



Office of
Environment & Heritage
NSW National Parks & Wildlife Service



Management plan for myrtle rust on the national parks estate

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Cover photograph: Myrtle rust on juvenile *Rhodamnia rubescens* – Angus Carnegie.

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Introduction

Myrtle rust is a plant disease caused by the exotic fungus *Uredo rangelii*. It was first detected in Australia on 23 April 2010 on the NSW Central Coast. It has established in coastal NSW from the Clyde River north into Queensland (see Figure 1). Myrtle rust is likely to spread rapidly to the extent of its biological range as the spores are dispersed readily by wind. Eradication is unfeasible.

Uredo rangelii belongs to a group of closely-related fungi known as the guava or eucalyptus rust complex. The complex includes the fungus *Puccinia psidii* which has had severe impacts on eucalypt plantations in Brazil and has been found in other parts of the Americas, Hawaii and Japan. *P. psidii* was considered as a potential biocontrol agent in the Florida everglades for the invasive plant *Melaleuca quinquenervia*, but it has since been found to attack some native American species, including a threatened species.

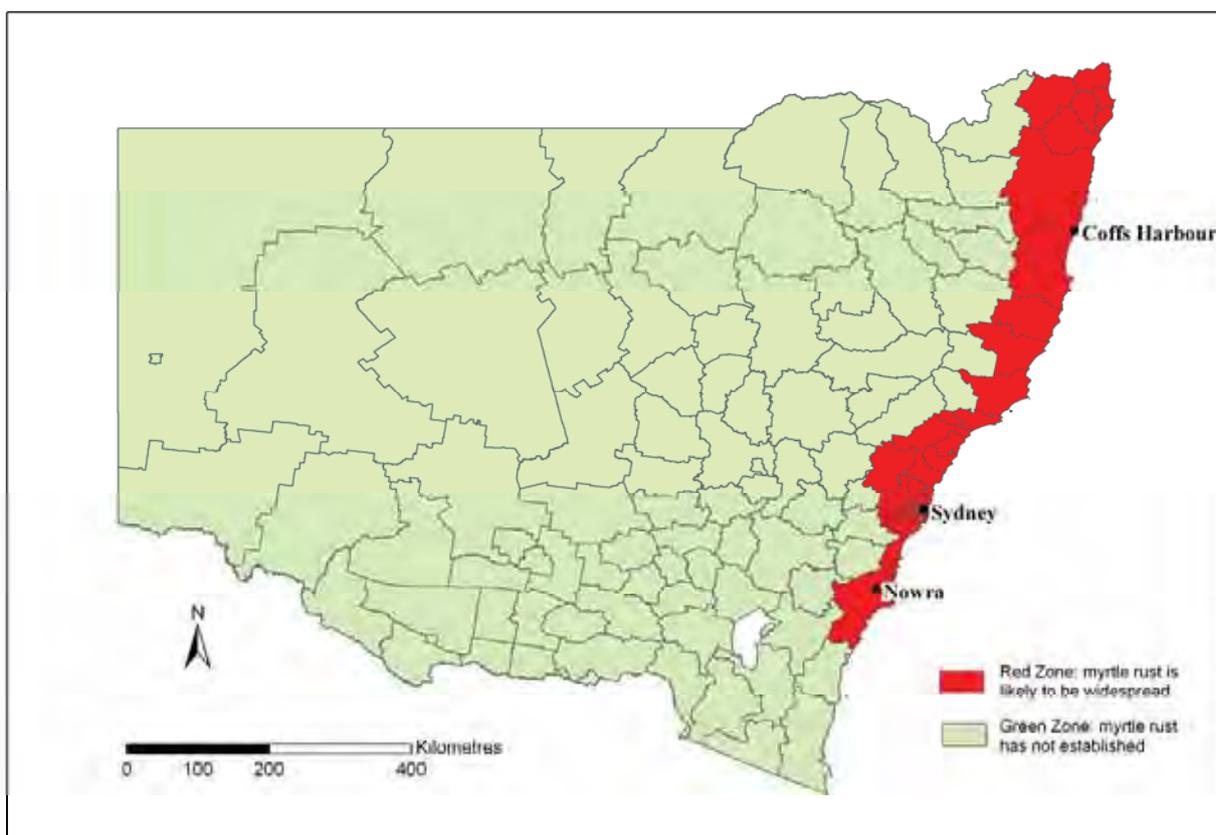


Figure 1: Approximate distribution of myrtle rust *Uredo rangelii* as of 24/01/2011.

The red zone is comprised of local government areas where rust has been detected and is likely to be widespread. The green zone is comprised of local government areas where rust has not established.

Sources: data from NSW Department of Primary Industries (www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust); local government boundaries from the Land and Property Management Authority.

Myrtle rust affects plants in the family Myrtaceae, including the genera Eucalyptus, Angophora, Callistemon, and Melaleuca. Infection occurs on young growing shoots, leaves, flower buds and fruits.

Myrtle rust produces masses of powdery bright yellow or orange-yellow spores on the infected areas (see cover photo). Leaves may become buckled and twisted and die as a result of infection. Images of myrtle rust on a broad range on Myrtaceae can be found at www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/hosts.

The likely impacts of myrtle rust on biodiversity in Australia are unknown. Like *P. psidii*, infection may cause significant mortality among younger plants and hence reduce recruitment into adult populations. This may contribute to the decline and extinction of species, which is of immediate

concern for those species already at high risk, i.e. threatened species. Reduced recruitment may also have severe impacts on the structure and function of the many natural ecosystems that depend on Myrtaceae.

As at 28 March 2011, myrtle rust had been detected in 68 species of Myrtaceae, spanning 27 genera. Severe infection had been observed in relatively few species (most notably scrub turpentine *Rhodamnia rubescens* and native guava *Rhodomyrtus psidoides*) but the number of species so affected may increase as new strains of rust evolve. All five threatened species of Myrtaceae exposed to myrtle rust under laboratory test conditions became infected.

This plan outlines how myrtle rust will be managed on the national park estate in NSW, including the potential impacts of myrtle rust on threatened species. The plan also provides guidance to managers of other bushland and threatened species sites. More information on myrtle rust and guidance for managing myrtle rust in other environments can be found at www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust.

Objectives

The objectives of this plan are to:

1. Slow the establishment of myrtle rust on the national park estate.
2. Minimise the impacts of myrtle rust on threatened species and ecological communities on the national park estate.

Actions

Action 1 Identify high value assets at risk

- Map the distribution of threatened species of Myrtaceae and threatened ecological communities that depend on Myrtaceae
- Identify management priorities

Figure 2 shows a climatic risk map developed for the closely-related rust *P. psidii* (D.J. Kriticos, CSIRO, unpublished data). This map may provide a reliable indication of the biological range of myrtle rust in Australia (research to clarify the relationship between *U. rangellii* and *P. psidii* is discussed in Action 5).

In the absence of better information on impacts, high-value assets at risk include:

- species of Myrtaceae listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) whose distributions overlap significantly with the predicted range of myrtle rust
- ecological communities listed under the TSC Act that depend on Myrtaceae and whose distributions overlap significantly with the predicted range of myrtle rust
- fauna species listed under the Act that depend on Myrtaceae and whose distributions overlap significantly with the predicted range of myrtle rust.

Myrtle rust may also increase the risk of extinction of species and communities not listed currently under the TSC Act.

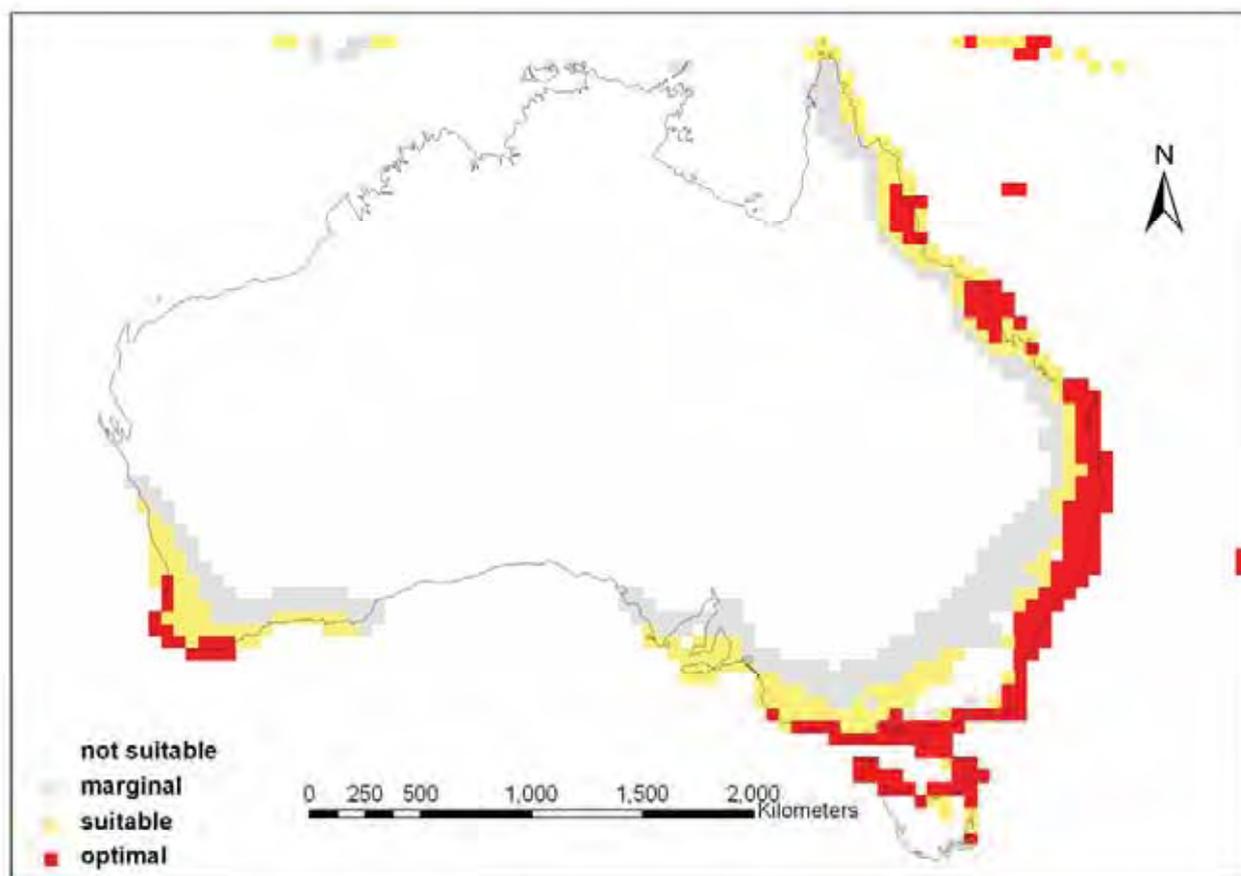


Figure 2: Climatic risk map for *Puccinia psidii* (D.J. Kriticos, CSIRO, unpublished data).

Red depicts optimal conditions (rust likely to persist at all times). Yellow depicts suitable conditions (rust likely to persist in most years). Grey depicts marginal conditions (rust unlikely to persist in most years). The risk areas are likely to be indicative of the biological range of myrtle rust.

As a starting point for mapping assets at risk, records of threatened species of Myrtaceae from the Atlas of NSW Wildlife (including the YETI database) were overlaid on the optimal and suitable zones for the rust (see Appendix 1). Thus, 63 species of threatened Myrtaceae were identified in the optimal zone and an additional 13 species in the suitable zone (see Appendix 2).

Records are likely to provide a poor basis for mapping the distributions of some species however, because of inadequate survey (false absences) and erroneous records (false presences). Moreover, no account has been made of the proximity of known infected sites and of potential vectors of disease (e.g. areas of high human traffic).

Maps for threatened ecological communities that depend on Myrtaceae are not readily available. However, maps for some communities may be drafted by overlaying key attributes that are likely to be indicative of the presence of the community using data from the National Vegetation Mapping System (www.environment.gov.au/erin/nvis/about.html).

