infection - %

Expansion of these studies has been made possible through additional funding support from NESP, Threatened Species Hub and Saving Our Species NSW. Additional survey sites cover areas in the north from K'gari (Fraser Island), Great Sandy National Park (NP), Gondwana World Heritage areas including Lamington NP and west to Mt Barney NP, Main Range NP, Nightcap NP, Washpool NP and Gibraltar NP as well as coastal areas around Taree NSW. Fire affected areas of southern NSW are also being assessed from the NSW border up to Batemans Bay. Due to COVID 19 restrictions, areas affected by fire in Victoria have not been included.

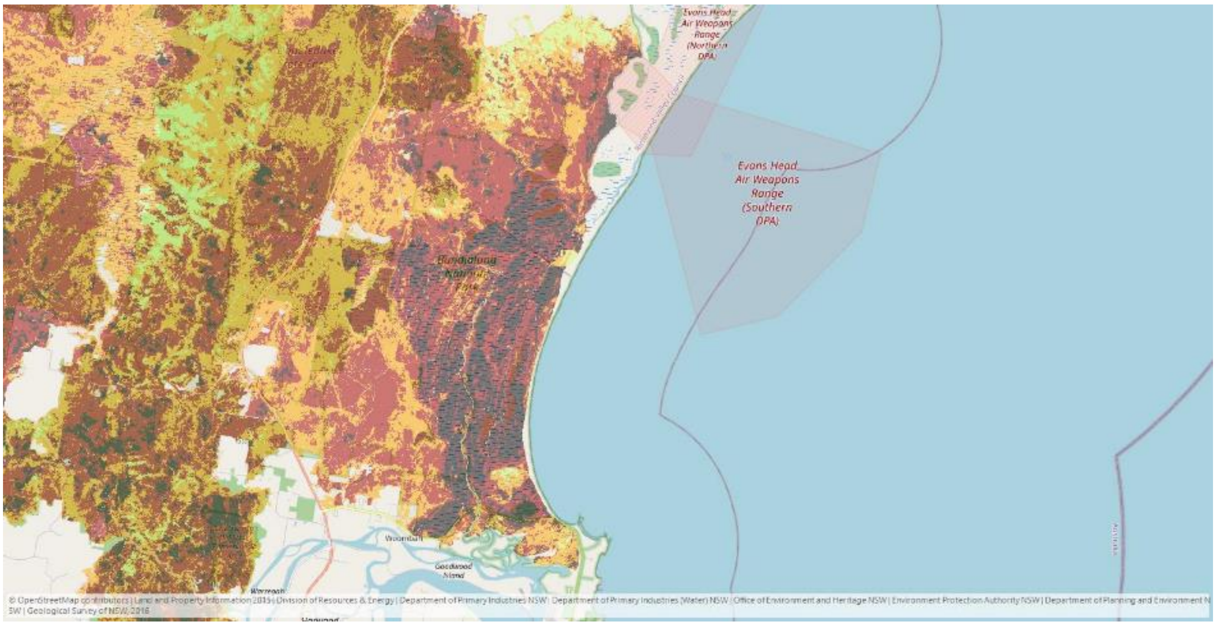

Figure 1 Example of fire maps used to assess relationships between fire intensity and impact of myrtle rust – Bundjalung National Park, New South Wales

Figure 2 Wildfire burnt large areas of coastal heath and woodland in Bundjalung NP with post fire regeneration sparked by rainfall in January 2020

Figure 3 Plots established in Myrtaceae rich environments and single species plots established for selected species

5. Achievements, Impacts and Outcomes

Austropuccinia psidii has been identified from all monitoring plots sites. Species affected has been variable and disease incidence and severity levels have increased over time, peaking in July-August before declining in September-October. This decline is likely due to climatic conditions being less favorable for infection and the phase of regeneration of host species following severe rust impact. Data is still being collected from all study sites.

Impacts have been identified on seedlings and reshoots (epicormics, root suckers). Impacts on different species have varied, with *Melaleuca quinquenervia*, *M. nodosa*, *Leptospermum trinervium*, *Eucalyptus pilularis* and *E. planchoniana* being some of the more susceptible species in coastal heath and woodland areas. Impacts on *Eucalyptus* appear to be declining over time with susceptible seedlings now dead and epicormic reshoots recovering and now showing no or little evidence of new infection. *Eucalyptus tindaliae* was one of the first species identified with rust symptoms post fire but it is now difficult to find rust symptoms (Fig 4). Impacts on *E. planchoniana* and *E. pilularis* have been more significant with both seedling deaths and dieback of reshooting epicormic growth (Fig 5, 6, 7). Interestingly, impacts on reshooting epicormics have generally been limited to the lower and mid canopy, with little to no evidence of infection/damage in the upper canopy. This supports reports from Brazil where it was suggested microclimatic factors influence disease development. Nonetheless, in Australia we have previously observed disease at all canopy heights, including in 80-100-year-old, 20+m tall trees.