National Parks and Wildlife Service (NPWS) staff will identify key sites on park for threatened species of Myrtaceae and threatened ecological communities that depend on Myrtaceae at risk from myrtle rust, informed by the ongoing collation of data on known infected sites (see Action 7). More information on these sites will be provided in a future version of this plan.

Threatened fauna that depend on Myrtaceae and non-listed species are not an immediate priority in this plan.

Options for managing high-value sites include restricting access, applying hygiene protocols, monitoring to detect rust and managing infection (Actions 2–4).

Action 2 Limit the spread of myrtle rust

- **Limit the spread of myrtle rust from infected sites**
- **Limit introduction of myrtle rust to uninfected sites**

The importance of human activity in spreading myrtle rust relative to wind and animal dispersal is unknown. Many detections in NSW to date have been linked to human activity, but this may in part reflect a bias in the search effort under the initial emergency response (i.e. trace forward of plant material from known infected sites). Nevertheless, some significant occurrences of myrtle rust in bushland have been linked to human activity, hence it is possible that human activity may be an important factor in the further spread of myrtle rust in natural environments. This risk should be managed.

NPWS managers will assess the risk that activities occurring in parks may spread the rust from infected sites or introduce the rust to uninfected sites, and will restrict access and apply hygiene protocols accordingly. This may require the partitioning of reserves into management zones or sites depending on:

- the spatial pattern of the land
- areas known to be infected
- roads and other potential disease vectors
- high value environmental assets at risk (e.g. threatened species)
- the cost-effectiveness of application.

Activities to be considered will include those of staff, contractors, utilities, other external stakeholders and the general public. Access restrictions and hygiene protocols will be most effective if managers liaise across tenure to achieve a common regional approach.

Low, medium and high level hygiene protocols for national parks are provided in Appendix 3. Effective application of the hygiene protocols will require training (see Action 6).

Infected sites

Medium-level hygiene protocols may be applied to activities involving disturbance of native vegetation at known infected sites. Even in areas of high visitation, decontamination after working at infected sites may prevent staff and contractors from spreading myrtle rust to uninfected reserves in the region.

Uninfected sites

Table 1 provides guidance on applying access restrictions and hygiene protocols to activities at uninfected sites, depending on the risk and consequence of introduction.

Activities that pose a high risk of introducing myrtle rust are those that involve disturbance of vegetation such as:

- clearing, slashing and weeding
- importing organic material such as mulch and tube stock
- off-track fauna and flora surveys.

Sites where the consequences of introducing myrtle rust may be high include sites that are critical to the regional survival of threatened Myrtaceae or threatened ecological communities that depend on Myrtaceae, and that are remote from high human activity and known infected sites.

Sites where the consequences of introducing myrtle rust may be medium include other threatened species sites and other bushland remote from high human activity and known infected sites.

Other factors which need to be considered in managing the risk of introducing myrtle rust include:

Controllable factors:

- whether access can be restricted
- whether appropriate hygiene protocols can be implemented
- the ability to limit the number of sites visited per day for controlled operations

Uncontrollable but predictable factors relating to propagule pressure and probability of establishment:

- whether plants susceptible to myrtle rust are present and their degree of susceptibility
- whether there is new growth present or imminent due to the season or fire regimes – such growth includes infrequent recruitment events for cohort-recruiting species or communities
- the proximity of known infected sites, including the connectivity of rust habitat and the incoming spore load
- whether neighbours will cooperate and thus reduce the likelihood of importing infected plants
- the site's proximity to the edge of the predicted biological range of rust.

Uncontrollable and less predictable factors:

- unauthorised or uncontrolled access by humans
- movement of animals
- the likelihood of long-distance wind dispersal.

Table 1. Risk and response assessment for activities that may introduce myrtle rust to uninfected sites in national parks

Hygiene protocols are provided in Appendix 3.

		Consequence of introduction		
		High	Medium	Low
Risk of introduction	High	Restrict access. All non-essential activity prohibited. Apply high-level hygiene protocol to essential activities.	Permit access. Apply medium-level hygiene protocol.	Permit access. Apply low-level hygiene protocol where possible.
	Low	Restrict access. All non-essential activity prohibited. Apply high-level hygiene protocol to essential activities.	Permit access. Apply low-level hygiene protocol where possible.	Permit access. Apply low-level hygiene protocol where possible.

Action 3 Monitor the spread of myrtle rust

- **Monitor high-value sites to detect and respond to myrtle rust**
- **Monitor sentinel sites (sites dispersed through the reserve system with populations of highly-susceptible species) to help map the extent of myrtle rust**

Critical sites for threatened species and ecological communities must be monitored to detect and respond to myrtle rust. Search effort does not have to be standardised (e.g. the same amount of time per area), but it should be sufficient to provide a reasonable chance of detecting myrtle rust. Search effort should not only focus on the target species, but include any known susceptible hosts (e.g. *Rhodamnia rubescens*) in the immediate vicinity. A myrtle rust survey form is provided in Appendix 4.

Monitoring will also be undertaken at sentinel sites dispersed throughout the predicted distribution of myrtle rust, as per Figure 2. Sites should target populations of highly-susceptible host species (e.g. *R. rubescens* and *R. psidioides*). Site selection may also target areas recently burnt by hazard reduction or wildfire or areas affected by other recent disturbance as the rust is identified more easily on new growth. Together with incidental records, monitoring sentinel sites will help map changes in the distribution of myrtle rust in national parks to inform management.

NPWS regions will monitor critical threatened species and sentinel sites in national parks. The number of sites to be monitored will be determined by available resources, but at least 5–10 sites per region should be selected. Each site should take 45–60 minutes to survey, depending on the density of plants. Monitoring should occur in spring and summer.

As an interim arrangement, photographs of suspected infection may be sent to the NSW Department of Primary Industries, Forest Health Research, for confirmation via angus.carnegie@industry.nsw.gov.au. Follow up samples may be required. Data will be stored as per Action 7.

Action 4 Manage infections

- **Prioritise treatment of infected sites**
- **Explore treatment options**
- **Develop standard operating procedures**

Not all infected sites should be treated. Rather, treatment should target the following areas:

- critical sites for threatened species and ecological communities
- sites where infection may promote further spread
- sites with high visitor numbers
- iconic sites.

Treatment should be attempted only where it is likely to be cost-effective. The cost-effectiveness of treatment will depend in part on the age and scale of the infection, the accessibility of the site and the likelihood of rapid reinfection from adjacent areas.

More work is needed to identify cost-effective and target-specific control options and operational procedures in bushland. Current treatment options include the application of fungicides and the destruction and removal of infected plants. Other options, such as chemical agents that induce systemic acquired resistance in Myrtaceae, may be explored in the future.

Application of fungicides and other chemical treatments

The current emergency use permit for a range of fungicides to control myrtle rust can be viewed at <http://permits.apvma.gov.au/PER12319.PDF>. The permit covers the use of the following fungicides: Amistar 250 SC fungicide and other registered products containing 250 g/L azoxystrobin as its only active constituent, Amistar WG fungicide and other registered products containing 500 g/kg azoxystrobin as its only active constituent, Bayfidan 250 EC fungicide and

other registered products containing 250 g/L triadimenol as its only active constituent, Saprool fungicide and other registered products containing 190 g/L triforine as its only active constituent and Tilt 250 EC systemic fungicide and other registered products containing 250 g/L propiconazole as its only active constituent.

The labels provide information on the suitability of the fungicide for the application. The approved fungicides vary in their mode of action, being either contact, translaminar or systemic (see AVPMA permit). Contact fungicides are not taken up into the plant tissue and only protect the plant where the spray is deposited; translaminar fungicides redistribute the fungicide from the upper, sprayed leaf surface to the lower, unsprayed surface; and systemic fungicides are taken up and redistributed through the xylem vessels to the upper parts of the plant so new leaf growth is protected for a short period. These factors may influence the selection of which fungicide to use.

Risks

- Most of the fungicides' material safety data sheets (MSDS) indicate contamination of waterways should be avoided, with the fungicides being either harmful or toxic to fish and aquatic invertebrates. For Bayfidan, the MSDS indicates 'harmful to aquatic organisms and may cause long term adverse effects in the aquatic environment. DO NOT contaminate streams, rivers or waterways with the product or used containers.'
- Fungicide applied in bushland areas at the headwaters of creeks and rivers could travel through other lands and into other waterways.
- Some of the fungicides listed in the permit pose a level of risk to human health so labels and MSDS should be consulted to advise the level of protection required.

Risk mitigation

- Only operators who are approved and certified in the use and handling of chemicals are permitted to apply fungicides.
- Fungicides MUST NOT be applied within 10 metres of any stream or dam. Application within 30 metres should be undertaken with extreme care and only through using targeted spraying with minimum fungicide usage.
- Infected plants occurring within 10 metres of watercourses must be removed by hand and translocated to beyond 10 metres of any watercourse before any fungicide may be applied.
- Chemical application cannot occur without appropriate safeguards against spillage when decanting, carrying or applying fungicide.

A sample job safety analysis for myrtle rust tagging and spraying is provided in Appendix 5.

Destruction and removal

Infected plants can be killed by an appropriate herbicide using the cut and paint method and moved to areas on the site to be buried.

Risks

- There is a high risk of transmission of disease during transfer, particularly during windy weather and if plants are being transported through uninfected sites.
- Ground disturbance may be significant if the volume of material is large and erosion may occur.

Risk mitigation

- Minimise the equipment used and the distance of transfer.
- Undertake operations during calm weather.
- Ensure adequate time for herbicide to take effect before plants are buried.
- Estimate the volume of material to be buried, then assess suitable burial sites and determine if access for machinery is suitable and the erosion risk has been considered.
- Ensure thorough decontamination of machinery when leaving the site.

Treatment of infected sites in parks will be done by NPWS regional staff. Treated sites will be monitored to record the persistence of the fungus and the response of treated plants (see Action 5). A sample conservation risk assessment for myrtle rust control is provided in Appendix 6.

The NSW Department of Primary Industries is leading a national research project to obtain efficacy data for various chemical agents to improve management. NPWS will assist as required. This may include trials in bushland. Note that a product that can be used by industries such as commercial nurseries may be inappropriate for application in bushland, including on threatened species sites.

The NPWS Pest Management Unit will develop standard operating procedures for spot treatment in national parks. The procedures will be informed by post-treatment monitoring.

Action 5 Research the impacts of myrtle rust

- **Long-term monitoring to determine impacts and management effectiveness**
- **Host range testing**
- **Taxonomy of fungus**

NPWS will monitor a selection of treated and other infected sites to assess the impacts of myrtle rust on plant health, survival and reproduction, and to measure the efficacy of various mechanical and chemical treatment options in reducing these impacts. Methods including the Myrtaceae species to be targeted, plant variables to be measured, experimental design and sampling design will be developed by the NPWS Pest Management Unit in consultation with regional staff, other staff in the Office of Environment and Heritage (OEH), and staff in the NSW Department of Primary Industries and CSIRO.

The NSW Department of Primary Industries will lead further work on a wide range of Myrtaceae species to explore the potential host range and impacts of myrtle rust. Work will focus on key commercial and environmentally significant species such as threatened species. Testing will be at a species level, but may include testing for variation within species. Testing will be conducted under controlled conditions in NSW, with a selection of key species tested under field conditions at an acceptable site. The NPWS Pest Management Unit will liaise with the NSW Department of Primary Industries regarding priorities for testing threatened species.

Subject to the availability of additional resources, the Royal Botanic Gardens will collaborate with other researchers to undertake morphological and molecular analyses of herbarium specimens, local and overseas collections and reference DNA extracts to examine the relationship between *U. rangellii*, *P. psidii* and other operative taxa. Clarification of this relationship will have significant consequences for Australia's international quarantine measures against eucalyptus rust (*P. psidii*). Further, the work will determine whether the sexual state of *U. rangellii* results in sexual recombination, which may in turn lead to an increase in the number of host species over time. The work will contribute to the development of molecular tests to complement morphological identification to distinguish taxa within the *P. psidii* complex. This will aid rapid screening and early distinction of any new incursions of rusts that affect Myrtaceae. The work may also provide evidence on the number of separate introduction(s) of *U. rangellii* to Australia.

Action 6 Training, extension and external communication

- **Inform and train staff and other relevant groups**
- **Develop best practice for external customers**
- **Tell the world what is happening**

A training course has been developed by the Australian Network for Plant Conservation (ANPC) to improve identification of, reporting on, and hygiene practices for myrtle rust. The course is designed for field staff of land management agencies (NPWS, Forests NSW, Land and Property Management Authority and local councils), professional and volunteer bush regenerators, utility contractors and other relevant groups. NPWS staff involved in the response to myrtle rust should consider attending this course. Opportunities to extend the course to address options for the treatment of infection may be explored with the ANPC. Further details are available at www.anbg.gov.au/anpc/courses/Myrtle%20Rust%20June%202011/Myrtle%20Rust%20Courses.html.

Best practice guidelines for risk assessment, hygiene practice, monitoring, reporting and treatment of infection in parks will be developed. The guidelines will be developed in consultation with the NSW Department of Primary Industries and extend on the information that is already available (see [www.dpi.nsw.gov.au/ data/assets/pdf file/0008/362096/preventing-spread-Myrtle-Rust-bushland.pdf](http://www.dpi.nsw.gov.au/data/assets/pdf_file/0008/362096/preventing-spread-Myrtle-Rust-bushland.pdf)).

NPWS community relations officers will communicate with their local stakeholders and regional advisory committees regarding myrtle rust. Other external communication will be via the internet.

Action 7 Record the incidence of myrtle rust

- **Store monitoring data (presence/absence at sites) in the Wildlife Atlas**
- **Import existing data (presence) from BioSIRT**

A template will be created in the Biological Survey Subsystem of the Atlas of NSW Wildlife to record the presence or absence of myrtle rust from monitoring threatened species and sentinel sites. A draft template for field use is given in Appendix 4. Data to be recorded include the date, geographical location and, if present, the host species on which the rust has been detected. Incidental observations of myrtle rust will also be recorded in the Atlas. The species code F044 for *Uredo rangelii* will be used to record data.

Data on the occurrence of myrtle rust and on interventions to date have been captured in BioSIRT (www.daff.gov.au/animal-plant-health/emergency/biosirt). BioSIRT is a surveillance, incident, response and tracing software application developed to improve emergency response to animal or plant diseases across Australia. Options for data exchange with BioSIRT will be explored. In particular, information on the date, geographical location and host species of myrtle rust detections thus far will be imported into the Wildlife Atlas if possible. Access to this data may be restricted.

Action 8 Liaise and report on the spread and impacts of myrtle rust

- **Liaison, data collation and reporting by NPWS**

This plan was prepared by a myrtle rust steering committee chaired by the Executive Director of Park Management (Bob Conroy), with representatives from Environment Protection and Regulation Group (Shane Ruming and Greg Steenbeeke), the Royal Botanic Gardens (Bob Makinson, Ed Liew, and Peter Wilson), NPWS field branches (Doug Beckers and Simon Hemer) and NPWS Pest Management Unit (Paul Mahon).

The Pest Management Unit will update this plan as required. The pest management unit will liaise with the NSW Department of Primary Industries, collate data and report as required.

Sally Barnes

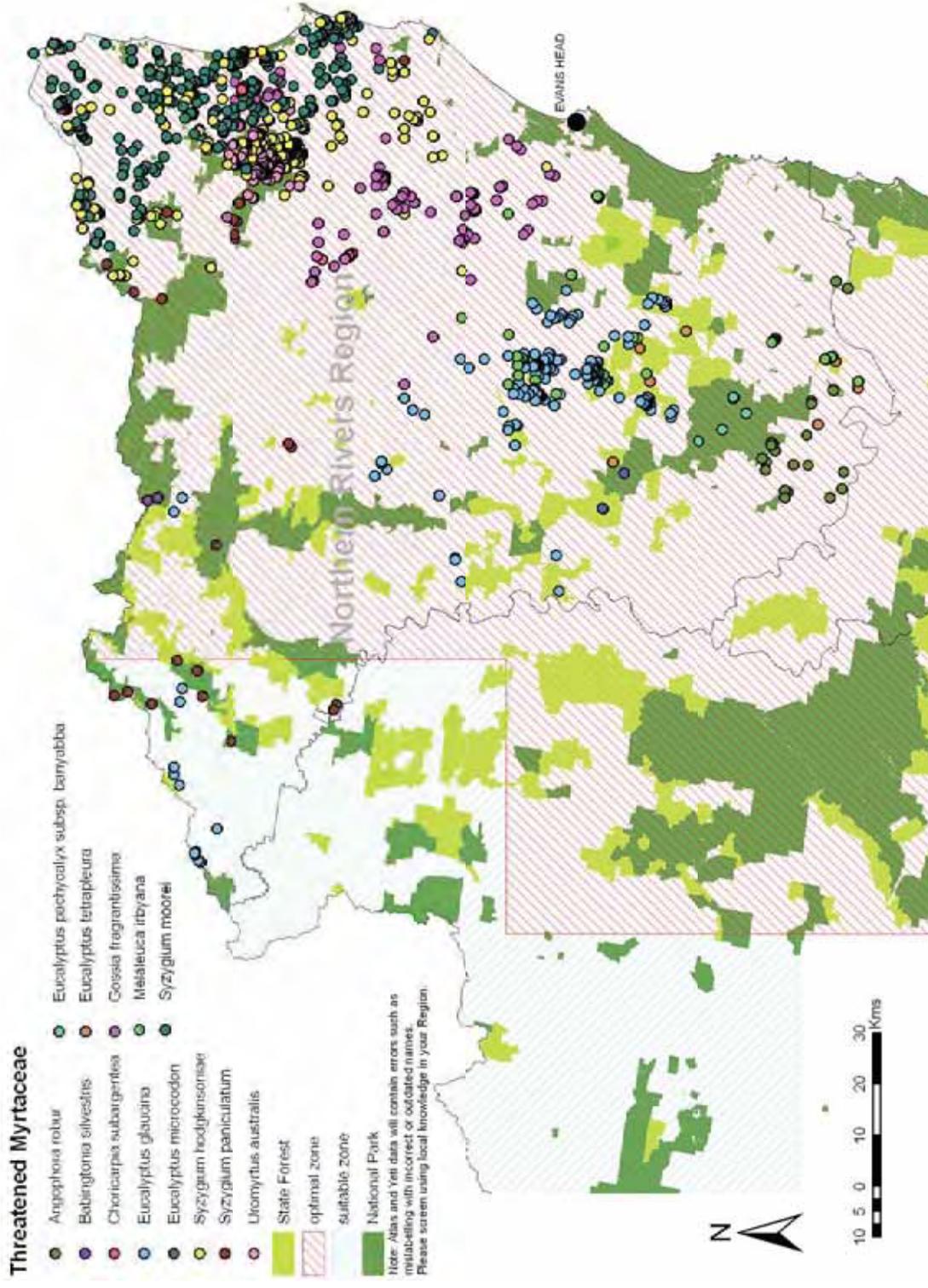
Head, National Parks and Wildlife Service

Deputy Chief Executive, Office of Environment and Heritage

Department of Premier and Cabinet

Appendices

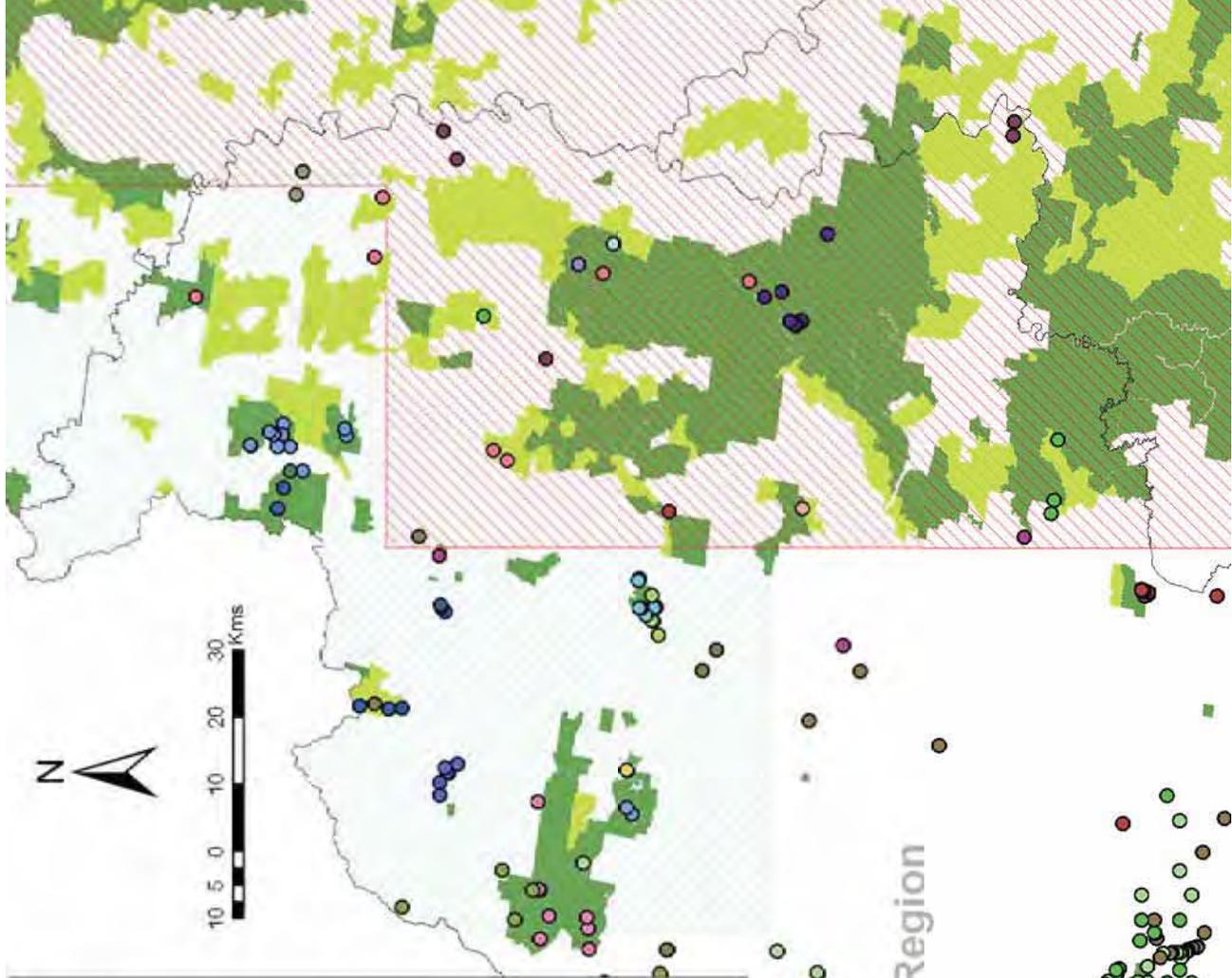
Appendix 1 Records of threatened species of Myrtaceae in optimal and suitable climatic areas for *Puccinia psidii*. Data from the Atlas of NSW Wildlife (including the YETI database).