Figure 4 *Austropuccinia psidii* symptoms on *Eucalyptus tindaliae* reshoots

Figure 5 *Austropuccinia psidii* impact on *Eucalyptus pilularis* epicormic reshoot

Figure 6 *Austropuccinia psidii* symptoms on new shoots and young foliage of *Eucalyptus pilularis* epicormic reshoots

Figure 7 *Austropuccinia psidii* on *Eucalyptus planchoniana* seedlings

Only low levels of rust have been identified on spotted gum (*Corymbia henryi*). However, in all sites where spotted gum has been assessed both seedlings and epicormic reshoots have been heavily infected and severely damaged by the endemic leaf and shoot pathogen *Quambalaria pitereka* (Fig 8). It is unknown if infection by *Q. pitereka* will prevent *A. psidii* infection and disease development. However, *Q. pitereka*, like *A. psidii*, affects new growth and requires similar climatic conditions for infection and disease development. Austropuccinia psidii has also been reported on a range of other eucalypts but only causing minor damage including *C. intermedia* and *E. amplifolia* subs. *amplifolia* (Fig 9). This is a first record for field infection in Australia.

Figure 8 *Quambalaria pitereka* infection and damage on spotted gum, *Corymbia henryi* and *Corymbia henryi* seedling with *Austropuccinia psidii* infection on the growing tip (top right)

Figure 9 *Austropuccinia psidii* infection on *Eucalyptus amplifolia* subsp. *amplifolia*

Myrtle rust has caused significant levels of decline in populations of reshooting *Melaleuca quinquenervia* and *M. nodosa* (Fig 10, 11, 12, 13). Repeated infection by *A. psidii* has caused severe dieback, and in some cases death, of epicormic shoots. For *M. quinquenervia* this includes young narrow stemmed and older large diameter trees growing in swamp areas and in "monoculture". For the larger trees, it is yet to be determined if infection and decline levels are lower in the upper canopy in comparison to the lower canopy. Regeneration in larger diameter trees post fire was much slower than in narrow stemmed trees, particularly in Bundjalung NP, and impact assessments have only recently commenced. Impacts on flowering of *M. nodosa* have been done but not yet analysed. No flowering has been observed on *M. quinquenervia* yet.

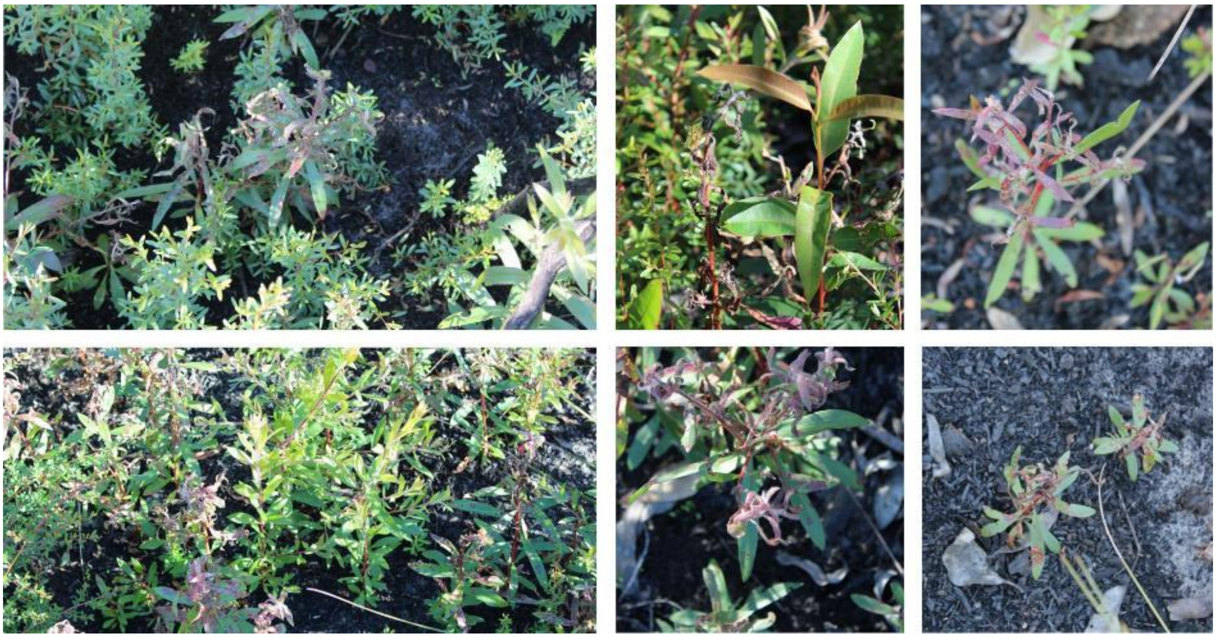

Figure 10 Dieback of *Melaleuca quinquenervia* seedlings caused by *Austropuccinia psidii*

Figure 11 *Melaleuca quinquenervia* reshoot dieback caused by *Austropuccinia psidii*. Mirid damage also adds to the decline of new shoots (Top left)

Figure 12 Rapid decline of *Melaleuca quinquenervia* reshoots caused by *Austropuccinia psidii* – left to right May, June, August 2020


Figure 13 *Austropuccinia psidii* infection on post fire reshoots of *Melaleuca nodosa*

Surveys of other environments have been conducted and will be completed by November 2020. Plot monitoring will continue until 2021.

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