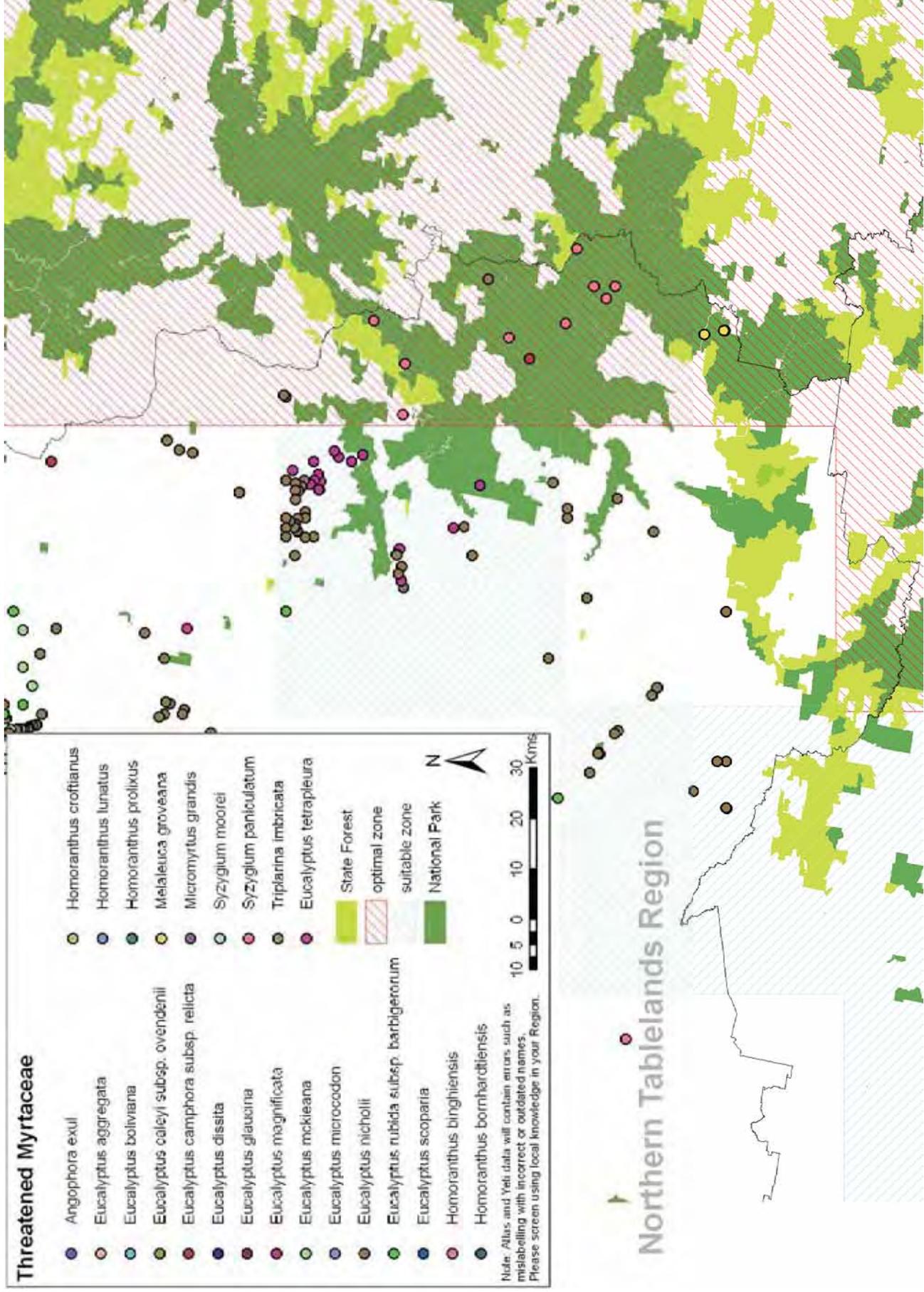


Threatened Myrtaceae

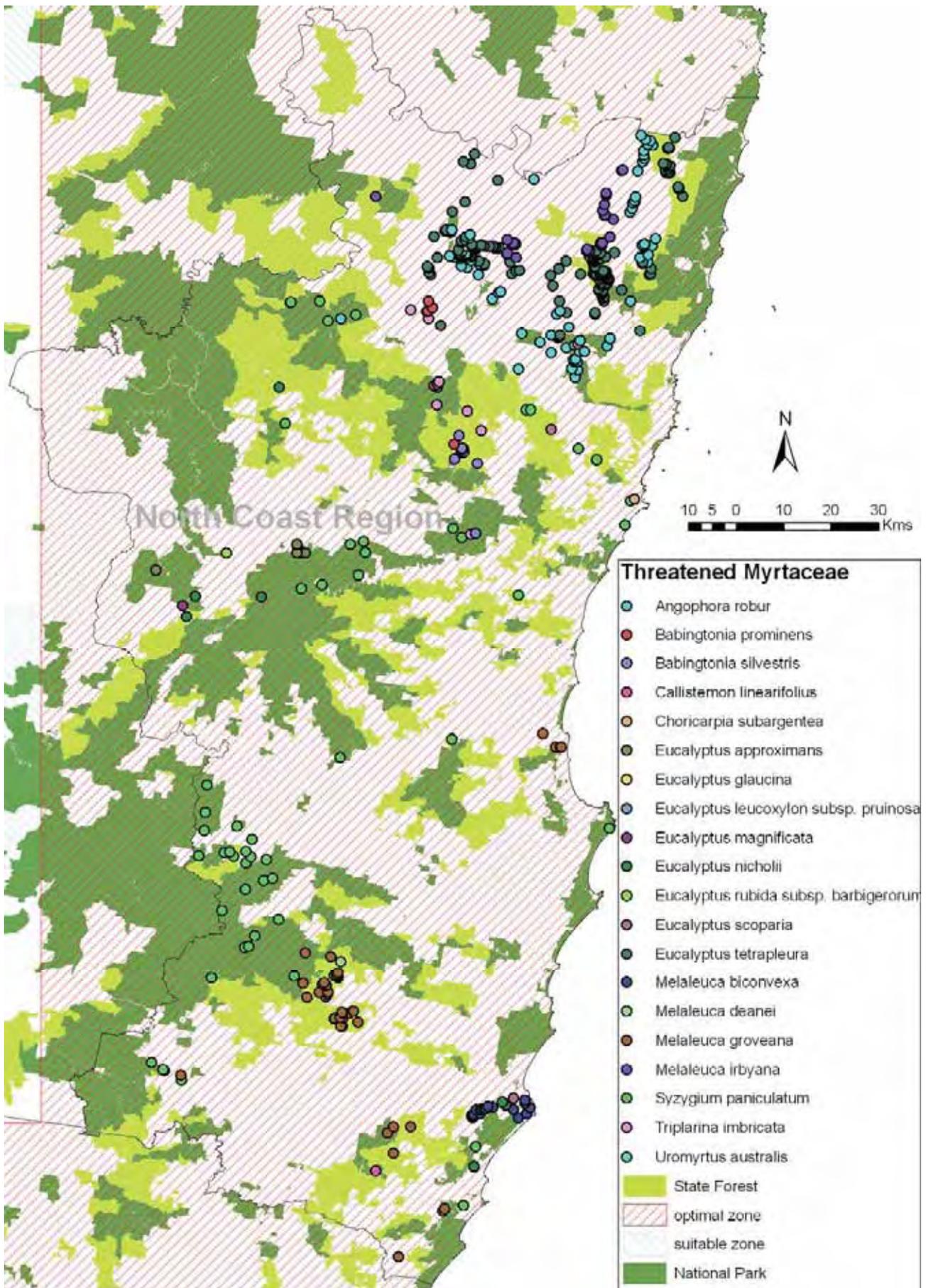
● <i>Angophora exul</i>	● <i>Homoranthus croftianus</i>
● <i>Eucalyptus aggregata</i>	● <i>Homoranthus lunatus</i>
● <i>Eucalyptus boliviana</i>	● <i>Homoranthus prolixus</i>
● <i>Eucalyptus caleyi</i> subsp. <i>ovendenii</i>	● <i>Melaleuca groveana</i>
● <i>Eucalyptus camphora</i> subsp. <i>relicta</i>	● <i>Micromyrtus grandis</i>
● <i>Eucalyptus dissita</i>	● <i>Syzygium moorei</i>
● <i>Eucalyptus glauca</i>	● <i>Syzygium paniculatum</i>
● <i>Eucalyptus magnificata</i>	● <i>Triplarina imbricata</i>
● <i>Eucalyptus mckieana</i>	● <i>Eucalyptus tetrapleura</i>
● <i>Eucalyptus microcodon</i>	■ State Forest
● <i>Eucalyptus nicholii</i>	■ optimal zone
● <i>Eucalyptus rubida</i> subsp. <i>barbigerorum</i>	■ suitable zone
● <i>Eucalyptus scoparia</i>	■ National Park
● <i>Homoranthus binghiensis</i>	
● <i>Homoranthus bornhardtensis</i>	

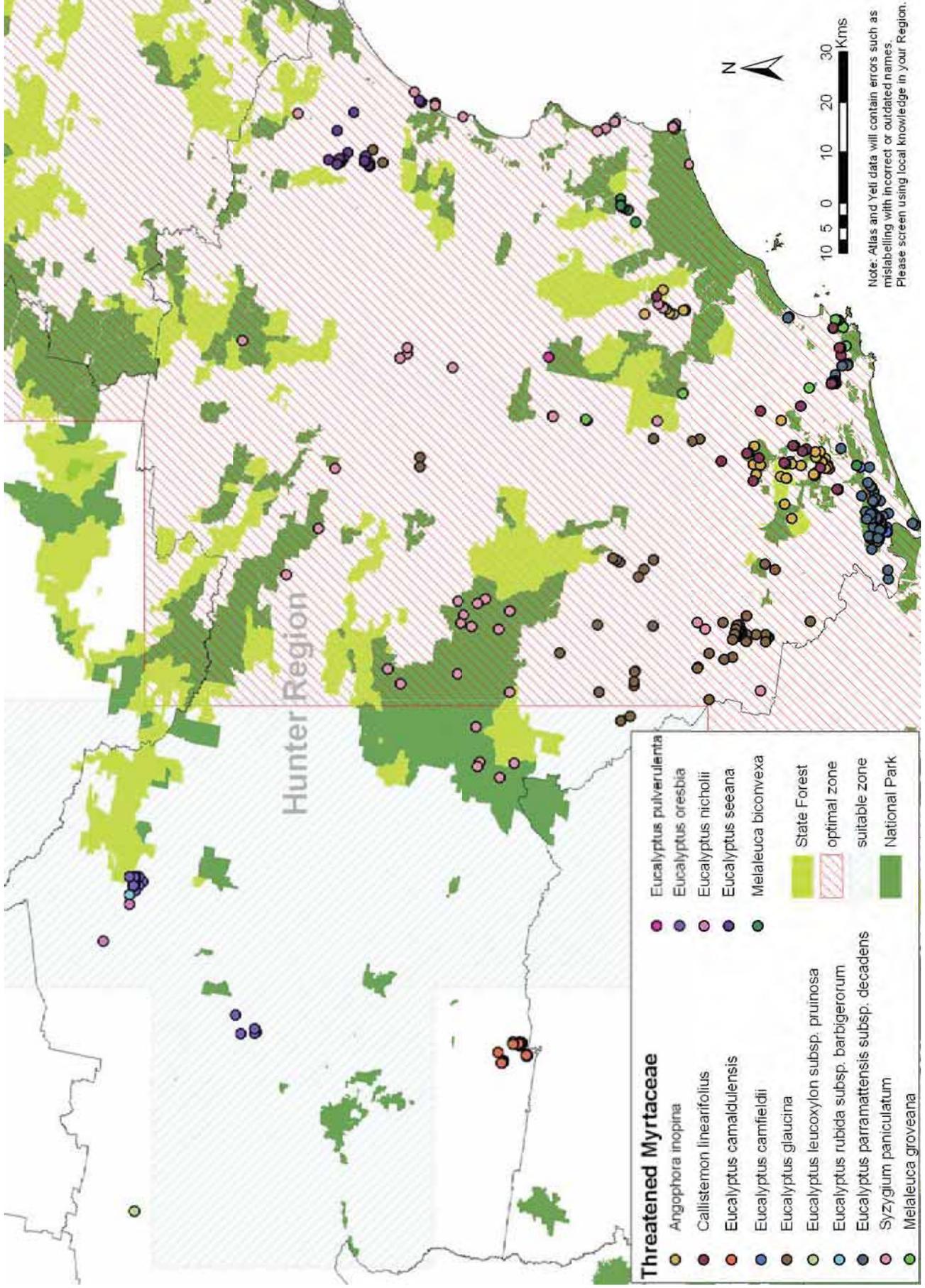
Note: Atlas and Yelt data will contain errors such as misspelling with incorrect or outdated names. Please screen using local knowledge in your Region.



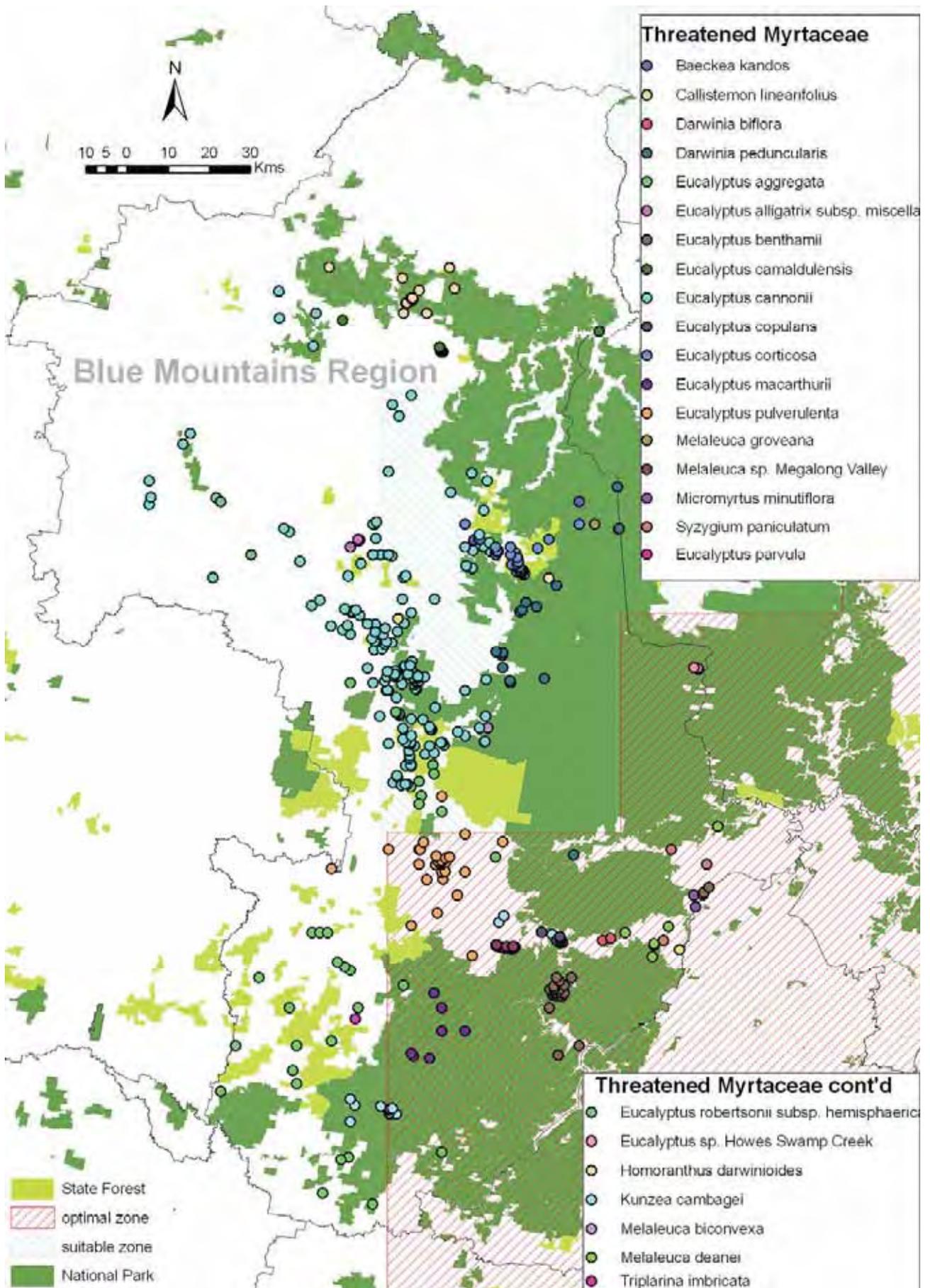


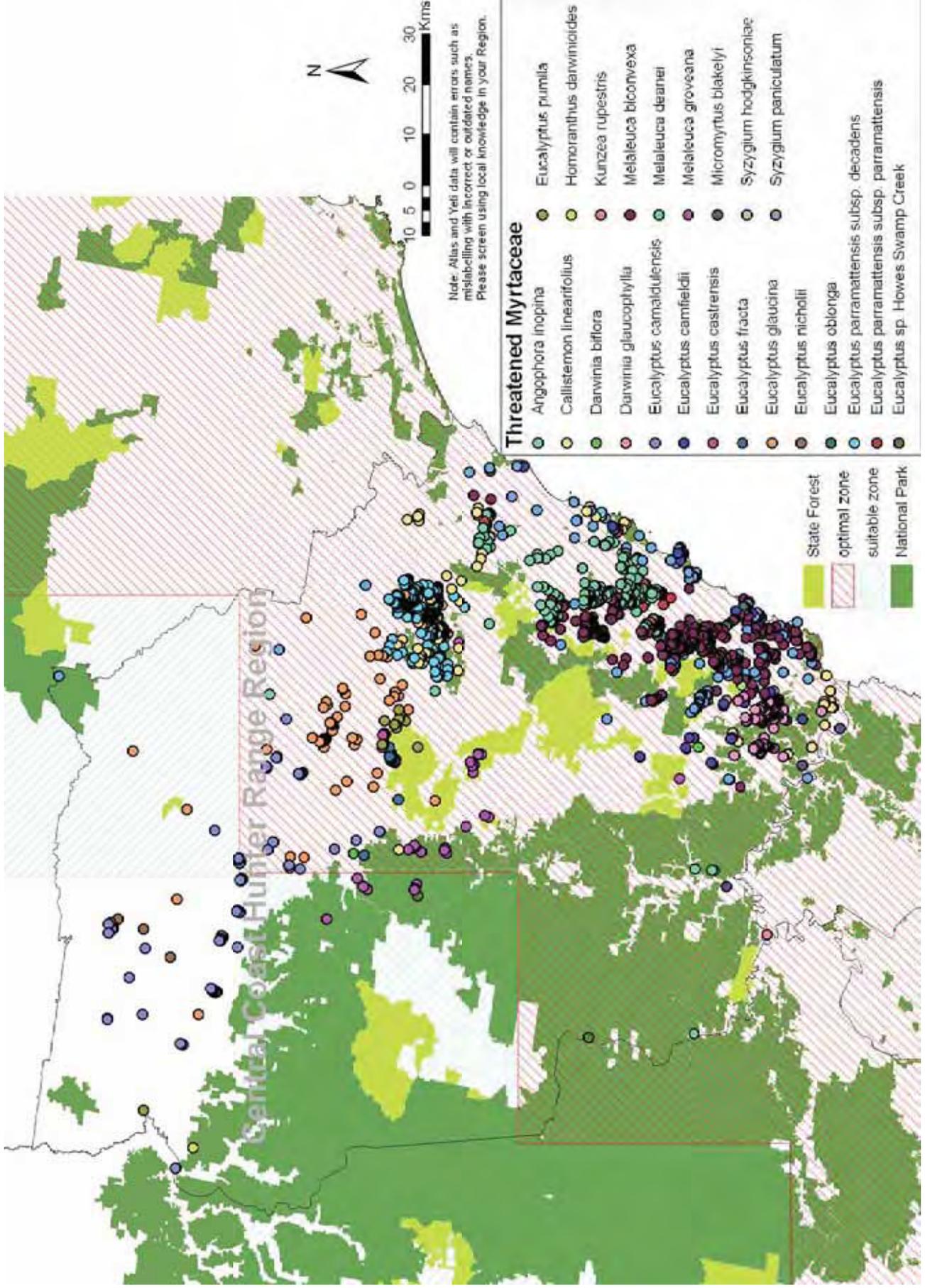
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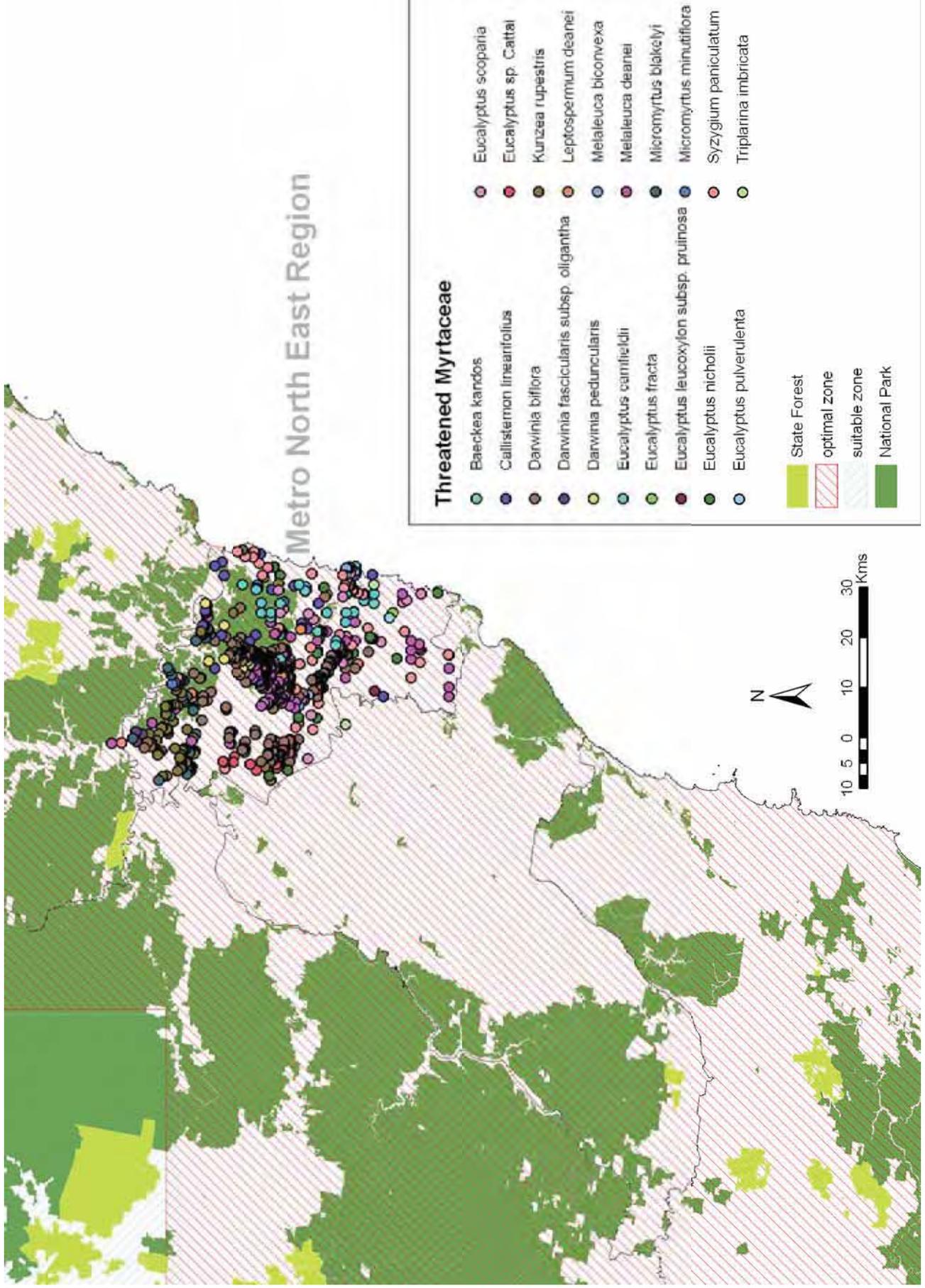


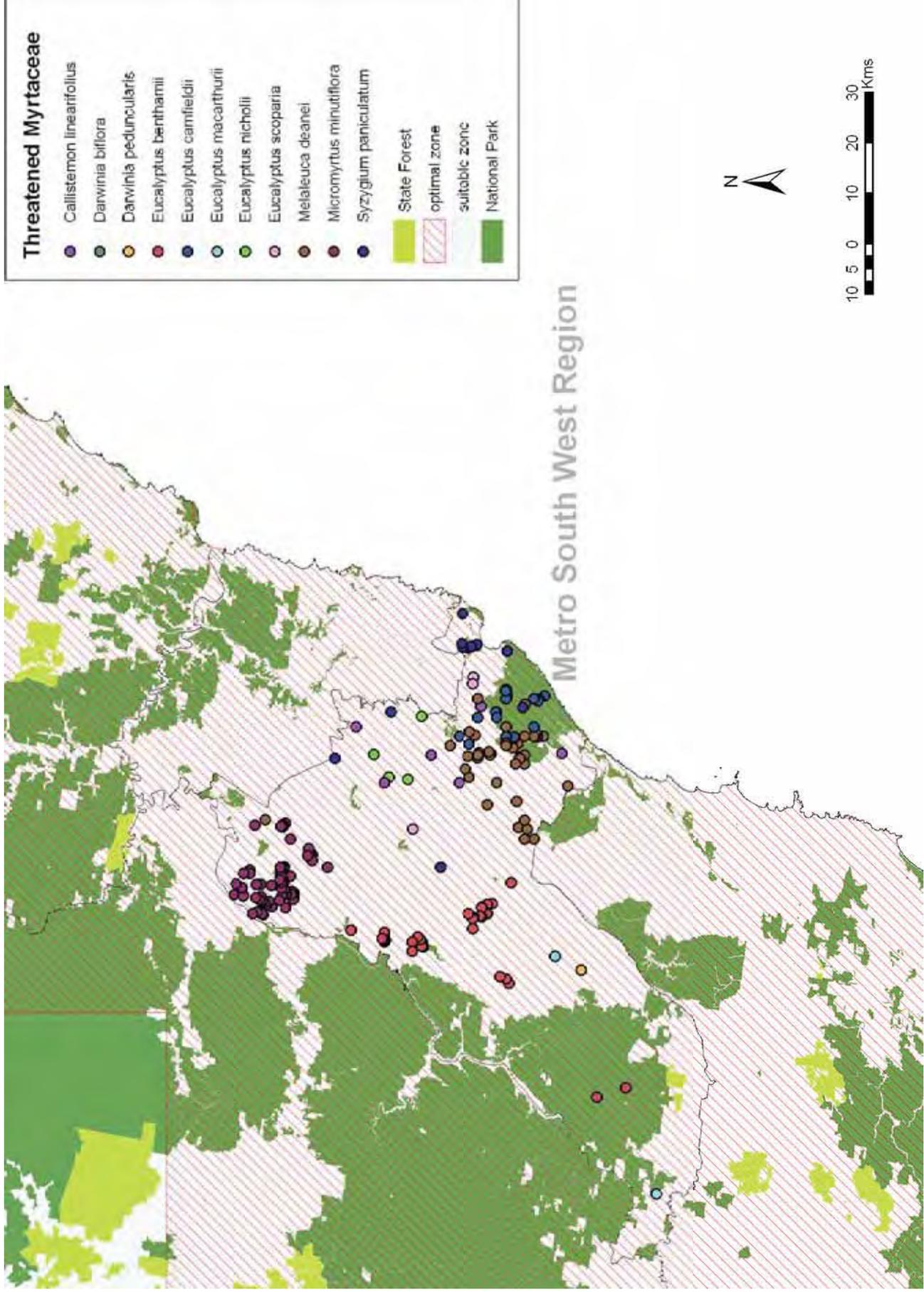
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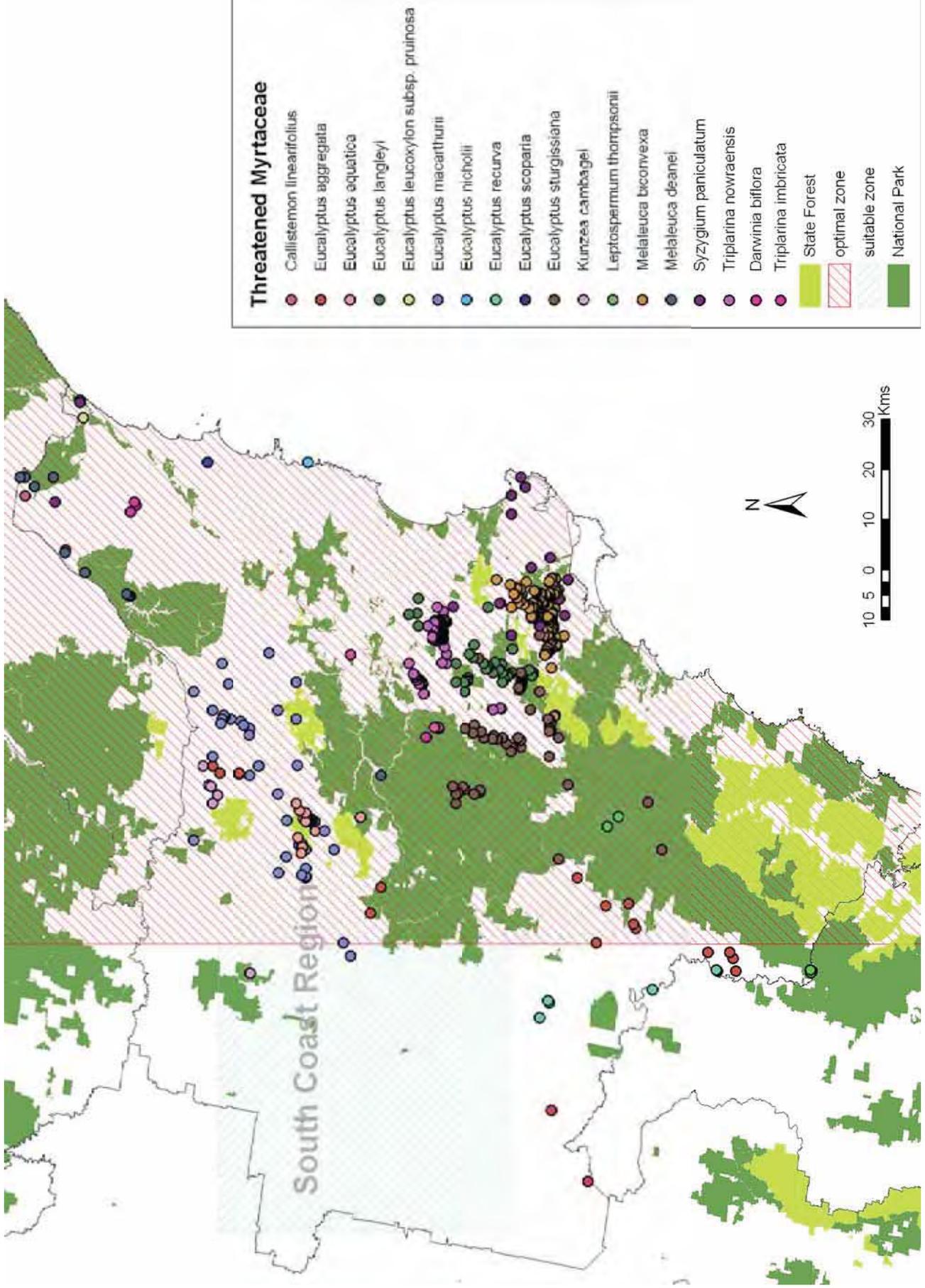


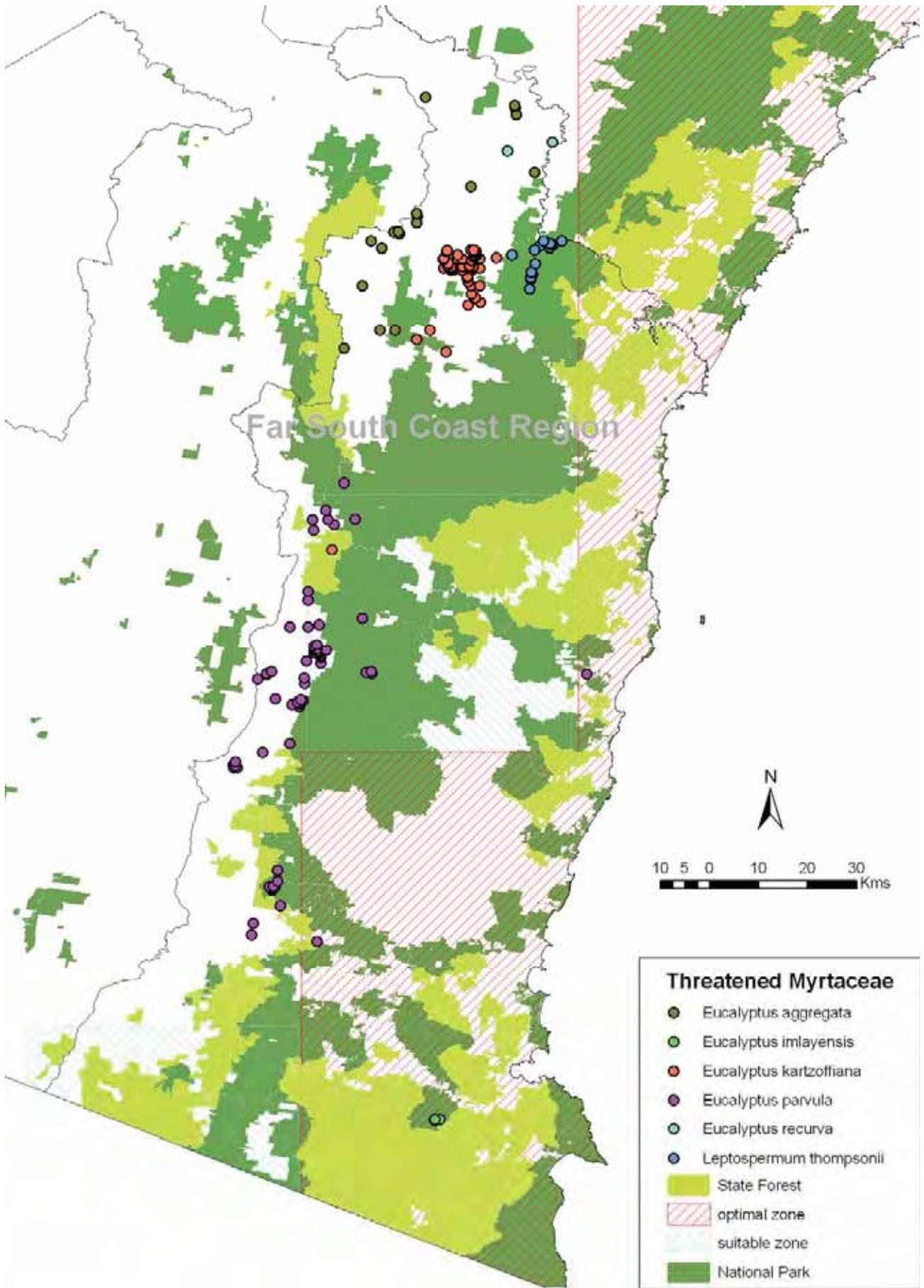


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Appendix 2 Threatened species of Myrtaceae potentially affected by the rust *Puccinia psidii*

Species with records in the optimal zone:

Scientific name	Common name
<i>Angophora inopina</i>	Charmhaven apple
<i>Angophora robur</i>	Sandstone rough-barked apple
<i>Babingtonia prominens</i>	Nymboida babingtonia
<i>Babingtonia silvestris</i>	Woodland babingtonia
<i>Baeckea Kandos</i>	
<i>Callistemon linearifolius</i>	Netted bottle brush
<i>Choricarpia subargentea</i>	Giant ironwood
<i>Darwinia biflora</i>	
<i>Darwinia fascicularis</i> subsp. <i>oligantha</i>	Darwinia fascicularis subsp. oligantha population in the Baulkham Hills and Hornsby local government areas
<i>Darwinia glaucophylla</i>	
<i>Darwinia peduncularis</i>	
<i>Eucalyptus aggregata</i>	Black gum
<i>Eucalyptus approximans</i>	Barren mountain mallee
<i>Eucalyptus aquatica</i>	Broad-leaved Sally
<i>Eucalyptus benthamii</i>	Camden white gum
<i>Eucalyptus camaldulensis</i>	Eucalyptus camaldulensis population in the Hunter catchment
<i>Eucalyptus camfieldii</i>	Heart-leaved stringybark
<i>Eucalyptus camphora</i> subsp. <i>relicta</i>	Warra broad-leaved Sally
<i>Eucalyptus castrensis</i>	Singleton mallee
<i>Eucalyptus copulans</i>	
<i>Eucalyptus dissita</i>	Gibraltar mallee
<i>Eucalyptus fracta</i>	Broken back ironbark
<i>Eucalyptus glaucina</i>	Slaty red gum
<i>Eucalyptus imlayensis</i>	Imlay mallee
<i>Eucalyptus langleyi</i>	Albatross mallee
<i>Eucalyptus langleyi</i>	Eucalyptus langleyi L.A.S. Johnson and Blaxell north of the Shoalhaven River in the Shoalhaven local government area
<i>Eucalyptus leucoxydon</i> subsp. <i>pruinosa</i>	Boland yellow gum

<i>Eucalyptus macarthurii</i>	Camden woollybutt
<i>Eucalyptus magnificata</i>	Northern blue box
<i>Eucalyptus microcodon</i>	Border mallee
<i>Eucalyptus nicholii</i>	Narrow-leaved black peppermint
<i>Eucalyptus oblonga</i>	<i>Eucalyptus oblonga</i> population at Bateau Bay in the Wyong local government area
<i>Eucalyptus pachycalyx</i> subsp. <i>banyabba</i>	Banyabba shiny-barked gum
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	<i>Eucalyptus parramattensis</i> C. Hall. subsp. <i>parramattensis</i> in Wyong and Lake Macquarie local government areas
<i>Eucalyptus parvula</i>	Small-leaved gum
<i>Eucalyptus pulverulenta</i>	Silver-leafed gum
<i>Eucalyptus pumila</i>	Pokolbin mallee
<i>Eucalyptus rubida</i> subsp. <i>barbigerorum</i>	Blackbutt candlebark
<i>Eucalyptus scoparia</i>	Wallangarra white gum
<i>Eucalyptus seeana</i>	<i>Eucalyptus seeana</i> population in the Greater Taree local government area
<i>Eucalyptus</i> sp. <i>Cattai</i>	
<i>Eucalyptus</i> sp. <i>Howes Swamp Creek</i>	
<i>Eucalyptus sturgissiana</i>	Ettrema mallee
<i>Eucalyptus tetrapleura</i>	Square-fruited ironbark
<i>Gossia fragrantissima</i>	Sweet myrtle
<i>Kunzea cambagei</i>	Cabbage kunzea
<i>Kunzea rupestris</i>	
<i>Leptospermum deanei</i>	
<i>Leptospermum thompsonii</i>	Monga tea tree
<i>Melaleuca biconvexa</i>	Biconvex paperbark
<i>Melaleuca deanei</i>	Deane's paperbark
<i>Melaleuca groveana</i>	Grove's paperbark
<i>Melaleuca irbyana</i>	Weeping paperbark
<i>Melaleuca</i> sp. <i>Megalong Valley</i>	Megalong Valley bottlebrush
<i>Micromyrtus blakelyi</i>	
<i>Micromyrtus minutiflora</i>	

<i>Syzygium hodgkinsoniae</i>	Red lilly pilly
<i>Syzygium moorei</i>	Durobby
<i>Syzygium paniculatum</i>	Magenta lilly pilly
<i>Triplarina imbricata</i>	Creek triplarina
<i>Triplarina nowraensis</i>	Nowra heath myrtle
<i>Uromyrtus australis</i>	Peach myrtle
<i>Angophora exul</i>	Gibraltar rock apple
<i>Eucalyptus boliviana</i>	Bolivia stringybark
<i>Eucalyptus caleyi subsp. ovendenii</i>	Ovenden's ironbark
<i>Eucalyptus cannonii</i>	Capertee stringybark
<i>Eucalyptus corticosa</i>	Creswick apple box
<i>Eucalyptus kartzoffiana</i>	Araluen gum
<i>Eucalyptus mckieana</i>	
<i>Eucalyptus oresbia</i>	Small-fruited mountain gum
<i>Homoranthus binghiensis</i>	Binghi homoranthus
<i>Homoranthus croftianus</i>	Bolivia homoranthus
<i>Homoranthus darwinioides</i>	
<i>Homoranthus lunatus</i>	Crescent-leaved homoranthus
<i>Homoranthus prolixus</i>	Granite homoranthus

Appendix 3 Hygiene protocols

Low-level (general) protocol

For use in all bushland in myrtle rust risk areas

- Clean vehicles weekly with high pressure spray and antifungal disinfectant (e.g. 5% Farmcleanse), including undersides and wheel arches.
- Decontaminate inside vehicles weekly (e.g. with 70% methylated spirits) concentrating on seats, steering wheel and floors.
- Commence each day with clean clothes.
- Decontaminate boots and hat each day (e.g. with 70% methylated spirits).

Medium-level protocol

For use at non-critical sites for threatened Myrtaceae and ecological communities that depend on Myrtaceae

For use in other bushland remote from high human activity and known infected sites

For use at known infected sites

Before/after field work

- Low-level (general) protocol applies.

At site entry and/or exit

Nominate decontamination point, usually at the front gate.

Vehicle and equipment decontamination

- Spray exterior of vehicle (e.g. with 70% methylated spirits) paying attention to undersides, wheel arches and chassis.
- Remove any vegetation and dirt where practical from the undersides of the vehicle.
- Spray inside the vehicle (e.g. with 70% methylated spirits) concentrating on seats, steering wheel and floors. Alcohol wipes can be used for inside vehicles.
- Spray equipment (e.g. with 70% methylated spirits). Alcohol wipes can be used on hand tools.

Personal decontamination

- Spray from head to toe (e.g. with 70% methylated spirits) including hats and boots.
- Use alcohol wipes for hands and personal effects like sunglasses, phones and GPS.
- Clean dirt from the soles of boots.

Organic material

- Leave all organic material (e.g. weeds, mulched vegetation, soil) from known infected sites on site.
- Limit travel between multiple sites in a day.
- Repeat personal and vehicle decontamination when entering or leaving each site.

High-level protocol – full personal and vehicle decontamination procedure

For use at critical sites for threatened Myrtaceae, and ecological communities that depend on Myrtaceae that are remote from high human activity and from known infection.

Before/after field work

- Low-level (general) protocol applies.
- Ensure personnel are adequately trained in the use of the equipment including personal protective equipment (PPE), e.g. trained in the fitting and removal of PPE.

At site entry and/or exit

- Nominate a decontamination point that is situated away from the location of threatened species or other high-value assets.
- Define a 'quarantine' line – this is the line that separates 'clean' from 'dirty'. Use a mark to indicate a line on the ground if appropriate. Lay down a ground sheet if necessary.
- Transfer any excess clothing and all unnecessary items from pockets to the vehicle.
- Make up disinfectant in accordance with instructions as required – both tub and sprayer.
- Fill bucket with water and soap, and place a towel nearby.
- Take all equipment and personal items to go on-site to the line now, NOT later; only take what is needed and do not go back and forth over the line.
- Dip or spray all the items to go on-site in disinfectant.
- Put on PPE appropriate to the task and in accordance with the task risk assessment and procedure. Put PPE on in the following order: clean shirts, shorts, socks and gloves (unless hands are washed at the end and then put on gloves), overalls, footwear, respiratory protection, eyewear, overall hood.
- Note: a snood for beards must be worn only if a P2 mask is not required. P2 masks, half and full face respirators are not suitable for personnel with beards.
- Enter the site. Once on-site, all items needed on the site should be reachable from the site side of the line, including the first aid kit.

Appendix 4 Myrtle rust survey – field data form

Survey name	Myrtle rust	Site name	5 to 8 characters. Keep consistent if re-surveying		Site no.	
Date		Name(s) of survey recorder(s)				
AMG grid reference	Zone 54 55 56 57	Datum AGD or GDA	Easting/longitude Six characters long or DMS		Northing/latitude Seven characters long or DMS	Source of location GPS, GIS, Google
Accuracy of location	e.g. 10 m, 10 0m, 1000 m				Survey area size	e.g. 1ha
Location description	e.g. Western side of day-use picnic ground in Orara Nature Reserve.					
<p>Myrtaceae species seen at the location – this family includes plants in the genera <i>Acmena</i>, <i>Angophora</i>, <i>Austromyrtus</i>, <i>Babingtonia</i>, <i>Backhousia</i>, <i>Callistemon</i>, <i>Calytrix</i>, <i>Choricarpa</i>, <i>Corymbia</i>, <i>Decaspermum</i>, <i>Eucalyptus</i>, <i>Eugenia</i>, <i>Gossia</i>, <i>Homoranthus</i>, <i>Kunzea</i>, <i>Lenwebbia</i>, <i>Leptospermum</i>, <i>Lophostemon</i>, <i>Melaleuca</i>, <i>Pilidiostigma</i>, <i>Rhodamnia</i>, <i>Rhodomyrtus</i>, <i>Syncarpia</i>, <i>Syzygium</i>, <i>Tristania</i>, <i>Tristaniopsis</i>, <i>Uromyrtus</i> and <i>Waterhousea</i>.</p> <p>Use a different row for any change – e.g. if seedlings are infected but adults are not.</p>						
Species (or common name and reference if scientific name not known)			Abundance of species at location¹	Maturity of plant(s)²	Infected? (yes or no)	Extent of infection³
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Indicate abundance, maturity and extent by using the appropriate number in each column:

¹ **Abundance categories:** 1 = rare, 2 = infrequent, 3 = occasional, 4 = common, 5 = abundant, 6 = the only Myrtaceae species present.

² **Plant maturity categories:** 1 = seedling, 2 = sapling, 3 = resprout (e.g. after fire or damage), 4 = early mature, 5 = mature, 6 = senescent, 7 = near deceased, 8 = deceased.

³ **Extent categories:** 1 = very small (e.g. a few leaves), 2 = single branch, 3 = several branches, 4 = majority of crown, 5 = whole crown. **Qualify** by inserting 'localised' or 'extensive' for each occurrence.

Appendix 5 Sample job safety analysis

NPWS Job Safety Analysis					
					
Area/unit/location: Gosford Area – Wambina Nature Reserve	Project/job name/no: Wambina Myrtle Rust	Manager: Jenni Farrell			
Work activity/task: Myrtle rust tagging and spraying operation	Staff consulted: Name(s)	Signature(s)			
Date to commence: 12.11.10	Date of JSA: 11.11.10	Date			
Prepared by: R. Ali	Deb Holloman				
Signature:	Alan Henderson				
Item	Job step Break the job down into steps.	Potential hazard What can harm you?	Risk rating	Controls What you are going to do to make the job as safe as reasonably practicable?	Person who will ensure this happens
1.	Working outdoors	UV radiation Dehydration and fatigue under high temperatures	L	Check weather forecast. Wear washable hat, disposable overalls and pants. Apply sunscreen. Ensure adequate water is available on vehicles and at staging areas. Team leaders to monitor fatigue and dehydration of team members and rest as required	Individuals and sector supervisors
2.	Working in bushland away from vehicle	Falls, tree falls, cuts from wait-a-whilest vine, bites, stings, ticks, leeches, snakes, and disorientation as a result of dehydration	H	Everyone must be aware of the location of the first aid kit in vehicles. Carry mobile phones as reception is good at all points in the reserve. There are many leeches in the reserve so take preventative measures such as insect repellent and salt. Maintain constant communication. Work in pairs/teams. Take time and seek assistance if descending/climbing unstable ground.	Individuals and sector supervisors

	3.	Operating in difficult terrain	Falls on unstable scree slopes, wet, mossy rocks and slippery leaf litter.	M	Ensure there are snake bandages in the first aid kit. Everyone should wear appropriate footwear with ankle support, be careful and take their time when traversing difficult ground. Do not work on-site in extremely wet weather. Backpackers must work in pairs.	Individuals and sector supervisors
	4.	Working in a myrtle rust infected area	Spreading myrtle rust to uninfected areas in and out of the reserve	H	All staff entering and leaving the site must practice strict personal and vehicle decontamination as per NSW DPI SOP (see attached protocols) All operational staff will attend a full DPI decontamination brief at Narara LCC. Decontamination supervisors will ensure a clean-in clean-out process for all staff entering the site. All operation vehicles to remain on-site behind the dirty line until the operation has been completed as declared by IC.	Individuals and sector supervisors
	5.	Spraying operations	Fungicide personal health effects Fungicide entering watercourses	M	Brief participants in safety and MSDS instructions Wear PPE as directed in safety brief and MSDS instructions Ensure water and first aid are available at both decontamination and staging areas. Do not spray within 20 m of a water course Do not spray in rainy conditions	Individuals and sector supervisors

Reviewed

by: _____
Job Supervisor/Project Manager

Signature

_____ / _____ / _____
Date

Risk rating: H = high, M = medium, L = low

Appendix 6 Conservation risk assessment for myrtle rust eradication at Wambina Nature Reserve

EXAMPLE ONLY. Control methods used here may not be the most effective or the most current.

Description

The fungal disease myrtle rust has been found on the NSW Central Coast. Gosford and Wyong local government areas (LGAs) have been declared a [quarantine area](#), meaning the movement of susceptible plants and related material out of the area is restricted. Myrtle rust is a significant threat to native bushland and has been preliminarily listed as a key threatening process under the *Threatened Species Conservation Act 1995*.

Justification

The NSW Department of Primary Industries have issued a Section 14 notice under the *Pest and Diseases Act 1924* on Wambina Nature Reserve directing OEH to undertake specific measures to prevent the spread of myrtle rust. The notice instructs OEH to treat the disease, restrict movement of infected plants and the disease, report any suspect material and allow access to authorised persons.

An off-label permit (APVMA PER 12516) has been obtained authorising the use of certain fungicides to treat the disease. Some of these fungicides are hazardous to aquatic organisms and their use near streams and watercourses should be avoided.

Site description

The rust has been detected at Wambina Nature Reserve within Gosford LGA and over 1,000 scrub turpentine (*Rhodamnia rubescens* – family Myrtaceae) plants have been infected at several locations within the reserve.

Wambina Nature Reserve is located at Matcham on the Central Coast of NSW, approximately 10 kilometres east-north-east of Gosford. Wambina Nature Reserve was gazetted on 21 May 1997 and protects 53.65 hectares of land at the headwaters of Erina Creek.

The reserve has been closed to public access, a surveillance and monitoring strategy has commenced and an eradication program is being planned.

This environmental assessment considers the affect of the various control options on the natural environment of Wambina Nature Reserve and surrounds.

Natural values

The vegetation communities of Wambina Nature Reserve include warm temperate rainforest with subtropical elements; and open forests of blackbutt *Eucalyptus pilularis*, spotted gum *Corymbia maculata* and Sydney blue gum *Eucalyptus saligna*. Two species of conservation significance in the plant family Myrtaceae occur at the reserve: the giant watergum *Syzygium francisii* occurs at its southern limit and the bottlebrush *Callistemon shiressii* is considered to be rare. Other species of *Syzygium* and *Callistemon* are susceptible to myrtle rust infection.

Another ten plant species in Wambina Nature Reserve are of special conservation significance. Native ginger *Alpinia arundelliana* occurs in the gullies of the reserve and is at the southern limits of its distribution and the Christmas orchid *Calanthe triplicata* is a restricted species. Although fairly widespread, *Tetrastigma nitens* only exists in isolated patches of subtropical, dry and littoral rainforest with a southern limit near Gosford. Other species such as blackbutt *E. pilularis*, spotted gum *C. maculata* and the small-leaved fig *Ficus obliqua*, provide important seasonal food resources for the fauna of the area.

One hundred and sixty nine animal species have been recorded in the reserve comprising 110 bird, 35 mammal, 13 reptile and 11 amphibian species. Twelve species are listed as vulnerable (Schedule 2) under the *Threatened Species Conservation Act 1995*, including seven species of mammal. The most abundant mammal, the vulnerable grey-headed flying-fox *Pteropus poliocephalus* is generally present in the reserve from October to June. The other species are the little bent-wing bat *Miniopterus australis*, common bent-wing bat *M. schreibersii*, yellow-bellied glider *Petaurus australis*, squirrel glider *P. norfolkensis*, greater broad-nosed bat *Scoteanax rueppellii* and platypus *Ornithorhynchus anatinus* which has been noted in the lower sections of Erina Creek below the reserve boundary.

Five bird species listed as vulnerable (Schedule 2) under the *Threatened Species Conservation Act 1995* have been recorded within the reserve, three of which are nocturnal. These comprise the barking owl *Ninox connivens*, powerful owl *Ninox strenua* and sooty owl *Tyto tenebricosa*, which depend on Myrtaceae species for breeding and food. The vulnerable little lorikeets *Glossopsitta pusilla* and varied sittella *Daphoenositta chrysoptera* also occur in the reserve.

The reserve has a rich frog fauna. Eight species have been recorded which depend on the small streams of the headwaters of Erina Creek.

Methods for the application of fungicide

The following activities are proposed to help control of myrtle rust:

- detection and mapping of infected plants via ground surveillance, and marking of infected plants with fluorescent tape
- spraying of infected plants with fungicides listed in the APVMA Permit
- cutting and translocation of infected plants
- burning of material cut from infected plants
- sterilisation of material cut from infected plants by enclosing in black plastic
- burial of infected material.

Risk assessment

Detection and mapping of infected plants

Mapping the distribution and extent of infected plants in the reserve is critical for assessing the degree of control effort required, and the effectiveness of any control effort.

Risks

Further spread of the disease is likely without adequate controls and protocols for surveillance. A main factor for transmission of the disease has been identified as the clothing and tools of workers in reserves. Risk to the two species of Myrtaceae of conservation significance, giant watergum *Syzygium francisii* and the bottlebrush *Callistemon shiressii* should receive special attention.

Risk mitigation

Strict hygiene protocols have been developed in conjunction with the NSW Department of Primary Industries to minimise the likelihood of further transmission within the reserve, into the reserve from outside and to areas outside the reserve.

The locations of *Syzygium francisii* and *Callistemon shiressii* should be identified and optimum hygiene protocols applied in these areas.

Spraying of infected plants

The APVMA Permit has approved the following fungicides for the treatment of myrtle rust : Bayfidan, AMISTAR® (Azoxystrobin), TRIFORINE, TILT® (Propiconazole), Mancozeb, Plantvax® (Oxycarboxin) and copper oxychloride.

Risks

Most of the fungicides' MSDS (Material Safety Data Sheets) indicate that contamination of waterways should be avoided with the fungicides being either harmful or toxic to fish. For Bayfidan,

the MSDS indicates 'Harmful to aquatic organisms and may cause long term adverse effects in the aquatic environment. DO NOT contaminate streams, rivers or waterways with the product or used containers.'

Wambina Nature Reserve is on the headwaters of Erina Creek, which travels through many private properties and eventually into Brisbane Water.

Risk mitigation

- Only operators approved and certified in the use and handling of chemicals shall be permitted to apply any fungicides.
- Application near watercourses will be avoided, with NO application of any fungicides to occur within 10 meters of any stream or dam. Application within 30 meters should be undertaken with extreme care and only targeted spraying with minimum fungicide usage.
- Infected plants occurring within 10 meters of watercourses will be removed by hand and translocated to beyond 10 meters of any watercourse before any fungicide may be applied.
- Chemical application cannot occur without appropriate safeguards against spillage when decanting, carrying or applying fungicide.

Cutting and translocation of infected plants

Infected plants will be sprayed then cut and translocated to areas within the reserve where they will be destroyed.

Risks

Transmission of disease during transfer, particularly during windy weather.

Risk mitigation

- Minimise the distance of transfer and undertake operations during calm weather.
- Ensure adequate time for fungicide to take effect before plants are either burnt, wrapped in plastic or buried.

Burning of infected plants

Cut infected plants could be collected into small piles to facilitate burning with 'flame throwers'.

Risks

Operator injury, escaping fire, spore transmission within smoke and ash.

Risk mitigation

- Ensure adequate time for fungicide to take effect before plants are cut and burnt.
- Only appropriately trained operators will use equipment.
- Burning operations must be accompanied by a NPWS fire crews with CAT 9.
- Piles must be as small as possible to facilitate rapid combustion of infected material.
- Small 'test burns' will be undertaken to ensure the technique is feasible in the field.

Sterilisation of material cut from infected plants by enclosing in black plastic

Cut infected plants could be collected and enclosed in black plastic, placed in the sun and if the heat generated from the plastic is over 70 degrees C, it will kill the spores.

Risks

Large amount of contact with potentially infected material is possible.

Inadequate sealing of plastic could result in incomplete spore death.

Plastic could be disturbed by unauthorised visitors and animals.

Plastic will eventually have to be removed off-site for disposal.

Risk mitigation

- Ensure adequate time for fungicide to take effect before plants are wrapped.
- Minimise contact with infected material.
- Thoroughly wrap and seal plant material.
- Inspect plastic daily for disturbance.
- Plastic will be taken off-site using proper hygiene protocols.

Burial of infected material

Cut infected plants could be collected and buried in discreet areas within the reserve.

Risks

Ground disturbance may be too great due to the volume of material to warrant burial, and erosion risks may develop.

Risk mitigation

- Estimate the volume of material to be buried.
- Assess suitable burial sites and determine if access for machinery is suitable and the erosion risk has been considered.
- Thoroughly decontaminate machinery before entering and when leaving the reserve.

Monitoring

The Section 14 order remains in place until the reserve has been declared free of myrtle rust for a 12-week period, then it will be declared 'resolved'.

Post spraying, fortnightly inspections will be carried out to determine further control measures, which will include spraying, cutting, bagging or burning up to four times.

In conjunction with DPI, long-term monitoring/control plots may be established.

Conclusion

Myrtle rust is a significant threat to bushland in Wambina Nature Reserve. All treatment options listed above can be applied in the right circumstances. Although no threatened fauna (e.g. amphibians) have been recorded in streams in the reserve, fungicide contamination of watercourses is a major concern and implementing the steps indicated to mitigate fungicide risk should be followed. Minimisation of fungicide usage, minimisation of infected plant translocation and burial of treated plants are preferred methods of treatment and disposal. However, the terrain and location of infected areas may necessitate a combination of all control measures.

Doug Beckers

Biodiversity Officer

Instrument of authorisation and consent

I, Tom Bagnat, Regional Manager, Central Coast Hunter Range Region of the Office of Environment and Heritage (OEH):

1. authorise OEH regional staff and other associated personnel involved in the operation, to exercise all the powers and duties of a person duly authorised under section 171 of the National Parks and Wildlife Act; and
2. grant consent of a park authority to the regional staff under clause 12 of the National Parks and Wildlife Regulation 2009.

This authorisation and consent is given pursuant to section 171 of the *National Parks and Wildlife Act 1974* and clause 12 of the National Parks and Wildlife Regulation 2009.

Conditions

This authorisation and consent is subject to the following conditions:

1. This authorisation and consent can only be used for the purpose of undertaking the eradication of myrtle tust, which includes the following activities:
 - detection and mapping of infected plants via ground surveillance and marking of infected plants with fluorescent tape
 - spraying of infected plants with fungicides listed in the APVMA permit
 - cutting of infected plants
 - burning of material cut from infected plants
 - sterilisation of material cut from infected plants by enclosing in black plastic
 - burial of infected material.

This authorisation and consent can only be used in [Wambina Nature Reserve] during specific programs organised by the OEH to eradicate myrtle rust. This authorisation and consent is effective from [4 November 2010.] to [30 June 2011].

Tom Bagnat

Regional Manager Central Coast Hunter Range Region
Parks and Wildlife Group

Office of Environment and Heritage
(by delegation)

Date: