Environmental Risk Mitigation Plan
for Australian Acacia Species

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Plant Health AUSTRALIA

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Department of Agriculture, Water and the Environment

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Disclaimer:

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List of acronyms

ABARES	Australian Bureau of Agricultural and Resource Economics
ABRS	Australian Biological Resources Study
ACPPO	Australian Chief Plant Protection Office
ACIAR	Australian Centre for International Agricultural Research
ACVO	Australian Chief Veterinary Officer
ANBG	Australian National Botanic Gardens
AFPA	Australian Forest Products Association
ANFAB	Australian Native Food and Botanicals
APPD	Australian Plant Pest Database
ASP	Australian Seedbank Partnership
ATSC	Australian Tree Seed Centre
BICON	Australian Biosecurity Import Conditions Database
BMSB	Brown marmorated stinkbug
CEBO	Chief Environmental Biosecurity Officer
CPHM	State Chief Plant Health Manager
CSIRO	Commonwealth Scientific and Industrial Research Organisation
QDAF	Department of Agriculture and Fisheries, Queensland
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions, Western Australia
DELWP	Department of Environment, Land, Water and Planning, Victoria
DJPR	Department of Jobs, Precincts and Regions, Victoria
DPI	Department of Primary Industries, New South Wales
DPIE	Department of Planning, Industry and Environment, New South Wales
DPIPWE	Department of Primary Industries, Parks, Water and Environment, Tasmania
DPIR NT	Department of Primary Industry and Resources, Northern Territory
DPIRD	Department of Primary Industries and Regional Development, Western Australia
EBO	Environmental Biosecurity Office
EICAT	Environmental Impact Classification of Alien Taxa
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
EPSDD	Environment, Planning and Sustainable Development Directorate, Australian Capital Territory
HPP	High Priority Pest
IBIS	International Biosecurity Intelligence System
IGAB	Intergovernmental Agreement on Biosecurity
IPSN	International Plant Sentinel Network
IUCN	International Union for Conservation of Nature
JCU	James Cook University
NAQS	Northern Australian Quarantine Strategy
NBMCC	National Biosecurity Management Consultative Committee
NDP	National Diagnostic Protocol
NEBRA	National Environmental Biosecurity Response Agreement
NPBS	National Plant Biosecurity Strategy
NPPO	National Plant Protection Organisation
NPPP	National Priority Plant Pest list

NRM	Natural Resource Manager
NSW	New South Wales
NT	Northern Territory
PHA	Plant Health Australia
QLD	Queensland
RBGS	Royal Botanic Gardens Sydney
SA	South Australia
SARDI	South Australian Research and Development Institute
SNPHS	Subcommittee for Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostics
Tas	Tasmania
TEG	Technical Expert Group
TST	Threat Summary Table
Vic	Victoria
WA	Western Australia

EXECUTIVE SUMMARY

Acacias are a quintessential component of the Australian environment. Acacia species occur naturally in all Australian landscapes and are the second most abundant natural forest cover in Australia, covering 9.8 million hectares (Commonwealth of Australia 2018). Acacia species have considerable commercial and amenity value, being valuable plantation forestry and bushfood species and a familiar favourite in home gardens, nature strips and parks across Australia. Australian Acacias have been introduced overseas for their commercial timber, tannin, cut flower and foliage attributes with significant plantings in South Africa, Israel, Indonesia and Vietnam. The introduction of Acacias into novel environments has led to pest and pathogen host shifts, and subsequently, the potential for exotic taxa to become pests on Australian Acacia. Additionally, the increasing global movement of people and goods provides more opportunities for pests and diseases, including hitchhiking pests to reach Australia. The coincident increase of pest[1] incursions worldwide also increases the risk to Australian Acacias from exotic pest incursions.

The *Environmental Risk Mitigation Plan for Australian Acacia Species* (the Plan) is intended for all stakeholders with an interest in Acacia including industry and natural resource management groups but the government is best placed to provide the leadership and tools necessary to guide decision-making and prioritisation of activities towards improving biosecurity outcomes for Acacias. This Plan has been developed to:

1. map and engage with critical stakeholders of Acacia biosecurity
2. identify exotic pest threats to Australian *Acacia* species and undertake a risk assessment to understand the risk posed by each pest
3. identify activities required to improve Acacia biosecurity so Australia is better protected from pest introductions and better equipped to respond to new pest incursions.

A focus on increasing key stakeholder engagement with biosecurity agencies, supporting border operations and expanding activities at high-risk entry sites will contribute to improving biosecurity preparedness for Australian Acacia species. An opportunity exists to leverage activity in the agricultural and environmental sectors to further expand ongoing risk mitigation strategies for these shared threats. Given the difficulty in developing a comprehensive list of exotic pest threats to Australian native taxa due to host switching, non-target impacts and undescribed or unidentified host-pest associations, a mix of targeted and general preparedness activities should be considered.

The recommendations proposed here are intended to address biosecurity threats for Australian Acacias. However, many of the key gaps identified by this project relate to institutional structures and capacity. These gaps apply to government, industry and the environmental groups[2]. The gaps in institutional structures and capacity vary across these groups and one approach will not work for all. The reviewers found a strong willingness among interviewed groups to assist with activities to improve Acacia biosecurity but many groups lacked the knowledge or resources to enable them to channel enthusiasm into productive practice.
It is felt by the reviewers that government would need to provide the overarching framework and guidance to enable the non-government groups to be able to embrace the proposed changes for the improvement of environmental biosecurity.

[1] Note: the definition of "pest" as adopted by the International Plant Protection Convention (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products) is used throughout this document. However, this project is limited to investigation of insect pests and disease threats to Australian Acacias and does not consider Acacia as weeds or weeds of Acacia.
[2] In this context, environmental groups is used widely to cover gardening groups or friends of botanic gardens etc as well as the better known or national environmental groups such as Landcare etc.

REVIEW OF FACTORS INVOLVED IN BIOSECURITY FOR AUSTRAILAN ACACIAS

BACKGROUND

Australian Acacias in context

Classification

Acacia, known commonly as wattle, is Australia's largest genus of flowering plants (MPIGA and NFISC 2018). Acacias are leguminous herbs, shrubs and trees that are abundant in all Australian states and territories. Acacias have adapted to all environments from tropical to temperate and coastal to arid climates (Figure 1). Worldwide, there are 1067 species of Acacia, 1063 of which are endemic to Australia and 20 of which are endemic to parts of South East Asia and the Pacific (Kodela and Maslin 2020). The Acacia genus has recently been reclassified to include only monophyletic species. This means that all Acacia species now share a single evolutionary lineage (World Wide Wattle 2019a), a factor that is likely to have biosecurity implications for the genus.

Until recently the genus *Acacia* contained ~1300 species, distributed across Australia, Africa, Asia, North America and South America. *Acacia* has since been separated into five genera (World Wide Wattle 2019a), as follows:

- *Acacia* (occur in Australia, Asia)
- *Acaciella* (occur in North America and South America)
- *Mariosousa* (occur in North America and South America)
- *Senegalia* (occur in Africa, North America, South America, Asia)
- *Vachellia* (occur in Africa, North America, South America, Asia, northern Australia).

Acacia, referred to in this document, refers to the revised *Acacia* genus classification.

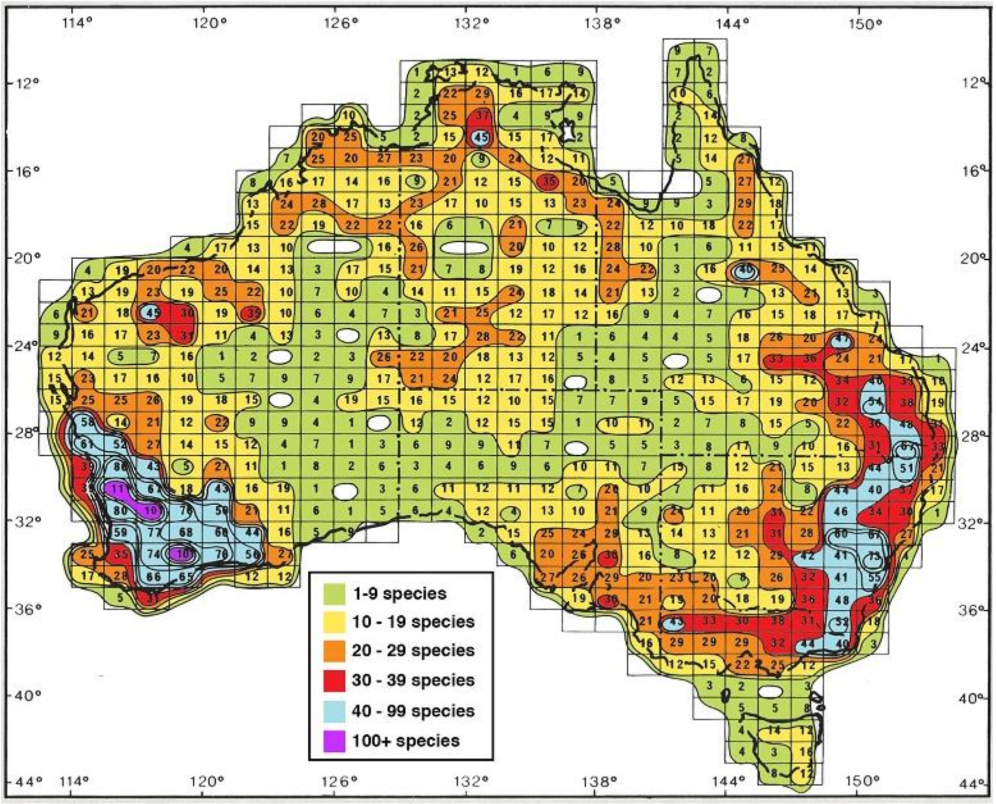

Figure 1: *Distribution and species density of Acacia species across Australia (source: World Wide Wattle 2019b- first published by Maslin & Hnatiuk (1987)).*

Australian cultural identity

The Acacia genus is a keystone of the Australian environment and psyche, providing vital ecosystem services, cultural functions and production outputs. An icon for Australian national and cultural identity, *Acacia pycnantha* (golden wattle) is the floral emblem of Australia, forming part of the national coat of arms and the basis for the green and gold national colours (ABARES 2020).

Acacias as a keystone in the natural landscape

In the environment, Acacias provide cover to smaller trees and shrubs, habitat for native animals and birds, stabilise soils and play an integral role in nutrient cycling through the fixation of atmospheric nitrogen (Brockwell et al. 2005). These services are particularly important in arid and semi-arid regions of Australia where species such as *Acacia aneura* (mulga) and *A. cambadgei* (gidgee) dominate and where few other species are adapted to serve these functions.

Many Acacias are 'pioneer' species, regenerating quickly after disturbance and establishing easily in cleared and degraded landscapes. Pioneering Acacias provide shade, soil stabilisation and a nitrogen source, which creates an environment that is conducive to the establishment of other trees and shrubs. This allows landscapes to regenerate and continue to flourish even after the Acacias have died out.

Acacia for land rehabilitation

Being central to the resilience of native ecosystems after disturbances, Acacia is a popular choice for many environmental planting projects including mine site rehabilitations, carbon farming projects and initiatives to remediate dryland salinity. These projects rely on Acacia as a fundamental component of ecosystem rehabilitation. Wattleseed harvesters often receive higher prices for their collected seed from mine site rehabilitation projects than from the native food industry because rehabilitation projects are large and the demand for seed is high ($60-$80 per kilo, instead of $15-$30) (Clarke 2012).

Indigenous connection and use

Acacia seed is an important traditional food source that is harvested for customary use and to supply the bushfood industry (Australian National Botanic Gardens and Centre for Australian National Biodiversity Research 2012). Some indigenous names for wattleseed include arlupa arlep (Anmatyerre linguistic group), tupurla urlupa urlepe (Arrernte linguistic group) and Pulkuru (Pintupi linguistic group) (Lister et al. 1996; Clarke 2012). Acacias continue to be used traditionally for medicinal (extracts used for toothache, colds, wounds, burn) and functional purposes (used to make boomerangs, clubs, dwellings) (Australian National Botanic Gardens and Centre for Australian National Biodiversity Research 2012).

Acacia timber industry

Acacia timber is harvested from native forests and to a lesser extent, commercial plantations. Annually, 10,000 cubic metres of *Acacia melanoxylon* (Tasmanian blackwood) and 500 cubic metres of *A. dealbata* (silver wattle) timber is harvested in Australia (Commonwealth of Australia 2018). Australian Acacia harvesters and producers are represented by the Australian Forest Products Association (AFPA) though Acacia is not a major component of Australian plantation forestry plantings. In 2016-17 there were 31,600 ha of commercial Acacia plantings in Australia, mostly within the Northern Territory and Tasmania (Commonwealth of Australia 2018). The largest Australian forestry plantation of Acacia on the Tiwi Islands began harvest in 2015. The Tiwi Plantation Corporation is currently reviewing species selection for the second planting.

Although commercial plantings in Australia are nominal, plantation companies have tracts of native bushland containing Acacia within and surrounding plantations with which they interact through fire management practices and pest surveys.

Acacia genetics are a valuable Australian resource. Between 1980 and 2010 the Australian Tree Seed Centre (ATSC) exported 36,021 individual Acacia seed orders (not including Australasian orders) to all regions of the world (Griffin et al. 2011). South East Asia is the primary importer of Australian Acacia seed genetics for the plantation industry (Griffin et al. 2011).

Wattleseed industry

Wattleseed harvest has been steadily increasing in response to the demand for new flavours and novel foods in domestic and export markets (Hegarty et al. 2001). In 2012, cultivated plantations produced an average of 3-4 tonnes of wattleseed each year with an additional 5 tonnes wild harvested. The price for wattleseed is variable but averages around $25 per kilo (Clarke 2012). Harvest occurs in summer when seed pods are threshed and sieved, and seeds are roasted and ground. Wattleseed has a nutty, coffee-like flavour which is used in crumbs, flour for cakes, biscuits and breads, and in many other dishes for garnish and flavour (Bryceson 2008). Essences are extracted and used to flavour ice-cream, whiskey, beers, sauces, and chutneys. Approximately fifty-seven Acacia species are utilised for human consumption[3] (Russell Glover, personal communication, 15 March 2020). The nutritional content of 27 Acacia species has been analysed and found

[3] *Acacia adsurgens, A. aneura, A. becklerei, A. colei, A. cowleana, A. dictyophleba, A. estrophiolata, A. holosericea, A. holosericea, A. kempeana, A. longifolia var. sophorae, A. lysiphloia, A. maitlandii, A. mernsii, A. microbotyra, A. murrayana, A. notabilis, A. oswaldi, A. pachyacra, A. pycnantha, A. podalyriifolia, A. retinodes, A. stipuligera, A. tenuissima, A. torulosa, A. victoriae* are the most common species utilised for wattleseed.

to be generally high in protein, magnesium, zinc, calcium, iron and selenium (Clarke 2012).

Half of the wattleseed sold to industry is wild harvested by Indigenous women in central Australia (Clarke 2012). Remaining production comes from a commercial plantation at the Indigenous community in Murray Bridge, South Australia and a number of other commercial enterprises that have diversified into wattleseed (Clarke 2012).

Australian Native Foods and Botanicals (ANFAB) represent wattleseed harvesters and businesses in Australia. The wattleseed industry is also covered by the AgriFutures Emerging Industries program, though to date investments have been limited to a couple of reviews. A recent project looking to expand the Australian wattleseed industry has funded a wattleseed working group, coordinated by ANFAB. The working group will gather interested parties, hold workshops, establish trials and organise demonstrations (Russell Glover personal communication, 20 February 2020).

Wildflower industry

Wattle flowers and foliage are sold by floriculture businesses throughout Australia. Though the industry does not collect data, it is thought that most wattle flowers and foliage are wild harvested, with some minimal cultivation (Bettina Gollnow, personal communication, 3 December 2019). Wildflowers Australia represents the wild harvesters of Acacia flowers in Australia.

Australian Acacias grown overseas

Twenty Acacia species occur naturally outside of Australia, in South East Asia and the Pacific (Kodela and Maslin 2020). Australian Acacias have also been introduced throughout the world (Table 1) for timber, tannins, cut flowers and foliage, livestock feed and food for human consumption (Griffin et al. 2011; Kull et al. 2011). In addition, Acacia biomass is increasingly being used for energy production (Thompson et al. 2018; Russell Glover, personal communication, 20 February 2020). The incidence of Australian Acacias grown and used overseas has implications for the biosecurity of Acacias in Australia. Growing Acacias in novel environments, often under plantation conditions facilitates increased pest pressure and the emergence of new pest species on Acacia resulting from new encounter and host switching affects.

The primary use for Australian Acacias overseas is within plantation forests. Griffin et al. (2011) estimates that in 2011 there was just over 3.3 million hectares of Australian Acacias in forestry plantations overseas, namely *Acacia mangium*, *A. crassicarpa, A. auriculiformis, A. saligna, Acacia × mangiiformis* (hybrid of *A. mangium* and *A. auriculiformis)* and *A. mearnsii*. These species are planted primarily for their value as pulpwood for paper but also for timber, fuelwood, tannin and charcoal (Griffin et al. 2011; Kull et al. 2011).

Table 1: *Distribution of major plantings of Australian Acacia species overseas (source: Griffin et al. 2011).*

ACACIA SPECIES	COUNTRIES WITH MAJOR PLANTINGS	ESTIMATED GLOBAL PLANTATION AREA (ha)
A. mangium	Indonesia, Vietnam, Malaysia	1 400 000
Acacia × mangiiformis	Vietnam	230 000
A. crassicarpa	Indonesia, Vietnam	330 000
A. auriculiformis	Vietnam, India	220 000
A. saligna	Libya, Ethiopia	600 000
A. mearnsii	South Africa, Brazil, India	540 000

Indonesia is a leading producer of Acacia pulpwood and has an estimated 0.9 million ha of *A. mangium* and *A. crassicarpa* plantations (Hardie et al. 2018). Many of Indonesia's Acacia plantations, planted in the 1990s, have since developed severe pest and disease issues. Hardie et al. (2011) reports that the accumulation of *Ganoderma* sp. and *Ceratocystis* sp. diseases has resulted in up to 50% tree mortality by the fourth rotation in some plantations. Disease load in Indonesian plantations appears to be rising and some plantation managers intend to abandon Acacia plantings for eucalyptus after the next harvest (Morag Glen, personal communication, 3 October 2019).

Despite this, the global spread of Australian Acacia species for forestry and revegetation is continuing. Myanmar recently declared *Acacia mangium* to be the favoured forestry tree and plans to plant 25,900 ha by 2028 for export and use in furniture and building (Ye Lynn 2018).

Agroforestry plantings of *Acacia colei*, *A. torulosa*, *A. tumida* and *A. saligna* occur in Niger and Ethiopia, particularly in desert regions where land is degraded and frequent drought leads to famine (Yates 2014). The seed is harvested for human and livestock consumption, foliage is fed to livestock and wood is used for fuel and construction (World Vision Australia 2012).

Retinodes water wattle (*Acacia retinodes*) and silver wattle (*A. dealbata*) are popular in Europe as cut flowers, foliage and perfume. Plantations in Israel and to a lesser extent, Italy and France supply the European market (Horlock et al. 2000; Russell Glover, personal communication, 20 February 2020).

Acacia as a weed

Several species of Acacia introduced overseas have become serious invasive weeds. Red-eyed wattle (*Acacia cyclops*), black wattle (*A. mearnsii*), Sydney golden wattle (*A. longifolia*) and silver wattle (*A. dealbata*), which were originally introduced into South Africa to produce tannins and to stabilise sand dunes, are examples of the invasiveness of some Acacia. Considerable effort has been expended towards developing biological controls to manage the impact of these Acacia weeds (Impson et al. 2004; Gwate et al. 2016). Biological controls introduced into South Africa from Australia to help manage invasive Acacia populations include the gall wasp (*Trichilogaster acaciaelongifoliae*) and the acecidomyiid midge (*Dasineura rubiformis)* (Impson et al. 2004; Impson et al. 2008).

A similar trend has been observed in Australia where Acacia species are introduced outside of their native range. For example, the Cootamundra wattle (*Acacia baileyana*) has been widely planted in Australia as an ornamental garden plant but it has escaped into the natural environment and become a significant weed in many places (Morgan et al. 2002).

The weediness of some Acacia species in Australia and overseas has extended the host distribution for Acacia pests, increasing the ability for pest populations to accumulate and spread. Additionally, Acacia weeds growing uncontrolled and in high numbers throughout novel landscapes may provide greater potential for pest host preferences to change and mechanisms of infestation/infection to advance.

Threats to Acacia

Despite their suitability to the Australian landscape, there are a number of serious threats to Acacia. As of March 2020, two Australian Acacia species are extinct, five are critically endangered, 33 are endangered and 38 are vulnerable (Commonwealth of Australia 2020a) (see Appendix 1: Table 1). Together with threats such as land clearing, livestock grazing and climate change, the trend towards an increasingly connected world heightens the risk of potentially harmful exotic pests and diseases being introduced and affecting Australia's natural landscapes (Lawson et al. 2018).

Governments around the world are beginning to realise that more attention must be given to species of environmental importance in order to adequately protect them from this increasing threat. There are currently no coordinated activities undertaken in Australia specifically to protect Acacia from exotic biosecurity threats. This project seeks to build on work initiated in 2017 with the development of a *Draft Biosecurity Plan for Australian Acacia Species* to assess the awareness, interest and capacity within the broad stakeholder base to contribute to biosecurity activities and to highlight the key gaps in Acacia biosecurity processes. The implementation plan in this document recommends risk mitigation strategies to address the gaps identified by this project with appropriate involvement from relevant stakeholders.

The outputs of this project will contribute to the body of work commissioned by the Environmental Biosecurity Office (EBO) within the Department of Agriculture, Water and the Environment (DAWE) to improve the environmental biosecurity system more broadly.

RISK MITIGATION PLANNING FOR ACACIA

Australia's geographic isolation and lack of shared land borders has provided a degree of natural protection from exotic plant pest threats. Australia's national biosecurity system also helps to prevent the introduction of harmful exotic threats to plant industries. However, there will always be some risk of an exotic pest entering Australia, through wind assisted natural dispersal, inadvertent introductions as a result of increases in overseas tourism, imports, mail and changes to transport procedures (e.g. refrigeration and containerisation of produce), or deliberate introduction of materials for personal use. Therefore, activities to reduce biosecurity risk and enhance biosecurity preparedness are increasingly important.

The agricultural industries have well developed processes, supported by peak industry bodies and government structures to minimise the risks posed by exotic pests. This includes the development of industry-specific Biosecurity Plans which provide a mechanism for industry, governments and stakeholders to identify opportunities for systemic improvements which enhance preparedness and mitigate risk. Biosecurity response processes for the environment and are managed by the Chief Environmental Biosecurity Officer (CEBO). Prior to the creation of the Environmental Biosecurity Office (EBO) in 2018, biosecurity activities and emergency response processes were managed by the Australian Chief Plant Protection Office (ACPPO) or the Australian Chief Veterinary Office (ACVO), however, supporting biosecurity activities such as surveillance and capacity building for natural landscapes could be strengthened (Carnegie and Pegg 2018). The review of the Intergovernmental Agreement on Biosecurity recognised that environmental biosecurity was being managed however the reviewers recommended that the environment needed a direct biosecurity focus similar to that of the agricultural sector. The EBO provides that focus at the Australian Government level.

Other recent work has identified the need for increased activity and resourcing to support biosecurity for the environment. Aichi Biodiversity Target 9 for signatories to the Convention on Biological Diversity requires that 'invasive alien species and pathways are (i) identified and prioritised; (ii) priority species are controlled or eradicated and (iii) measures are in place to manage pathways to prevent their introduction and establishment' (Convention on Biological Diversity 2020). Additionally, the 2019 Inspector-General Review of *Environmental Biosecurity Risk Management in Australia* recommended that the Australian Government 'work with stakeholders to contribute to the development of environmental biosecurity plans targeting specific pests and diseases aimed at environmental sectors of concern and include the community as much as possible' (Inspector-General of Biosecurity 2019).

The 2010 incursion of myrtle rust (*Austropuccinia psidii*) is a demonstration of the inherent difficulties associated with eradication and management of biosecurity incursions in the environment. Myrtle rust is a severe plant pathogen of myrtaceous species (e.g. *Eucalyptus* spp.), affecting 350 native species (DAWE 2020). It was first detected on the Central Coast of New South Wales (NSW) and has since spread throughout Australia (excluding SA and WA). The spread of Myrtle rust via natural pathways (in this case wind dispersal) to Norfolk Islands, Lord Howe Islands, and New Zealand is also an example of the difficulty in managing such biosecurity threats. The damaging consequences of this exotic pest to the natural landscape exemplifies the importance of biosecurity risk mitigation and contingency plans and processes for exotic pests and diseases of Australian native species.

Risk mitigation planning looks at procedures to reduce the risk of pests of Acacia entering the country. Additionally, preparedness activities increase the likelihood that an incursion would be detected in a timely manner to reduce the social and economic costs of pest incursions on Acacia industries (e.g. nurseries, plantation forests, floriculture and bushfoods), the environment and the wider community.

The key objectives of this environmental risk mitigation plan are to:

1. map, identify and engage with critical stakeholders for Acacia biosecurity
2. identify exotic pest threats to Australian *Acacia* species and undertake a risk assessment to understand the risk posed by each pest
3. identify activities required to improve *Acacia* biosecurity so Australia is better protected from pest introduction and better equipped to respond to new pest incursions.

Like many other natural resources, Acacia serves a variety of productive and ecological functions. Subsequently, there are a diverse group of relevant stakeholders with an equally wide range of interests and constraints. In the case of an Acacia pest incursion decisions around how to respond may be dependent on whether the pest is detected in an agricultural or environmental setting e.g. World Heritage Area. In each of these situations the management options and "affected" stakeholders could potentially be quite different. For pests which impact both agriculture and the environment, systems are needed which can include both sets of stakeholders in the decision making. It should be noted that in many cases where a pest cannot be eradicated the decision making could be a journey to ensure all stakeholders appreciate the complexity of the situation and that a decision not to eradicate is the only possible outcome.

The environmental biosecurity system as it relates to Acacia

Management of environmental biosecurity risks to Australia is provided for under the *Biosecurity Act 2015* and the *Environment Protection and Biodiversity Conservation Act 1999* legislation. The framework for delivery of Australia's plant biosecurity system is built on a range of strategies, policies and legislation, such as the Intergovernmental Agreement on Biosecurity (IGAB), the National Plant Biosecurity Strategy (NPBS) and state biosecurity legislation including the General Biosecurity Obligation (QLD), General Biosecurity Duty (NSW) and the Biosecurity Act 2019 (Tas).

These strategies, policies and legislation provide details about the current structure and responsibilities for management of biosecurity activities and outline a vision of how the future plant biosecurity system should operate.

Australia has a unique and internationally recognised biosecurity system to protect our plant production industries and the natural environment against new pests and diseases. The system is underpinned by a cooperative partnership between plant industries, environmental stakeholders, the general public and all levels of government. Effective biosecurity relies on commitment from all stakeholders (Figure 2).

PRE-BORDER

Federal government (Department of Agriculture, Water and Environment)

- Analysing pest risks associated with proposed imports
- Inspecting, verifying and auditing overseas exporters
- Undertaking pest surveillance overseas
- Developing international standards
- Building capacity overseas
- Anticipating pest threats by gathering global pest intelligence
- Negotiating export market access
- Maintaining the Manual of Importing Country Requirements (MICoR) and Export Documentation System (EXDOC) to facilitate exports

INTERNATIONAL BORDER

Federal government (Department of Agriculture, Water and Environment)

- Inspecting and monitoring arrivals of people, cargo, mail and plant products
- Raising awareness of international plant pests and movement restrictions
- Imposing biosecurity measures at first ports of entry
- Encouraging the reporting of suspected new pests by port workers and importers
- Protecting Australia's north from exotic pests with the Northern Australia Quarantine Strategy (NAQS)
- Enforcing international border restrictions
- Isolating newly arrived plant material in post-entry quarantine

POST-BORDER

Federal and state governments, industry, environment stakeholders and the general public

- Federal govternment has a role in providing national coordination, leadership and support of national responses and other programs
- Responding to emergency plant pests under biosecurity response agreements
- State governments manage domestic border and associated quarantine requirements
- Maintaining the ability to diagnose plant pests
- Maintaining emergency response capacity
- Providing early warning of incursions of exotic pests through surveillance
- Protecting farms with on-farm biosecurity measures
- Managing risks under the control of everyday Australians
- Obeying quarantine laws when making online purchases or returning home after travel
- Reporting any sightings of potential exotic pests, weeds or diseases
- Managing established pests

Figure 2: *Biosecurity: a shared responsibility.*

The Environmental Biosecurity Office (EBO), led by the CEBO within DAWE, is working to strengthen Australia's environmental biosecurity system, including by investing in improving preparedness and response activities for environmental taxa, including Acacia. The CEBO is also the national point of contact for notification of environmental biosecurity incursions under the National Environmental Biosecurity Response Agreement (NEBRA). The EBO facilitates improved relationships with environmental stakeholder groups and ensures that consideration of the environment is forefront in national biosecurity planning discussions.

DAWE plays a key role pre-border, working with exporting nations to minimise risks before product leaves a country and manages the international border, where the movement of people and goods are regulated. These activities aim to prevent entry and establishment of exotic pests and diseases.

The Australian Biosecurity Import Conditions (BICON) database at agriculture.gov.au/bicon contains the current Australian import conditions for more than 20,000 foreign plants, animal, mineral and biological products and is the first point of access to information about Australian import requirements for a range of commodities, including Acacia.

BICON can be used to determine if a commodity intended for import to Australia requires a biosecurity import permit and/or treatment or if there are any other biosecurity prerequisites. There are a number of cases for Acacia currently listed on BICON, these are summarised in Appendix 2: Table 1.

DAWE regularly review import conditions and where new information becomes available the import conditions are modified appropriately. For a more detailed summary of BICON conditions relating to Acacia visit https://bicon.agriculture.gov.au/BiconWeb4.0.

Within Australia, post-border biosecurity measures aim to prevent the spread of regionalised weeds, pests and diseases, and to contain and eradicate any new pest that may enter Australia. Post-border biosecurity relies on the activities of federal government, state governments, local governments, property owners and everyday Australians to manage existing threats, report any suspected new pests and obey quarantine laws.

Biosecurity response framework

There are two existing arrangements that could be used to respond to an exotic pest incursion affecting Acacia. The arrangement applied depends on the pest detected. If the plant pest meets the definition of an Emergency Plant Pest as defined by the Emergency Plant Pest Response Deed (EPPRD), then this deed would apply. If the pest is not considered to meet the definition of an Emergency Plant Pest under the EPPRD and the pest has the potential for impacts on the environment, social amenity or business activity and otherwise meets the requirements of the NEBRA then that agreement may apply.

The Emergency Plant Pest Response Deed

The EPPRD is an agreement between the Australian government, the state and territory governments, 37[4] plant industries and Plant Health Australia (PHA) (collectively known as the signatories), that allows the rapid and efficient response to Emergency Plant Pests (EPP). The EPPRD is a legally binding document that outlines the basic operating principles and guidelines for EPP eradication responses[5].

The EPPRD provides:

- a national response management structure that enables all governments and plant industry signatories affected by the EPP to contribute to the decisions made about the response

[4] Current as of April 2020.
[5] For further information on the EPPRD visit planthealthaustralia.com.au/epprd.

- an agreed structure for the sharing of costs to deliver eradication responses to EPPs detected in Australia. Costs are divided between signatories affected by the EPP in an equitable manner based on the relative public/private benefit of eradication of the EPP
- a mechanism to encourage reporting of EPP detections and the implementation of risk mitigation activities
- a mechanism to reimburse growers whose crops or property are directly damaged or destroyed as a result of implementing an EPP Response Plan
- rapid responses to EPPs
- a framework for decisions to eradicate are based on appropriate criteria (e.g. eradication must be technically feasible and cost beneficial)
- an industry commitment to biosecurity and risk mitigation and a government commitment to best management practice.

There are two national plant industry bodies that are signatories to the EPPRD that potentially represent Acacia industry stakeholders if an EPP affecting Acacia is detected. These are Greenlife Industry Australia and the Australian Forest Products Association. Involvement of a peak industry body would depend on the *Acacia* species impacted.

The current version of the EEPRD is available at planthealthaustralia.com.au/epprd.

The National Environmental Biosecurity Response Agreement

The NEBRA establishes the national arrangements for responding to significant pest and disease incursions that impact the environment, social amenity and business activity, where there are predominantly public benefits. The NEBRA was signed in 2012 by state, territory and Commonwealth governments. Funding a response under the NEBRA is the responsibility of government with, 50% contributed by the Commonwealth and the remaining 50% shared by affected state and territory governments.

The NEBRA includes a clause which indicates that if an emergency response to a pest or disease can be handled under existing cost-sharing arrangements (such as the EPPRD) the parties will agree to manage it under those existing arrangements. If the pest does not meet the Emergency Plant Pest definition outlined above or other existing national cost-sharing arrangements, then the response may be eligible for eradication under the NEBRA.

A copy of NEBRA is available from coag.gov.au/sites/default/files/agreements/National-Environmental-Biosecurity-Response-Nov-2012.pdf.

UNDERSTANDING ACACIA STAKEHOLDERS

Who needs to be involved in Acacia biosecurity?

Acacias have a range of commercial and cultural uses and are significant components of the natural landscape. The stakeholders who may be impacted by a new pest to Acacia are many, diverse and often context specific. The way that stakeholders will be impacted will be different for each stakeholder, as will the approach to and requirement for engagement. In the event of an exotic plant pest incursion affecting Acacia species, it is useful to understand who the relevant stakeholders are and how they relate to the bigger picture, so they can be targeted to participate in relevant aspects of an emergency response or ongoing management.

To understand the stakeholder context for Acacia, key stakeholders were identified through multiple networks and online searches. Interested parties were engaged through a combination of phone, email and face-to-face meetings. Discussions with stakeholders revealed how they interact with Acacia, their areas of expertise, interest in involvement in biosecurity activities and barriers to improving Acacia biosecurity.

Key messages arising from stakeholder consultations were considered and informed recommendations where appropriate.

Stakeholder map

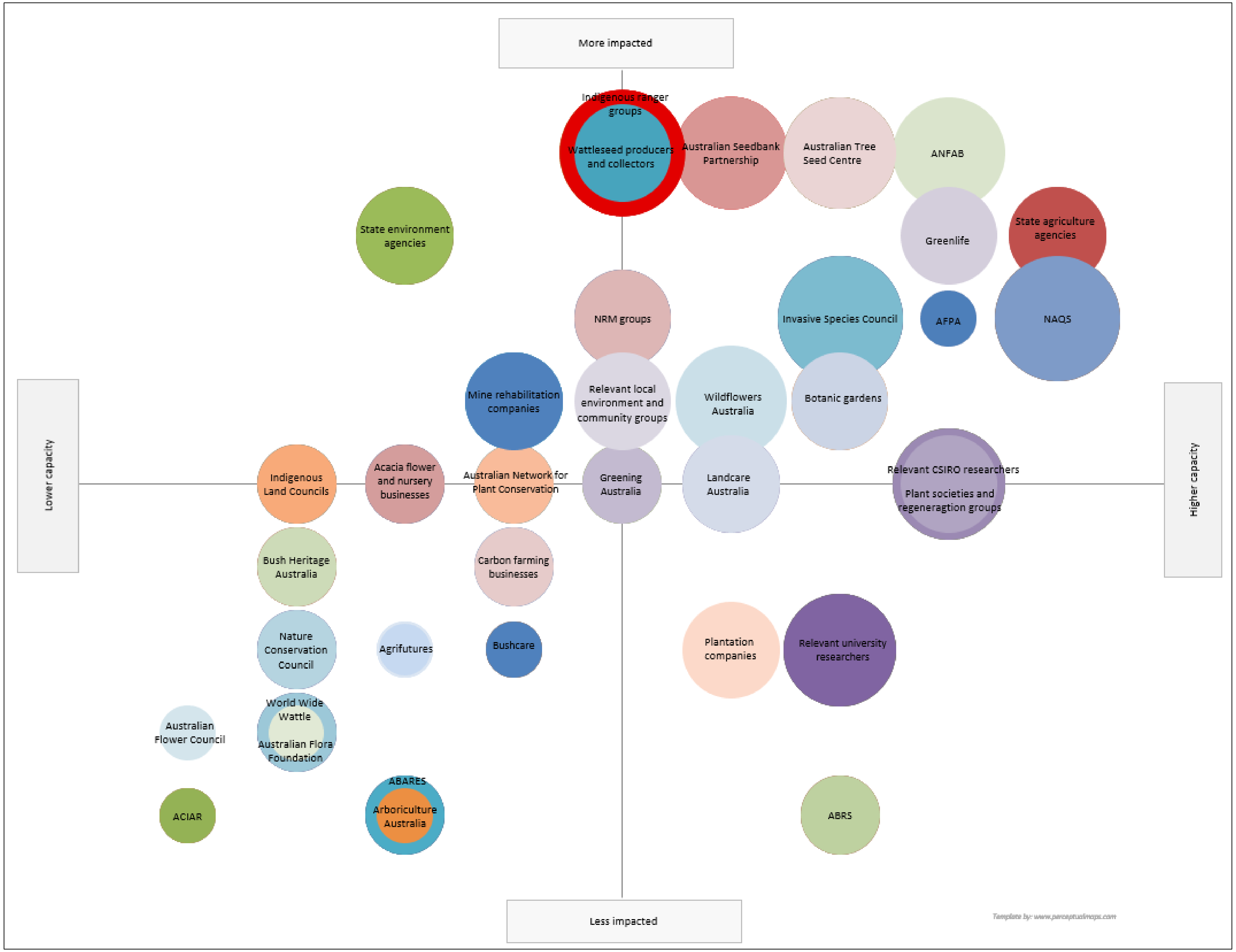

Figure 3: *Assessment of Acacia stakeholder groups in terms of impact level and helpfulness during an emergency plant pest response affecting Acacia species relevant to the stakeholder. *Size of circle indicates interest in the development of this Plan. Colour has no relevance.*

THE RISKS

Specific pest and pathway risks

Threat identification and assessment

Under the previous Acacia project (*'developing a draft environmental biosecurity plan for Australian Acacia species'*) a Threat Summary Table (TST) for exotic invertebrate pests and pathogens of Acacia was developed through a comprehensive literature review and expert input (Appendix 3: Table 1). A Technical Expert Group (TEG) was formed to conduct a risk assessment for the identified threats. The TEG was coordinated by PHA and was comprised of technical experts with expertise in pathology and entomology from various universities and state agriculture agencies.

The process included assessment of the risks of:

- **Entry potential:** The determination of entry potential considers multiple possible pathways for the legal importation of plant material as well as illegal pathways, contamination and the possibility of introduction through natural means such as wind.
- **Establishment potential:** The determination of establishment potential considers the ability of the pest to survive in Australia based on the TEG's understanding of the pest's biology.
- **Spread potential:** The spread potential of the pest considers the ability of the pest to spread to new areas.
- **Impact potential:** The impact potential only considers the impacts of the pest on Acacia species, including commercially grown Acacia and Acacia occurring in the natural environment.

THIS METHOD CONSIDERS ALL POTENTIAL PATHWAYS BY WHICH A PEST MIGHT ENTER AUSTRALIA, INCLUDING NATURAL AND ASSISTED SPREAD (INCLUDING SMUGGLING). THIS IS A BROADER VIEW OF POTENTIAL RISK THAN THE IMPORT RISK ANALYSES CONDUCTED BY THE DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT WHICH FOCUS ONLY ON SPECIFIC REGULATED IMPORT PATHWAYS.

An overall risk rating for each pest was calculated using established risk assessment matrices. The risk assessment process used in Biosecurity Plans was developed in accordance with the International Standards for Phytosanitary Measures No. 2 and 11 (Food and Agriculture Organization of the United Nations 2019). Pests with an overall risk rating of HIGH are regarded as High Priority Pests (HPP) posing the greatest risk to Australian Acacia species. Further information on the risk assessment process can be found on the Plant Health Australia website: planthealthaustralia.com.au/biosecurity/risk-mitigation.

To capture the representative impact to 'Acacia' within an environmental context, this project sought to develop a method to measure pest impact on taxa with 'environmental significance.' The framework is based on the approach used by the International Union for Conservation of Nature (IUCN) for Environmental Impact Classification of Alien Taxa (EICAT) and the ABARES development of the Priority List for Exotic Environmental Pests and Diseases (the Priority List) (ABARES forthcoming). A workshop was held with Northern Australia Quarantine Strategy (NAQS) technical staff to test the framework by assessing the potential impact of the exotic pests to Acacia.

In addition to the literature review provided for each pest, the technical specialists reviewed information relating to the pests prior to the workshop. Despite this, the workshop concluded that it was not possible to assess the potential impact of the exotic pests to Acacia using the framework. The reasons for this include:

The breadth of Australian Acacia species that exist in the Australian environment is not represented in landscapes or research overseas

- Acacia pests are not well studied overseas. The available literature addressing pests of concern outside Australia almost exclusively pertains to pests and pest impacts on a few plantation and weedy species, namely, *Acacia mearnsii*, *A. mangium*, *A. auriculiformis*, *A. decurrens*, *A. crassicarpa* or *A. x mangiiformis.* Pest impacts reported on a small number of Acacias cannot be assumed to be shared by other species of Acacia. Therefore, the available documented pest impacts cannot represent the impact to the breadth of Acacias that exist in the Australian environment. While in general it might be said that the closer in phylogeny two species are the more likely the pest impacts will be shared, this cannot be relied on as a rule.
- Further, the majority of these studies are confined to South Africa, Vietnam or Indonesia and have been conducted in plantation environments, where host-pest interactions were studied for their impact to plantation operations and timber product.
- The impacts experienced under plantation forestry conditions are not representative of those likely experienced in a natural landscape. In a natural landscape, plant demographic phase would be variable, alternate hosts would be available, predatory insect populations would be different and conditions would typically result in lower pest pressure. Acacias in the natural landscape are probably more resilient than those grown in plantations due to the phenomena of boom-and-bust cycles. Many Acacias have a short lifespan but are prolific seeders and are quick to regenerate. Affected populations often recover fully, so although a pest may have a considerable short-term effect, it may be inconsequential in the longer term. Therefore, impacts documented in plantations may not be representative of impact in natural ecosystems.
- Other Acacia species with some published studies are those which have become an invasive species themselves outside of their natural environment, namely, *Acacia saligna, A. decurrens* and *A. dealbata.* This research pertains to the introduction of biological controls for their management (Impson et al. 2008; Mukwada et al. 2012).

There is limited published information relating to pests of Acacia that have been documented overseas

- Within the narrow body of research addressing Acacia pests overseas, the information available is nominal. Many pests are mentioned just once without any supporting information. Some pests have been described in a few published papers, but the information required to conduct a detailed risk assessment such as alternate hosts, biology and population thresholds is lacking. Additional knowledge to support impact ratings in this project was acquired by contacting researchers involved in international projects to discuss in more detail their experience with the pest. Nevertheless, information gaps remained significant. Of the documented pest impacts to Acacias overseas, the majority have insufficient detail. Most papers refer to impact only in terms of 'leaf-feeding' or 'gall-forming' without elaboration regarding the extent and seriousness of impact.
- A number of the pests have not had their taxonomy properly resolved, or there are a number of biotypes (e.g. tea mosquito bug, and cossid moth), so accurate assessment of impact based on the literature is difficult.

For these reasons, the technical specialists decided that a reliable designation of the impact of exotic pests to Australian Acacias was unachievable. The available data are too weak and outside of the direct context of application to draw robust conclusions about the impacts to Acacias growing naturally in the Australian environment.

The group commented that the proposed framework for defining impact of a pest species to the environment was sound and could be used well if published literature were available to support conclusions and it were used to assess impact on a specific host species, rather than an entire genus. Overall, it was agreed that this was a useful exercise to explore mechanisms towards prioritising pests of environmental species and highlighting the challenges in doing so.

Nevertheless, the development of a threat list for Acacia species grown overseas is worthwhile. The list can be used as a proxy to understanding the types of threats that should be prepared for and to confirm assumptions that there are no documented obvious emerging threats missing from biosecurity planning considerations.

As a result of these discussions, the High Priority Pest (HPP) list developed under the previous project was kept to indicate risks to Acacia. This Acacia threat list developed under the previous project is technically sound and considered impacts to both industry and the environment. Since more information is available for industry impacts, the threat list is biased towards this. While many of the pests outlined in Table 2 below attack dead or processed wood, all of the pests also attack living trees. This, together with their history of invasiveness around the world and their documented impacts on Acacia mean that, though not comprehensive for exotic threats to Acacia in the environment, the list remains useful as an indicator of risk to Acacias in the environment. A significant number of the Acacia HPPs are also HPPs for some of the agricultural production crops.

High Priority Pests of Acacia

As outlined above, studies of Acacia pests are limited to a small number of species in a few locations. This limits the adequacy of an exotic high priority pest threat list in covering the entire Acacia genus. This list should be used as only one component of a comprehensive approach to mitigating Acacia pest threats. A combination of both targeted and general approaches to threat abatement will be required.

Table 2: *High Priority Pest list for Australian Acacia species.*

COMMON NAME (SCIENTIFIC NAME)	HOSTS	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
Citrus longicorn beetle (*Anoplophora chinensis)*	Polyphagous, attacking living trees including *Acacia decurrens, A. mearnsii, Citrus* spp., apple, pear, willow, lychee, fig, poplar, maple, rose	China, Japan, Korea, Malaysia, Myanmar, Philippines, Taiwan, Turkey, Vietnam, Italy, Switzerland	HIGH Infested timber products. Many products imported from countries where the pest occurs.	HIGH Suitable climate and hosts in Australia.	HIGH Spread with infested plant material.	HIGH Wood boring pest; will attack living trees.	HIGH
Polyphagous shot hole borer (with *Fusarium euwallaceae*) (*Euwallacea sp. near fornicates)*	*Acacia* spp. (including: *A. cyclops, A. melanoxylon, A. stenophylla*), *Senegalia visco* (syn. *Acacia visco*), *Vachellia caven* (syn. *Acacia caven*), oaks, maples, sycamore, plan tree, camellia, weeping willow, red flowering gum (*Eucalyptus ficifolia*), kentia palm, kurrajong (*Brachychiton populneus*) and many other trees	South East Asia, California, Israel	HIGH Spread with the movement of infested timber. Could enter from US or Asia.	HIGH Related species in genus occur in Australia.	HIGH Spread with the movement of infested timber.	HIGH Bore into trees and vector *Fusarium euwallacea* (Eskaen et al. 2013). Gum weeping symptoms reported in Acacia. Infestations can also cause dieback, wilting and plant death. This species has caused significant damage in the United States where it was recently introduced.	HIGH
Gypsy moth *(Lymantria dispar)*	Very wide host range including *Acacia* spp. (including: *A. baileyana, A. longifolia, A. koa*), *Eucalyptus* spp., birch, oak, maple, pines, beech, larch, *Prunus* spp., apple, pear, elms, *Senegalia greggii* (syn. *Acacia greggii*), *Vachellia farnesiana* (syn. *Acacia farnesiana, A. pinetorum*), *Vachellia tortuosa* (syn. *Acacia tortuosa*),	Widespread in Europe, Asia, some areas of the United States, as well as northern Africa (Algeria, Morocco, Tunisia)	MEDIUM Hitchhiking as egg masses on cargo a proven pathway. Conditions are in place to reduce risk.	HIGH Wide host range would allow establishment.	HIGH Natural dispersal and egg masses on goods.	HIGH Defoliator with wide host range.	HIGH

COMMON NAME (SCIENTIFIC NAME)	HOSTS	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
	Senegalia wrightii (syn. *Acacia wrightii*)						
Albizia borer (*Xystrocera festiva*)	*Acacia auriculiformis,* Sengon (*Paraserianthes falcataria* (main host)), gum arabic tree (*Vachellia nilotica* (syn. *A. nilotica*)), *Senegalia catechu* (syn. *A. catechu*), *A. mangium*, *A. mangium*, hybrid (*A. mangium* × *A. auriculiformis*), *Albizia chinensis, Al. lebbeck, Al. sumatrana, Caliandra callothyrsus, Enterolobium cyclocarpum, Pithecelobium jiringa, P. dulce, Parkia peciosa, Samanea saman*	Indonesia, Vietnam	MEDIUM Potentially introduced with infected timber.	HIGH Wide host range increases risk of establishment in Australia.	HIGH	HIGH Stem borer. Up to 11% of trees infested in some areas in Indonesia. Usually doesn't kill Acacia trees but is a significant and emerging pest in South East Asia.	HIGH
Ceratocystis wilt (*Ceratocystis albifundus)*	*Acacia mearnsii, A. decurrens, Senegalia caffra* (syn. *Acacia caffra*), *Protea* spp., various native woody plants in South Africa in 7 genera	Southern Africa (including South Africa, Kenya, Tanzania, Uganda Zambia and Malawi)	MEDIUM Could enter on timber, pallets, soil, plant material or insect vectors. Less imported from Africa so lower risk of entry than Asian species *C. manginecans*.	HIGH General dispersal of *Ceratocyctis* is by insects, wind, root grafts and humans working amongst infected plants (Alexopoulos et al. 1996).	HIGH Spread on timber, pallets, soil, plant material or insect vectors	HIGH Most damaging pathogen of *A. mearnsii* in South Africa (Wingfield et al. 2011). Causes stem lesions, wood discolouration, kills young trees rapidly (1-year-old trees can die in 6 weeks after infection). Needs wounds to enter and infect the plant (FAO 2007). Three nitidulid (Coleoptera: Nitidulidae) beetles, *Brachypeplus*	HIGH

COMMON NAME (SCIENTIFIC NAME)	HOSTS	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
						depressus, *Carpophilus bisignatus*, and *C. hemipterus* are reported to vector the pathogen in South Africa (Health et al. 2009).	
Ceratocystis wilt (*Ceratocystis manginecans*, syn. *C. acaciivora*)	*Acacia mangium*, *A. crassicarpa*, citrus, cacao (*Theobroma cacaomango*), mango (*Mangifera indica*), Duku (*Lansium parasiticum*), rubber tree (*Hevea brasiliensis*) and *Eucalyptus* spp.	Indonesia, Malaysia, Oman, Pakistan, Vietnam	MEDIUM Could enter on timber, pallets, soil, plant material or insect vectors. More goods imported from Asia so pose higher risk of entry than the African species *C. albifundus*.	HIGH General dispersal of *Ceratocyctis* is by insects, wind, root grafts and humans working amongst infected plants (Alexopoulos et al. 1996).	HIGH Spread on timber, pallets, soil, plant material or insect vectors.	HIGH Wilt and die back disease of Acacia in South East Asia (Tarigan et al. 2011). Also, a significant mango disease.	HIGH
Fusarium euwallaceae (with vector)	55 host genera in United States. *Acacia mangium* reported as a host	United States, Israel, widespread in Asia	HIGH Could be introduced on infected plants or on beetle vectors (Polyphagous shot hole borer).	HIGH Vectored by *Euwallacea spp.* especially *Euwallacea* sp. near *fornicates* (polyphagous shot hole borer). Related beetle species occur in Australia, however it is unknown how effectively they would vector the pathogen.	HIGH	HIGH Affecting up to 50% of *A. mangium* trees in Vietnam. Pathogen is invasive in Israel and California.	HIGH
Xylella (with vector) (*Xylella fastidiosa* subsp. *multiplex)*	Wide host range including *Acacia dealbata, Prunus* spp., rosemary, hebe, pecan, almond, blueberry, elm, peach, pigeon pea and a wide range	Europe, North America. Reported on Acacia in Europe through the International Plant Sentinel Network (IPSN).	HIGH Could be introduced with infected plants or vectors.	HIGH Very wide host range would favour establishment. Xylem feeding insects vector	HIGH Spread with infected plants or vectors.	HIGH In Europe this subspecies causes die back symptoms. Plants generally die	HIGH

COMMON NAME (SCIENTIFIC NAME)	HOSTS	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
	of other species			the disease including glassy-winged sharpshooter (*Homalodisca vitripennis*), blue-green sharpshooter (*Graphocephala atropunctata*), willow sharpshooter (*G. confluence*), red-headed sharpshooter (*Xyphon fulgida*) meadow spittlebug (*Philaenus spumarius*).		quickly after becoming infected.	
Xylella (with vector) *(Xylella fastidiosa* subsp. *pauca)*	Wide host range including *Acacia saligna, Gravillea juniperina*, lavender, *Myrtus communis*, oleander, olive, coffee, citrus, *Prunus* spp., grapevine, *Westringia* spp.	Europe, North America. Reported on Acacia in Europe.	HIGH Could be introduced with infected plants or vectors.	HIGH Very wide host range would favour establishment. Vectors include; glassy-winged sharpshooter (*Homalodisca vitripennis*), blue-green sharpshooter (*Graphocephala atropunctata*), willow sharpshooter (*G. confluence*), red-headed sharpshooter (*Xyphon fulgida*) meadow spittlebug (*Philaenus spumarius*).	HIGH Spread with infected plants or vectors.	HIGH In Europe this subspecies causes die back symptoms, plants generally die quickly after becoming infected. Observation from Italy suggests that olives will be decimated before the Acacia but when Acacia are infected they die rapidly (<12 months) (Donato Boscia *pers comm*).	HIGH

Current preparedness for Acacia High Priority Pests

Through the threat identification and risk assessment process, 99 exotic Acacia pests including 9 High Priority Pests (HPPs) were identified as posing a risk to Australian Acacia species. Understanding current biosecurity activities for Acacia pests will help determine gaps and will assist with planning discussions to better protect Australian Acacia species from biosecurity risks. Table 3 summarises current biosecurity activities relevant to each Acacia HPP.

Table 3: *Current preparedness activities for High Priority Pests of Acacia.*

PEST COMMON NAME (SCIENTIFIC NAME)	DIAGNOSTICS[6]	SURVEILLANCE PROGRAMS THAT TARGET PEST[7]	FACTSHEETS/ PUBLIC AWARENESS MATERIAL[8]	CONTINGENCY PLAN	LISTED ON NPPP OR THE PRIORITY LIST[9]
Citrus longicorn beetle (*Anoplophora chinensis*)	No formal diagnostic protocols listed	Multiple Pest Surveillance (WA), exotic longicorn beetle surveillance (SA) and National Plant Health Surveillance Program (QLD) targets this pest	Yes – a fact sheet has been developed for Production Nurseries (see PHA website) (note not specifically about Acacia)	Yes – a contingency plan has been developed for Production Nurseries (see PHA website) (not specifically about Acacia)	Yes- NPPP (#32)
Polyphagous shot hole borer (*Euwallacea* sp. near *fornicatus*) (with *Fusarium euwallacea*)	No formal diagnostic protocols listed	No formal programs target this pest Forestry Surveillance Program will survey at high-risk sites	No Australian material developed to date. Some United States documents available online (not specifically about Acacia)	Not developed to date	Yes- Priority List
Gypsy moth (*Lymantria dispar*)	Draft – see National Plant Biosecurity Diagnostic Network website for more information	Ports of Entry Trapping Program (SA), National Plant Health Surveillance Project (NSW, Vic, Tas), Port of Entry Trapping (WA) target this pest	Yes –a fact sheet has been developed for Forestry and Production Nurseries (see PHA website) (not specifically about Acacia)	Yes –a contingency plan has been developed for Production Nurseries (see PHA website) (not specifically about Acacia)	Yes- NPPP (#6), Priority List
Albizia borer (*Xystrocera festiva*)	No formal diagnostic protocols listed	No formal programs target this pest	Not developed to date	Not developed to date	No
Ceratocystis wilt (*Ceratocystis albifundus*)	No formal diagnostic protocols listed	No formal programs target this pest	Not developed to date	Not developed to date	Yes- Priority List
Ceratocystis wilt (*Ceratocystis manginecans* (Syn. *C. acaciivora*))	NDP in development	No formal programs target this pest	Not developed to date	Not developed to date	Yes- Priority List
Fusarium euwallaceae	No formal diagnostic protocols listed	No formal programs target this pest	Not developed to date	Not developed to date	No

[6] For further information on which pests have diagnostic protocols or links to diagnostic protocols see: http://plantbiosecuritydiagnostics.net.au/resource-hub/priority-pest-diagnostic-resources/

[7] Surveillance for Acacia HPPs is not necessarily conducted in Acacia environments. For further information on surveillance programs refer to the National Plant Biosecurity Status Report, available from: www.planthealthaustralia.com.au/national-programs/national-plant-biosecurity-status-report/

[8] For copies of factsheets or contingency plans refer to the Pest Information Document Database: www.planthealthaustralia.com.au/resources/pest-information-document-database/

[9] Two priority pest lists developed by DAWE include the *National Priority Plant Pest list* (NPPP) and the *National Priority List of Exotic Environmental Pests, Weeds and Diseases (the Priority List).*

PEST COMMON NAME (SCIENTIFIC NAME)	DIAGNOSTICS[6]	SURVEILLANCE PROGRAMS THAT TARGET PEST[7]	FACTSHEETS/ PUBLIC AWARENESS MATERIAL[8]	CONTINGENCY PLAN	LISTED ON NPPP OR THE PRIORITY LIST[9]
Xylella (*Xylella fastidiosa* subsp. *multiplex*)	NDP 6 and EPPO 2016 - see National Plant Biosecurity Diagnostic Network website for more information	National Plant Health Surveillance Program (NT and QLD, targets multiple hosts), National Plant Health Surveillance Program (SA, targets citrus and grapes), Multiple Pest Surveillance Program (Tas, targets grapes), National Plant Health Surveillance Program (Vic, targets grapes) Multiple Pest Surveillance (WA, targets citrus) target this pest[10]	Yes –a fact sheet has been developed for Production Nurseries (see PHA website) (not specifically about Acacia)	Yes –a contingency plan has been developed for Production Nurseries (see PHA website) (note not specifically about Acacia)	Yes- NPPP (#1), the Priority List
Xylella (*Xylella fastidiosa* subsp. *pauca*)	NDP 6 and EPPO 2016 - see National Plant Biosecurity Diagnostic Network website for more information	National Plant Health Surveillance Program (NT and QLD, targets multiple hosts), National Plant Health Surveillance Program (SA, targets citrus and grapes), Multiple Pest Surveillance Program (Tas, targets grapes), National Plant Health Surveillance Program (Vic, targets grapes) Multiple Pest Surveillance (WA, targets citrus) target this pest	Yes –a fact sheet has been developed for Production Nurseries (see PHA website) (not specifically about Acacia)	Yes –a contingency plan has been developed for Production Nurseries (see PHA website) (not specifically about Acacia)	Yes- NPPP (#1), the Priority List

[10] Surveillance sites aligned to early detection of *Xylella* spp. on listed host plants which may not be useful for early detection of *Xylella* spp. on *Acacia*.

Risk pathway identification

The entry pathways for exotic pests of Acacia were identified by utilising border expertise, literature reviews and data on interceptions, detections and imports (Table 4).

While there are limitations to the data used in the analysis, combining the information with anecdotal evidence from border experts, examining the trends in the interception data may be useful to indicate general patterns and gaps in threat awareness.

NOTE: Eighty of the 99 exotic pest threats to Acacia (81%) identified in the TST were polyphagous outside of the Acacia genus. The majority are polyphagous across a range of plant families, including many of the major forestry and horticultural crops (see TST, Appendix 3: Table 1). The implications of this are that entry risk of Acacia pests is not strongly correlated to the management of Acacia imports but spread across the suite of imports. This increases the difficulty in targeted actions to decrease the risk associated with specific pathways. Thus, it is sensible to ensure that biosecurity measures are effective across all imports and vessel inspections at the border.

Table 4: *Comparison of the relative risk of each entry pathway for biosecurity threats of Australian Acacia species.*

BIOSECURITY RISK PATHWAY TYPE	SPECIFIC BIOSECURITY RISK PATHWAY	RELIATIVE RISK OF PATHWAY	NOTES
Imports	Imports of Acacia seed	MEDIUM	Australian's can buy Acacia seeds online from Israel, Portugal, India, Thailand etc. Acacia seed imports do occur. Acacia seeds imported for sowing in seedmat, biofilm, cardboard form or for human consumption do not require a permit and imports of these may not be recorded. The main biosecurity concern with Acacia seed is the weedy Acacia species, which are prohibited, and for the other non-restricted species contaminants e.g. soil, trash, weed seeds or insects. There are no documented exotic seedborne pathogens of Acacia, though there are some serious fungal diseases that may be able to be transported on the seed coat. There have been a number of invertebrate pest interceptions associated with Acacia seed imports.
	Imports of Acacia timber product (processed)	LOW	There have been no recorded interceptions of pests associated with processed Acacia wood in the past 16 years. Although interception data is not absolute, this may indicate a lower risk of this pathway when compared with other pathways which have had detections.
	Imports of Acacia timber product (unprocessed)	MEDIUM	Pest interceptions associated with unprocessed Acacia wood do occur.
	Import of organic fertilisers	LOW	Acacias demonstrate relatively low incidence of susceptibility to diseases other than fungal galls. Organic fertilisers are subject to biosecurity inspection on arrival.
	Import of research samples/equipment	LOW	Some Acacia pest research is undertaken by Australian researchers overseas, but they generally have a good awareness of the biosecurity system.
	Import of cut flowers	MEDIUM	Acacia pest interceptions have occurred on this pathway.
	Imports of other food products	LOW	
	Import of other timber products (processed)	LOW	Import conditions in place reduce the risk.
	Import of other timber products (unprocessed)	HIGH	Many identified pests of Acacia are pests of other timber species.
	Import of other plant products	MEDIUM	Nursery stock imports and other plant material, particularly those brought in illegally via post and baggage may not have had biosecurity measures applied.
Import packaging material	Acacia woodchips and sawdust as packing material	LOW	

BIOSECURITY RISK PATHWAY TYPE	SPECIFIC BIOSECURITY RISK PATHWAY	RELIATIVE RISK OF PATHWAY	NOTES
	Dunnage	MEDIUM	Pest interceptions associated with dunnage have occurred.
	Other organic packing material	UNKNOWN	
People	Hitchhiking on boots, possessions (e.g. tents) or clothes	LOW	The main pathogens of concern for being transported on clothes or equipment are *Ceratocystis albifundus* and *C. manginecans*. Current distribution of these diseases is southern Africa, Oman, Malaysia, Vietnam, Indonesia and Pakistan.
	Hitchhiking on military staff boots, possessions or clothing	LOW	Acacias are primarily grown in plantations throughout South East Asia or in southern Africa which are not areas of major Australian military presence. Some military presence continues in Papua New Guinea and the Solomon Islands where Acacia is present. The military have good biosecurity processes and undertake wash-downs before arrival back into Australia. Military manuals have been developed to address how to pull apart and clean every part of equipment.
	Traditional movement of people from Papua New Guinea	LOW to MEDIUM	Nine Acacia species are present in Papua New Guinea and Indonesia including *A. crassicarpa, A. mangium* (Skelton 1987). It is likely that many of the Acacia pests in Papua New Guinea are also present in Australia. There are two documented Acacia pests present in Papua New Guinea not currently present in Australia, coffee borer (*Zeuzera coffeae*) and red root rot (*Ganoderma philippii*). These pests have the potential to move on this pathway. If the pest status changes in Papua New Guinea the risk profile will change.
Luggage and mail	Passenger baggage	HIGH	Acacia pest interceptions have occurred on this pathway.
	Articles in the mail	HIGH	Acacia pest interceptions have occurred on this pathway.
Hitchhiking	Military vessels and airplanes	LOW	Some precedence, but good adherence by the Australian military to biosecurity practices.
	Sea cargo (including in imported vehicles)	HIGH	Acacia pest interceptions have occurred on this pathway.
	Air cargo	LOW	
	Cruise liners	UNKNOWN	
	Itinerant vessels, including fishing vessels, superyachts, and other leisure craft	LOW	Some termite risk exists on this pathway. The risk of kitchen stuffs on fishing vessels, superyachts etc. bringing in a pest of Acacia may be low as risk mitigation measures are in place. Pests of Acacia may hitchhike on other plant material or wooden artifacts brought through this pathway though biosecurity staff perform inspections for risk material.
	Ghost nets and flotsam	LOW	Some precedence of termite travel in driftwood in flotsam and ghost nets, however, the likelihood of establishing is low given

BIOSECURITY RISK PATHWAY TYPE	SPECIFIC BIOSECURITY RISK PATHWAY	RELIATIVE RISK OF PATHWAY	NOTES
			difficulty in accessing hosts from the beach.
Illegal movement of goods	Illegal trade in plants, animals and artifacts	MEDIUM	Many of the identified Acacia pests have a wide host range. Illegal import of plant material even if it is not Acacia plant material increases the risk of bringing in something that may also affect Acacias.
	Abandoned fishing vessels and smuggler boats	LOW	Numbers believed to have much reduced in recent years. Abandoned fishing vessels often have major borer and termite problems. Acacias are relatively susceptible to borer attack but borers would need to come into proximity with host onshore in order to establish. Detected vessels are destroyed in a manner appropriate to mitigating biosecurity risk.
Natural dispersal	Wind	LOW	Nine Acacia species are present in Papua New Guinea and Indonesia including *A. crassicarpa, A. mangium* (Skelton 1987). Invertebrate Acacia pests exotic to Australia are recorded in either Indonesia or Papua New Guinea – comma moth, bag worm, albizia borer, Javanese grasshopper and rose beetle.
	Cyclone	LOW	Nine Acacia species are present in Papua New Guinea and Indonesia including *A. crassicarpa, A. mangium* (Skelton 1987). Only a couple of large insect pests identified in the TST as being in either Indonesia or Papua New Guinea – comma moth, bag worm and albizia borer.
	Migratory birds	UNKNOWN suspected LOW	There is no information regarding seedborne pathogens of Acacia overseas.

General risks to Acacia biosecurity identified through stakeholder discussions

The following general biosecurity risks to Australian Acacia species have been identified through a combination of expert and stakeholder consultation, literature review and experience in progressing this project. Many of the general biosecurity risks to Acacia are common to environmental species across the board. Addressing these gaps will improve biosecurity outcomes across a range of environmental taxa.

Endemic and plantation Acacias grown overseas

Acacia species, particularly *Acacia mearnsii*, *A. mangium*, *A. auriculiformis*, *A. decurrens*, *A crassicarpa* and *A. x mangiiformis* are planted throughout South East Asia and Africa as a forestry tree in high-density plantings. The cultivation of Acacias in non-native regions exposes Acacia to insects and pathogens that may take up the novel plants as a host. The potential for new pests of Acacia increases with the expansion of Acacia forestry plantations into new geographical regions and the time available for new pest interactions to develop (Richardson et al. 2011). For instance, since the introduction of *Acacia mearnsii* and *A. melanoxylon* into South Africa in the 1860's there has been a steady increase in the number of pests impacting Acacias in the country (Gleason 1986). Figure 4, taken from Wingfield et al. (2011), shows the cumulative appearance of diseases on *A. mearnsii* since 1910.

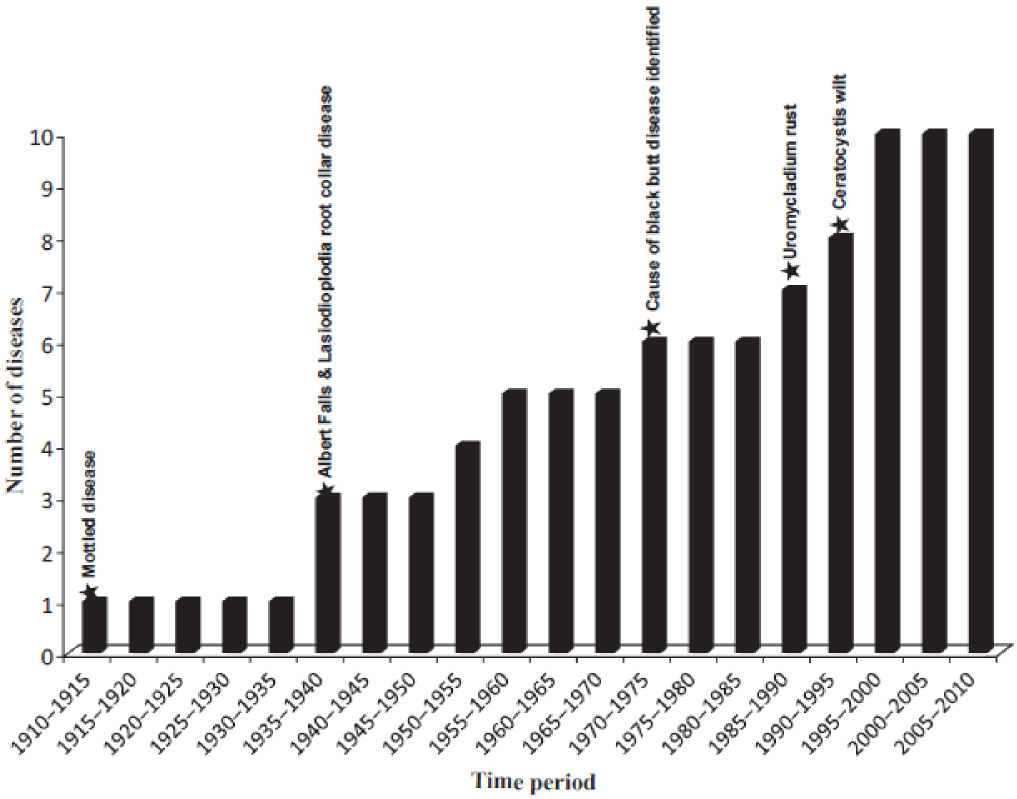

Figure 4: *Cumulative appearance of diseases on Acacia* mearnsii *in South Africa from the time of first pest detection on the species in the country (source: Wingfield et al. 2011).*

Wingfield et al. (2011) report that regular disease monitoring on *A. mearnsii* occurred since the early 1900s and most disease problems are not likely to have been overlooked. The increase in disease number is therefore likely to be mostly a true increase, rather than a result of increasing study. *Ceratocystis albifundus* is a pathogen in South Africa which rarely causes disease in native South African trees but results in rapid wilt and decline in *Acacia mearnsii* and *A. decurrens* (Wingfield et al. 2011). Similarly, the pathogen *Ceratocystis manginecans* (syn. *C. acaciavora)* has undergone a host shift to affect Acacias in Indonesian plantations (Slippers et al. 2005).

The phenomena of host switching has been well documented (Griffiths et al. 2004; Roux et al. 2007) as plantings of high-density, genetically uniform Acacia limits access to alternative hosts and appears to encourage insects and pathogens to adapt to Acacia as a new host (Wingfield et al. 2011). Plantation forests can support pest population levels that are rare in native landscapes. The accumulation of such pest numbers can cause a "beachhead," effect whereby increasingly robust populations facilitate a permanent change in population equilibrium which further accommodates the spread of that pest (Wingfield et al. 2011).

There are a number of native Australian Acacias which have been introduced overseas and now occur naturally in the country of introduction. Table 5 below is taken from World Wide Wattle (2019b) and documents these species. The natural occurrence of Acacia species in these locations provides the opportunity for naturally evolved exotic pests of Acacia.

Table 5: *Natural distribution of Acacia species outside of Australia (World Wide Wattle 2019b).*

Taxon	Distribution
Acacia auriculiformis	New Guinea (Papua New Guinea and West Papua), Moluccas (Kei Island, Indonesia)
Acacia confusa	Philippines, Taiwan (uncertain)
Acacia crassicarpa	Papua New Guinea
Acacia heterophylla	Mauritius, Reunion Island
Acacia kauaiensis	Hawaiian Islands
Acacia koa	Hawaiian Islands
Acacia koaia	Hawaiian Islands
Acacia leptocarpa	Papua New Guinea
Acacia mangium	Moluccas (Indonesia), New Guinea (Papua New Guinea and West Papua)
Acacia mathuataensis	Fiji
Acacia oraria	Lesser Sunda Islands (Indonesia and Timor)
Acacia peregrinalis	New Guinea (Papua New Guinea and West Papua)
Acacia pubirhachis	Papua New Guinea
Acacia richii	Fiji
Acacia simsii	New Guinea (Papua New Guinea and West Papua)
Acacia simplex	Fiji, New Caledonia, Samoa, Tonga, Vanuatu, Mariana Island (uncertain)
Acacia spirobis subsp. spirobis	New Caledonia, Vanuatu
Acacia spirobis subsp. solandri	Papua New Guinea
Acacia wetarensis	Lesser Sunda Island (Indonesia)
Acacia sp. *Wetar (A. aff. elacantha)*	Lesser Sunda Island (Indonesia)

The reasonably close proximity of Acacias in northern Australia to those in Indonesia and Papua New Guinea is a risk. This is particularly so given the heavy pest pressure sustained by Acacia plantations in Indonesia over recent years (Morag Glen, Simon Lawson, personal communication, 2019).

The main Acacia species cultivated overseas are widely distributed across various locations around Australia (Figure 5). The risk is, if an exotic pest of one of these Acacia species arrived in a suitable location, it would easily find hosts and establish. Further, the monophyletic nature of the genus means that there may be an increased likelihood of shared pests between closely related Acacia species. In this case, the available host distribution is potentially extended, amplifying establishment opportunities.

If the pest status changes in any of the countries near to Australia, then the pest risk to Australia changes. It is prudent to ask the question, are our mechanisms to know our near neighbour's pest status adequate? The relationship between NAQS and the governments of Papua New Guinea, Timor and the Solomon Islands is strong. These countries often inform the Australian government when their pest status changes and NAQS staff also undertake pre-border surveillance. However, as is the case in Australia, the focus of pest surveillance is agricultural, and it is unlikely that pests in the environment would be detected with enough time to provide warning to biosecurity agencies in Australia.

Australian researchers that work overseas in Acacia plantations are aware of some of the exotic risks, but particularly if pests are not the research focus, may not have documented them. Discussion with researchers who have experience with these pests overseas is valuable to explore the potential risk and impact to Acacia within Australian environments. It would be beneficial to undertake an activity to identify the Australian researchers that have and are working in these environments on research projects overseas and link them to biosecurity planning staff so that unpublished knowledge can be leveraged.

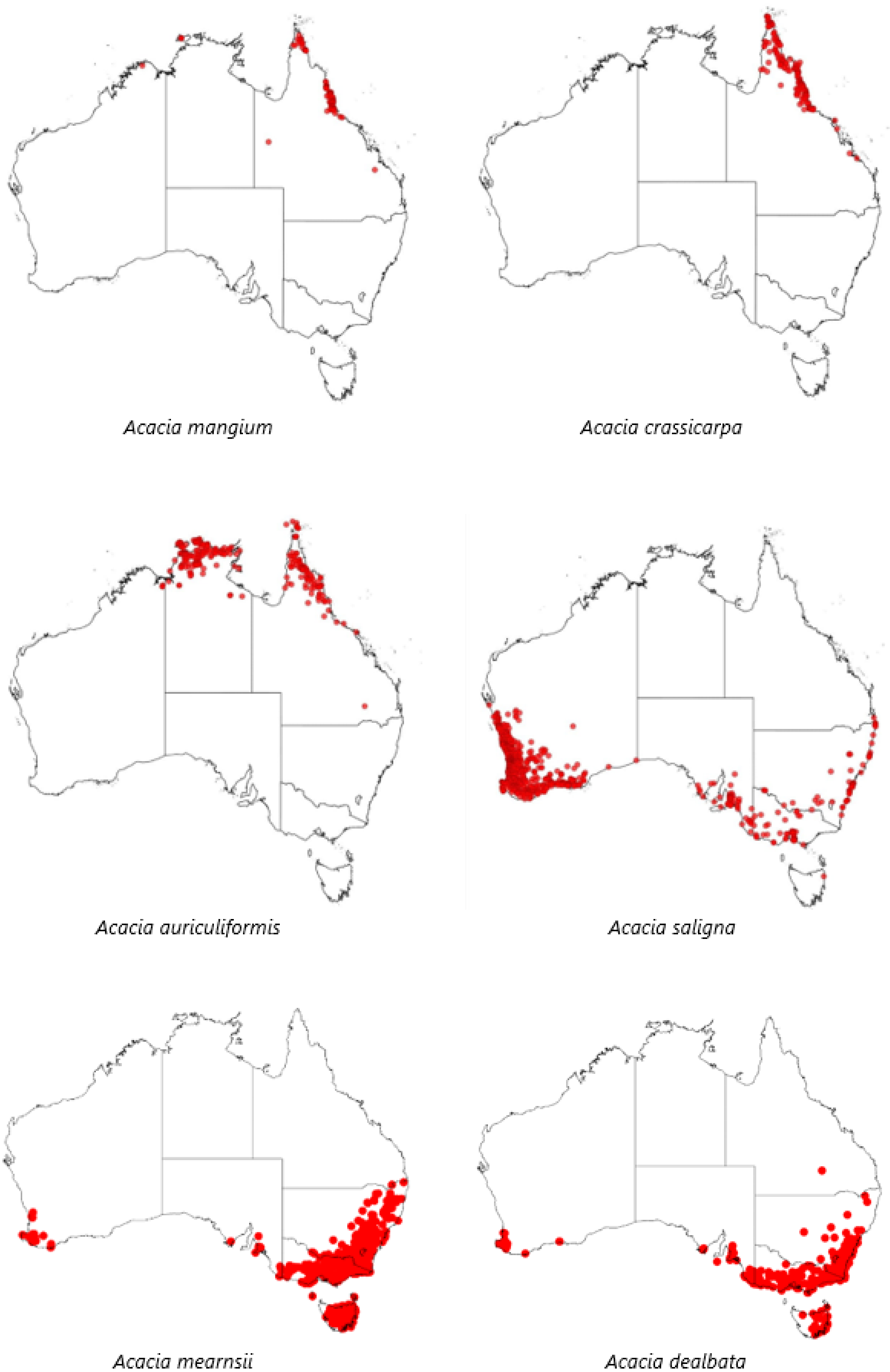

Figure 5: *Australian occurrence of Acacia species commonly grown overseas. Distribution based on records of collected preserved specimens (source: ABRS, generated by Atlas of Living Australia).*

Inability to develop a comprehensive view of risk to Australian Acacias

The risk of unknowns is consistent across all biosecurity operations, but the lack of scientific research addressing insects and diseases affecting Australian Acacia species exacerbates this effect. Unknown risks include new encounter species (species which previously have not come in contact), non-target hosts or undocumented/unexpected impacts that did not occur in the pest's native range but which may arise under unique Australian conditions. Some pests may be previously unknown to science until impact in a new environment occurs. Additionally, there may be pests causing impact in their countries of origin that are undocumented. Species that do not use Acacia as hosts in their countries of origin may switch host preferences once in Australia due to a lack of other suitable hosts or a combination of other contributing factors.

Unknown unknowns are a more significant concern in environmental biosecurity when compared to agricultural biosecurity because of the expanded range of relevant environmental conditions and biological variables. For example, in its native range in China, the emerald ash borer was innocuous and did not register as a pest of concern. In 2002, the emerald ash borer entered and established in the United States through wood packaging material. In this new environment the emerald ash borer caused trillions of dollars in damage and continues to be a significantly damaging pest (USDA 2020). However, because the emerald ash borer was insignificant in its native range, it had never been flagged as a pest of concern and as a result, the United States could not prepare.

The context for environmental biosecurity planning is very different to that of agriculture. Agricultural industries are concerned with a narrow species range (cultivar is often the only difference between crops at various locations) with defined climatic requirements and known agro-ecosystem interactions. Agricultural crops have benefitted from sustained investment and are well studied around the world. This has enabled the identification of most of the major pests and diseases that interact with a given crop in most countries. Since crops of the same species are grown in similar environments globally, pest impacts experienced in one growing region can be regarded as reasonably representative of the potential impact on the crop anywhere it is grown.

Australia is a centre for biological diversity, home to an extensive range of species within a vast range of climatic zones. The current body of literature pertaining to the Australian environment provides a partial view of the baseline conditions of native hosts. Brockwell et al. (2005) states that "it is a curiosity that, in Australia with its great wealth of native plants, so little science apart from taxonomy has been devoted to this unique flora." Additional to this, published literature relating to exotic pest biology is narrow and incomplete. The mismatch of conditions between the native range of a pest and the Australian environment and lack of supporting knowledge creates inaccuracies and gaps in risk assessments.

This lack of certainty regarding pest-host interactions in an environmental context complicates accurate and complete targeting of exotic pest threats for regulation, prevention and detection. Therefore, environmental biosecurity planning must strike a balance between preparedness activities arising from threat prioritisation processes and general preparedness activities, which will reduce vulnerability to undetermined threats.

In order to address the inevitable gaps left by unknown unknowns, general preparedness is required. Targeting activities and community awareness campaigns to high-risk locations maximises impact for effort. The Department should consider identifying locations around Australia which are the highest risk for generic pest entry and use these to prioritise the implementation of preparedness activities, both with the community and biosecurity agencies. Higher-risk sites for exotic pest incursion can be identified using pathways analysis and data relating to the distribution, density and species composition of key environmental taxa, including Acacia. This approach has been used in the National Bee Pest Surveillance

Program and has enabled targeted resourcing of high-risk sites.

Further, experience in this project highlighted the need to develop a framework to assess exotic pest risk when exotic pest information specific to the Australian host is unavailable or limited. Though the framework developed in this project is appropriate for assessment of the impact that an exotic pest will have on an individual plant species of environmental importance, this approach relies on having information on pest associations with the host overseas. Acacia is one example of a native Australian taxon that has at least a few species grown in a significant way in countries outside of Australia and has therefore been exposed to a range of exotic invertebrates and pathogens.

However, many other environmentally significant native taxa are almost exclusive to Australia, and information on specific exotic threats is unavailable. For these taxa, risk profiling and preparation must use a different approach. A project to investigate and document a process for identifying and profiling biosecurity risk for environmental taxa in the absence of documented exotic pest associations would be constructive in aiding future work. The approach should investigate how to apply rules such as reviewing pest groups of related families and relying on similarities in pest or host characteristics towards the assessment of risk. This work could link with or leverage findings from projects currently underway to amalgamate the plant trait databases and global invasive species trait databases. When complete, these databases may be useful to narrow down and make assumptions about species that are more likely to be impacted by a particular pest incursion based on trait similarity to known affected hosts.

Regular monitoring of pests and vectors shown to be moving around the world through horizon scanning of invasive pest databases and using the International Biosecurity Intelligence System (IBIS) is useful for identifying pests with a higher entry potential. The five-yearly review of the Priority List will go some way towards achieving this. It may be useful to consider the likelihood of host switching and potential affects to Australian native taxa of each high entry-risk pest, given that no exposure does not mean no risk.

Opportunities for broadening exotic pest knowledge for Australian Acacias may exist through collaboration with international gardens and projects funded by the Australian Centre for International Agricultural Research (ACIAR). The Department may consider a project to exchange survey data between gardens. The Department could identify which gardens overseas could grow Acacia in return for Australian gardens growing plant species of interest to their governments for susceptibility testing. Alternatively, ACIAR projects present an opportunity to provide some of this knowledge as part of their requirement to deliver benefit back to Australia. The Department could work with ACIAR to develop project activities that test the susceptibility of Australian native taxa to pests in partner countries, assess the risk and conduct preparedness activities based on this. A previous example of this is the ACIAR project *Assessment of eucalypt rust as a pathogen of Eucalyptus spp. and other Myrtacea*e FST/1996/206 (Gordon and Davis 2007) which included an activity to test the susceptibility of a number of Australian Eucalypt species to myrtle rust which was at that time present in South America.

Increasing movement of people and goods

The significant increase in the mobility of pests and diseases as a result of the increasing movement of vehicles, people and goods has resulted in a heightened risk of exotic pest incursions compared to previous decades (Hulme 2009). Each year DAWE border staff intercept over 20,000 exotic pests at the international border (Anderson et al. 2016). From 2009 to 2019, there was a 69% increase in international traveller numbers arriving in Australia (Tourism Research Australia 2020). The increasing risk of biosecurity incursions over time is a problem that is shared globally and contributes to the increasing difficulty of the adequate mitigation of risk by border staff.

There are limits to the number of inspections that DAWE border staff can perform on the large volumes of imported goods. The sharp rise in internet purchasing over the past decade, with many purchases from overseas sites, has placed further pressure on border staff. The import triage process is based on tariff codes supplied by customs brokers and therefore relies on accurate reporting of goods contents. Barcodes at the airport or seaport are digitally scanned. Anything listed under a code that is not a concern proceeds straight through to collection. A randomised inspection process exists to check import barcodes against what they claim to contain, but the huge volumes of imports mean that only a small percentage of imports are verified under the cargo container compliance process or are audited under the Non-commodity for Containerised Cargo Clearance scheme.

Access to diagnostic capacity

The capacity of state and territory environment departments to respond to environmental biosecurity incursions is low. National parks conduct pest surveys, but these are confined to invasive weeds, endemic threats and *Phytophthora* species. The skill base is generalised and lacking plant health specialists. Environment departments rely on external laboratories for sample analysis. For example, WA Department of Biodiversity, Conservation and Attractions (DBCA) rely on a paid partnership arrangement with Murdoch University for diagnostics of samples other than *Phytophthora cinnamomi*. The cost of diagnosis by WA Department of Primary Industries and Regional Development (DPIRD) is in the range of $300 per sample. This cost excludes DBCA from being able to utilise this capacity. Similarly, and as with other state environment departments, the NSW Department of Planning, Industry and Environment (DPIE) relies on the botanic gardens for diagnostic services and some reliance on the goodwill of universities and the agriculture departments for support where the botanic gardens are unable to assist. The botanic gardens also link with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for diagnostic assistance.

Organisations such as botanic gardens, seed banks and national parks rely heavily on volunteers for essential activities. The requirements for surge capacity would not be met through these arrangements in an emergency scenario. A significant proportion of sample diagnosis already relies on goodwill from retired experts, university researchers and enthusiasts. There is little margin to increase throughput without formalisation and resource allocation. There are opportunities to leverage the diagnostic resources of agricultural agencies but whole of government arrangements would need to be established for this to occur on a structured and regular basis.

Australian diagnostic capacity will come under further pressure as general surveillance using citizen science and tools such as iNaturalist or MyPestGuide are increasingly encouraged. While engaging the community in biosecurity is essential for advancement, sufficient diagnostic services must be available to support the inherent increase in sample volume.

The project also received feedback from the Acacia industries regarding the lack of cut flower expertise in the state agriculture departments. Sample diagnosis is expensive and can be slow. This reduces industry's motivation to have samples analysed and problems identified.

Lack of clarity with regard to environmental biosecurity roles among state agencies

State agencies lack a unified vision regarding roles and responsibilities for environmental biosecurity incursions. Several agriculture departments take the view that their role is to support environmental departments during an incursion of environmental pests or pathogens but they are not the designated lead. These agricultural departments expressed that although they have previously defaulted to the role of lead agency during an environmental biosecurity response this departmental flexibility may not persist into the future with increasing resource constraints.

State environment agencies expressed concern regarding their lack of capacity to respond to exotic threats other than *Phytophthora* spp. Other state environment departments only viewed biosecurity activities within national parks as being within their remit.

The recent formation of the Environmental Biosecurity Office (EBO) provides an opportunity to establish and strengthen relationships with state departments that have response obligations.

Different stakeholder priorities during an incursion affecting Acacias

Under an emergency response to a biosecurity incident affecting Acacia, the ability to make rapid decisions can be a key factor of success. Stakeholder discussions illuminated disagreement about what the priorities for protection and action regarding Acacia species should be. Some stakeholders emphasise the importance of protecting the abundant and keystone species, which provide extensive ecosystem services to the Australian landscape, first, while other stakeholders advocate for focusing effort towards conserving threatened and endangered species, given their increased vulnerability to extinction under a biosecurity threat. Stakeholders also recognise the importance of ensuring that the species that are protected are adequately protected. Without prioritisation, resources may be spread too thin, and efforts may fail to protect anything adequately. This recurring contention may cause problems and delay activity during an emergency response or management plan relating to an exotic pest affecting Acacia (or other environmentally significant taxa).

There is value in providing a forum to formally initiate this discussion in an effort to reach a mutual understanding of all the critical considerations in biosecurity response planning, but failing that, provide the opportunity for all views to be heard and considered. The maturity of the system will evolve when discussions around decision-making are inclusive and weigh up on balance the competing priorities. If key stakeholders feel overlooked when these decisions are made, it may cause controversy at the time of implementation and any time saved may be spent having to re-address their concerns at that time. Australia has many experts with well-considered thinking on this topic, and the community would benefit from the workshopping of some of these complex considerations before an event so that government and decision-maker approach is congruent with expert reasoning and has considered the priorities of the stakeholders.

A literature review and prioritisation checklist could be developed to help prioritise species for conservation based on discussions. The matrix should articulate the species of most importance to the environment, whether they are threatened or endangered and how pragmatic their protection would be. This could then be used to inform on balance what priority they should be.

Difficulty of conducting surveillance in vast, natural ecosystems

The rationale for early detection of biosecurity threats through targeted surveillance is strong. The earlier a problem is detected, the less it will have spread, and the more options will be available for successful eradication or management. Ongoing pest management costs are high, so it makes sense to invest in early detection of exotic pest threats. However, the impracticalities of effective surveillance in vast and understudied natural ecosystems presents additional challenges. The relatively high density of Acacias across a broad distribution would facilitate rapid pest spread. It may be unlikely that a threat affecting Acacia would be detected in a timely enough manner to enable eradication or containment.

Further, there are only a couple of clear targets for exotic Acacia pest surveillance. Table 3 outlines the surveillance activities already in place for four of the exotic HPPs of Acacia as part of the National Plant Health Surveillance Program (NPHSP) and Port of Entry Trapping programs. These are brown marmorated stink bug, glassy-winged sharpshooter, gypsy moth and the *Xylella fastidiosa* subsp. These pests have known pathways, host range, symptoms, life cycle and climatic requirements, which is vital in planning effective targeted surveillance. Many of the Acacia HPPs are shared global and national pests, with three listed on the Priority List, five on the NPPP list and a number identified through industry biosecurity plans as being HPPs of Australian agricultural industries. Surveillance for the Asian gypsy moth, wood borers (including the polyphagous shot hole borer), *Fusarium* spp. and *Phytophthora* spp. will be undertaken by the Forestry Surveillance Program at high-risk sites around Australia. National parks also undertake surveillance for *Phytophthora* species.

To increase coverage of targeted surveillance for Acacia HPPs, the Department may consider supporting existing programs to expand their activities and ensure they adequately consider the environment. The EBO may also consider engaging the Subcommittee for Plant Health Surveillance (SNPHS) towards initiating activities for the remaining four[11] HIGH and MEDIUM priority pests of Acacia with no existing surveillance activities. Partnership with the forestry surveillance program could also be used to expand its operations to include additional Acacia targets.

However, given the narrow range of Acacias grown outside of Australia, it is likely that many of the exotic invertebrates and pathogens which might affect Acacia if they established have not yet been exposed to Acacia. Coverage of the biggest threats to Acacia through targeted surveillance based on a pest list is therefore unlikely to be a comprehensive approach. For this reason, the best approach is a mix of targeted and general surveillance for exotic Acacia threats.

General surveillance is more challenging than targeted surveillance. It requires an intimate knowledge of what is typical within a landscape. Differentiating between exotic pest or disease symptoms and endemics or abiotic influences requires both an extensive and specialist skill set. Trained biosecurity or plant health specialists are the most appropriate persons for this role, but capacity is limited. Engagement of appropriately trained council workers, gardens staff and Indigenous rangers may be useful for surveillance in local areas. It may also be possible to support specific research teams to conduct general surveillance simultaneous to their normal activities. Research teams frequent remote ecosystems, have a good knowledge of what is typical for that environment and are scientifically trained. This may reduce the degree of support required for quality sample collection. A good opportunity for collaboration may be research teams associated with the Terrestrial Ecosystem Research Network (TERN) (tern.org.au/Ecosystem-Processes-pg32474.html), Landcare, Universities and NRM organisations.

Additionally, there are opportunities to extend monitoring in forestry plantations and rehabilitated mine sites. Forestry plantation managers actively monitor native bush surrounding their plantations. This monitoring is not intensive but would detect obvious problems. Forestry plantation companies engaged during this project expressed interest in partnering with other companies or the government to facilitate better surveillance on their land or surrounding lands. However, forestry plantations are generally not willing to pay for any increased surveillance activities.

Appreciating the difficulty in conducting effective targeted surveillance and the resource constraints that greater encouragement of general surveillance would cause, a sensible approach would be to focus any general surveillance activities to targeted high-risk sites, as discussed above.

If a general surveillance approach is taken for environmental biosecurity then consideration must be given to the challenge of unknown and undescribed endemics. A 2009 Department of Environment report estimated that only 31% of Australian invertebrates and 24% of fungal species present in Australia have been described (Chapman 2009). This leaves an estimated 320,465 invertebrates and 50,000 fungal species undescribed

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[11] Ceratocystis wilt (*Ceratocystis albifundus*), Ceratocystis wilt (*Ceratocystis manginecans*), Albizia borer (*Xystrocera festiva*), Sri Lankan weevil (*Myllocerus undatus*), shot-hole borer (*Xylosandrus compactus).*

(Chapman 2009). This will increase confusion around whether the identified pest is endemic or exotic which will impact decision-making around initiating emergency response procedures. It is for this reason that general surveillance is best undertaken by people with appropriate skill sets who have experience in the ecosystems in which they are surveying.

There may also be opportunities to invest in 'Blitz' activities at high-risk locations to gather baseline data on existing endemic invertebrate, fungal and bacterial species associated with Acacia hosts in those environments and limit disruption to sample identification in the future. Taxonomy Australia has initiated a campaign to 'discover and document all remaining Australian species of plants, animals, fungi and other organisms… in a generation'[12]. There would be value in engaging Taxonomy Australia to prioritise promotion of the discovery campaign at high-risk sites to improve baseline species data.

It is also important to keep in mind that investing in surveillance only makes sense if detection is likely to lead to eradication. While surveillance may be effective for a few species on the threat list, the limited capacity to respond post-border, increases the importance of preventing border breaches.

Difficulty of mounting a response in vast, natural ecosystems

As discussed above, any response to an exotic pest incursion would need to occur relatively rapidly to ensure the best chances of eradication or containment. Given the vastness and remoteness of Acacia ecosystems, and the disparate nature of the stakeholder base, there are significant constraints to quick and effective biosecurity incident responses.

Weak or non-existent connections between government biosecurity agencies and key stakeholders in the environmental context is also an impediment to effective responses. Stakeholder mapping and determination of the most appropriate communication strategy for key stakeholders goes some way toward rectifying this. Stakeholders possess local knowledge not readily available elsewhere. Their assistance could increase response effectiveness and contribute to the surge capacity required for responses in natural landscapes.

There are many examples where effective cooperation with key stakeholders has contributed to better response outcomes. An example is the 2018 gall wasp response in the United Kingdom. During this response, the government connected with amateur gall recorders and engaged them to conduct further surveillance, enabling better coverage of large areas. The gall recorders reported their survey findings on an app which was then used by biosecurity staff to plan additional surveys. In the environmental context, there are many small, locally focused groups that have the knowledge and capacity to usefully contribute to response operations. This was also evident in another project PHA is undertaking for the CEBO, to develop an *Environmental Risk Mitigation Plan for Mangroves and Associated Communities*. The key finding of that project is that the identification of the 'key' stakeholders is critical because of their ability to link-in effectively with the smaller local groups and be a conduit for information sharing and reporting.

A significant risk for the protection of Australian native taxa, including Acacia, is the lack of ongoing management options for established (see Appendix 3: Table 2) and new exotic pests (Figure 6). A considered approach is required to manage pest issues in ecosystems more broadly. Laws et al. (2018) showed that pests can take decades to spread to different regions and thus recommended an investigation into mechanisms to slow the domestic movement of pests within Australia. Subsequently, consideration should be given to contingency and continuity planning, where exclusion of new pests from unaffected areas may be the most viable option. In this case, exploration of improved biosecurity practices for campers and bushwalkers as well as the movement of vehicles and machinery between regions should be considered.

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[12] For more information see taxonomyaustralia.org.au/our-mission.

Regarding contingency and continuity planning, Australian seed bank capacity was raised as a concern. Seed banks rely on small numbers of staff and many volunteers. This limits surge capacity and would require strict prioritisation of species conservation if utilised in a response. Additionally, due to historical legislative changes, QLD does not have a seed bank.

There are several other groups working in the ecosystem continuity space. The Australian Tree Seed Centre (ATSC), Forestry Corporation of NSW, Sustainable Timber Tasmania and the Queensland Government, have established ex-situ seed orchards and restoration seed banks which may be useful (State of the forests 2018). There are currently 464 Acacia species stored in Australian Seed bank Partnership seed banks around Australia, including all the important plantation forestry species. Additionally, Greening Australia's Nindethana Australian Seeds business maintains seed collections of over 3000 species to be used for revegetation purposes. Greening Australia also manages several seed production areas which supply seeds for biodiversity planting projects (Greening Australia 2020).

All Acacia species can be banked using orthodox methods, but any project funding for collection of seeds for preservation and restoration should consider long-term maintenance costs including germinating and re-storing seeds. Another consideration of seed banking is the need to secure sufficient genetic diversity within a species. This is important for Acacia as Australia is a centre of origin for many Acacia species, and significant genetic diversity has developed over time. Seed banks may also supply seeds to resistance breeding projects. Resistance breeding projects require 10,000 seeds to start. The needs of resistance breeding should be factored into the capacity and maintenance of seed banks.

The potential to link in with generic land restoration and existing conservation response measures such as those initiated for the bushfire recovery effort is promising. For example, Greening Australia's $5 million bushfire restoration project is exploring rapid seed production and long-term standards which may be relevant for a landscape recovery effort following an eradication. Much of the work required for biosecurity continuity planning is similar. The Pilbara Restoration Initiative, the Restoration Seedbank Initiative and the Western Australian Biodiversity Science Initiative's Restoration and Ex-Situ Conservation node are examples of partnerships of enthusiastic individuals from botanic gardens, national parks, industry and the community working to preserve and restore landscapes. There exists a wealth of goodwill and potential to establish mutually beneficial partnerships. The development of an inventory of related activities between agriculture, environment and conservation groups would be a useful exercise to determine synergies and ensure that any planned environmental biosecurity initiative does not create an unnecessary overlap with existing work.

Appetite among environmental stakeholders for increased engagement from government

During project discussions, stakeholders expressed a willingness to have more engagement from government on environmental biosecurity issues. This sentiment was also expressed in the IGAB review and inspector general review of *Environmental Biosecurity Risk Management in Australia* (Inspector-General of Biosecurity 2019). The perceived lack of dialogue from government with environmental stakeholders and a recent history involving a few difficult environmental biosecurity incursions has led to a feeling among some environmental stakeholders that that there is no energy behind eradication of environmental biosecurity incursions. Environmental stakeholders expressed frustration at feeling that their priorities are consistently overlooked and wanted clarity on a mechanism to apply pressure to the government to mount an emergency response in the same way that agricultural industries can apply pressure and influence decision-making. Examples such as the myrtle rust and yellow crazy ant incursions were repeatedly referenced as a demonstration of environmental biosecurity incursions dropping down the priority list. The question (which captures the sentiments of many stakeholders interviewed) was posed, 'how can we stop environmental biosecurity being put in the too hard basket?'

Stakeholders emphasised the value in increasing the two-way dialogue with government to allow the opportunity to present the case for the real impacts of environmental biosecurity incursions, not only to the affected host species but also encompassing the flow on impacts to ecosystems, economies and livelihoods.

Stakeholders highlighted that impacts to environmentally important species are not a simple decision tree as with the agricultural industries. Subtler, pervasive impacts to host species may result in unacceptable, long-term, ecological impacts that may not be considered 'nationally significant' if only the impact to the host plants is considered. A pest, which causes only a 10% reduction in plant reproductive productivity could have a significant cumulative impact on the landscape and flow-on effects to wildlife and the broader ecosystem. Stakeholders expressed that a considered approach would appreciate that the biosecurity incident is not the only threat simultaneously impacting the ecosystems. Considering the cumulative effects of multiple stressors such as climate change, land clearing, grazing and invasive weeds, a 10% reduction in plant reproductive productivity from the introduction of a new pest may be the difference between a productive or a degraded ecosystem. Further, there have been successive introductions of exotic pests to Acacia since European arrival in Australia. Figure 6 shows the cumulative burden of introduced Acacia pest species since 1890, for which data is available. Any new introduction of an exotic Acacia pest will have impacts additional to those already introduced.

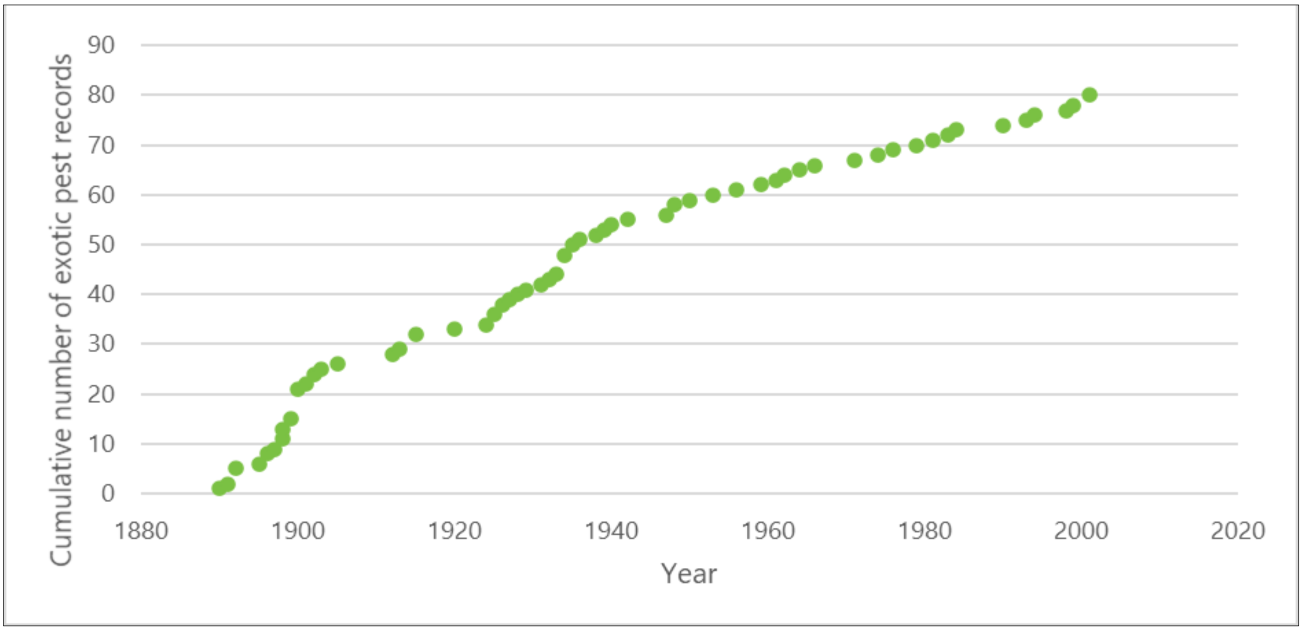

Figure 6: *Cumulative number of Acacia-associated exotic pests recorded in Australia since 1890 (source: Helen Nahrung, QDAF –data sourced from APPD datasets).*

Lessons learned from previous environmental threat establishments, such as Siam weed demonstrate the considerable time and resource burden involved in ongoing management. Though eradication is costly, it is important to discuss it amongst the backdrop of ongoing management costs and ecosystem impacts.

In order to address these concerns and strengthen collaboration with environmental stakeholders, the Department may consider workshopping the current environmental biosecurity processes and decision-making considerations with stakeholders to increase understanding among environmental stakeholders that government has an appreciation of the real value that the environment has to the social, cultural, ecological and economic functioning of Australia and has adequate processes in place to protect it.

Need for more targeted communication with key stakeholders

There are key stakeholders who, if targeted for greater engagement on biosecurity issues could valuably improve biosecurity outcomes. Except in a few key industries, awareness of biosecurity threats and practices is limited, despite these industries being key risk creators and having the ability to act at critical points in the supply chain.

An opportunity exists to develop a relationship with the wattleseed industry from its early stages. Australian Native Foods and Botanicals (ANFAB) has received funding to support a wattleseed industry working group to 2022. The group plans to expand interest and investment in the industry through workshops and research trials. ANFAB expressed interest in having biosecurity staff attend and present at workshops to connect growers with biosecurity practices and threats from the outset and encourage incorporation of these principles into the establishment of their businesses.

Many plantation companies are eager for increased engagement with state agriculture departments and want to know what else they can do to link in with existing biosecurity activities. Plantation companies would welcome training of their staff on specific biosecurity threats and procedures. Some companies have a dedicated research team focused on biosecurity issues, e.g. sirex woodwasp and other exotic pests to pine and would appreciate closer contact with state departments to validate their priorities and align efforts.

There is considerable work already ongoing within Acacia ecosystems that could be leveraged to further improve biosecurity outcomes. Botanic gardens have staff on the ground with plant health and diagnostics expertise. These staff would notice unusual plant health concerns quickly. Natural Resource Management (NRM) groups and those that manage large tracts of land, including national parks, Landcare and local council, conduct management and monitoring activities and would be useful to engage for awareness-raising and reporting of unusual plant symptoms.

Acacia seed collectors regularly visit remote Acacia landscapes. Acacia seed collectors have intimate knowledge of the ecosystems and Acacias from which they collect. Seed collectors would notice unusual pest impacts and have expressed that they would gladly pass on such information if there was a clear communication channel with which to do so. Tapping into the knowledge held by seed collectors would be useful in determining Acacia forest locations and species density to assist in surveillance planning decisions.

Carbon farming and monitoring companies monitor the same plots of land each year for vegetation health and density. Companies expressed interest in receiving awareness materials and linking to biosecurity teams so that they can communicate any unusual pest changes in the environments in which they work. If at particular times, there was a specific pest risk that would benefit from increased surveillance, carbon farming companies expressed interest in participating.

Further, Acacia seeds are imported for mine site and other rehabilitation projects. The implications of this could be that some of the high-risk sites for Acacia seed pests may not be found around ports and airports, but in the locations where seeds are planted, e.g. inland mine rehabilitation sites. This makes clear the risks that a lack of biosecurity awareness of key Acacia stakeholders poses.

Having so many groups active in Acacia ecosystems but with no or minimal engagement from government is a missed opportunity. There are many examples of cases where positive relationships with community, industry and environment groups led to more successful biosecurity outcomes. For instance, in the 2019 outbreak of oak processionary moth, the UK government relied on its strong links with community groups such as Observatree, a group of volunteer tree specialists who assist in locating pest and disease problems, to assist in the response surveillance efforts (Forestry Commission Tree Health Team 2019).

Given the evident difficulty in reliably planning for environmental biosecurity risks, it may become increasingly important to foster a culture of environmental biosecurity awareness and connectedness within the general community. A culture change within the community would greatly enhance environmental biosecurity reach. New Zealand presents a good example of pursuing culture change, having a campaign to involve the entire population and build a biosecurity team 4.7 million strong[13]. The plan centers on unifying the New Zealand population, communities and businesses under a shared vision of cooperation and protection of the country's natural assets. A marketing campaign, together with incentives, such as biosecurity awards, citizen science campaigns and a web portal for people to share their stories and communicate with biosecurity agencies is expected to increase biosecurity awareness and adherence in New Zealand (Biosecurity New Zealand 2018).

To assist uniting the Australian population to value the protection of Acacia, events such as National Wattle Day (1 September) could be leveraged. Valuable links could also be made with work undertaken by the office for the Threatened Species Commissioner.

Limited capacity among environmental groups and smaller industries

Environmental organisations and smaller industry bodies were generally eager to have increased biosecurity activity but are hindered by funding and other resourcing constraints. Flowers Australia has folded since the last CEO left and Wildflowers Australia only has a position funded until 2021. Project staff on this project could not achieve contact with the Australian Flower Council. These resourcing constraints resulted in difficulties in getting traction with some organisations during the project and would likely inhibit engagement with additional biosecurity activities. As an example, the wildflower industry has no biosecurity arrangements in place, no grower register, no extension officers and is not a signatory to the EPPRD. These constraints limit the oversight it can maintain over the industry as Wildflowers Australia is unable to assess how many harvesters and growers there are in the industry.

Environmental groups and smaller industry bodies are willing to facilitate information flow through their extensive magazine, email and online networks and include the discussion of biosecurity messaging at workshops and meetings. However, more intensive involvement from these groups would require funding support. Since the biosecurity message is new to many stakeholders, groups highlighted the need for face-to-face support for any awareness material or documents that are circulated to ensure a base level of understanding is achieved and that documents are workable for the industry.

[13] See biosecurity.govt.nz/dmsdocument/29168-engagement-plan-strategic-direction-1 for engagement plan.

RISK MITIGATION PLAN FOR AUSTRALIAN ACACIA SPECIES

A plan for implementing improved biosecurity

The process of risk identification and stakeholder consultation has informed the recommendations in this environmental risk mitigation plan. This risk mitigation plan is principally designed for decision-makers. The plan provides a roadmap for improving biosecurity for Australian Acacia species with consideration of the risk and stakeholder context. Prioritisation of these recommendations considers practicality and priority. Implementing some of the actions will not only strengthen the biosecurity of Australian Acacias but also the broader plant biosecurity system.

Table 6: *Implementation table detailing priorities and recommended actions for the improvement of Acacia biosecurity in Australia* (prioritisation scale; 1 = high, 2= medium, 3 = lower priority).

PRIORITY LEVEL	RECOMMENDATION	NOTES
Preparedness coverage for High Priority Pests of Acacia		
1	CEBO to engage with SPHD towards prioritising the development of a diagnostic protocol and contingency plan for the Ceratocystis wilts (*Ceratocystis manginecans* and *C. albifundus).* ***NOTE: since the development of this recommendation DAWE have initiated this activity.***	Due to the cross-sectoral nature of many of the HPPs of Acacia and their presence on national priority lists, preparedness coverage for Acacia HPPs is fair. However, preparedness for *Ceratocystis manginecans* and *C. albifundus* would benefit from improved diagnostic capability, especially given increasing pressure of Ceratocystis wilt in Indonesian Acacia plantations.
3	CEBO to link with the work of the National Xylella Coordinator to ensure that planned activities adequately consider and address the environmental context.	Xylella is the biggest threat to agricultural industries across the board and is the top priority on the NPPP list. CEBO engagement with the existent *Xylella* sp. preparedness work will ensure the approach to national biosecurity outcomes is not fragmented between industry and environment. *Xylella* sp. provides an ideal opportunity to bring the two systems together to plan how a combined environmental and agricultural pest could be co-managed. The National Xylella Coordinator is funded by Hort Innovation and Wine Australia. PHC has oversight responsibility for the National Xylella Action Plan but no funding has been provided.
Risk pathways		
2	DAWE to consider developing public awareness campaigns which highlight the biosecurity laws and risks to the environment from the import of plant material.	Import of unprocessed Acacia timber product is a key risk carrier for Acacia pests as identified by border experts and the interception data. An important focus of a public awareness campaign would be to raise awareness of the rules and requirements regarding, online purchases, receiving items in the mail and bringing artifacts home from holidays in personal baggage. The import of smaller wooden artifacts, seeds and propagation material should be specifically addressed. There appears to be a perceived weakening of baggage inspections at the airport which may lead to increased volume of risk items entering through this pathway. A public awareness campaign should seek to educate and remind the public about what is at stake and foster a culture of ownership of environmental protection responsibility. Awareness campaigns could also increase engagement with importer warehouse staff responsible for unpacking imported consignments. Better awareness and relationships between warehouse staff and biosecurity staff will increase the likelihood of reporting.

PRIORITY LEVEL	RECOMMENDATION	NOTES
Endemic and plantation Acacias grown overseas		
3	DAWE to develop and maintain linkages with the environmental agencies in Indonesia and Papua New Guinea.	NOTE: these may already be established within the (former) environmental department as they are for agricultural biosecurity.
2	DAWE to investigate a mechanism to identify Australian researchers working in relevant environments on international research projects and link them to Australian biosecurity staff and planning processes.	Formalised linkages with ACIAR would assist in identifying synergies for research and communication of project outcomes with Australian biosecurity agencies.
Inability to develop a comprehensive view of risk to Australia		
1	EBO to consider work to identify high-risk sites for exotic pest entry around Australia to assist in targeting general environmental biosecurity preparedness activities.	Exotic pests threats to native species are difficult to capture adequately and exotic pest threat lists are likely to under-represent the risk. Because of this it is not adequate to conduct preparedness activities targeting specific exotic pests. General preparedness activities must also be undertaken, including general surveillance, capacity building, stakeholder engagement and public awareness. Focussing general preparedness activities and community awareness campaigns in locations with the highest likelihood of pest entry maximises impact for effort. An example of this is the National Bee Pest Surveillance Program. DAWE and CSIRO undertook a project to identify high-risk bee pest entry sites across Australia and this information was used to target resource allocation. This work is currently being reviewed and updated and the modelling used could be fed into an examination of risk sites with an environmental focus. Initial work towards identifying 'high-risk' entry sites would involve the investigation into characteristics of high-risk sites based on historical events, interrogation of DAWE datasets and comprehensive pathways analysis. Information from this investigation could be used to develop a 'matrix' for assessment of pest entry risk for a location so that site risk mapping could be conducted overtime and under constantly changing parameters.
3	EBO to consider work to develop an approach to assess risk to Australian native taxa for which documented pest associations are unavailable or information is limited.	Many taxa of environmental significance are unique to Australia and have had limited exposure to exotic pests and diseases overseas. Without access to documented exotic pest impacts, existing risk assessment frameworks are inapplicable. Given these constraints, there would be value in workshopping approaches to profiling risk with scientific and modelling experts. A number of experts engaged in this project indicated that there are ways in which such risk profiling could be addressed but agreement of approach was lacking. The current project to develop an *Environmental Risk Mitigation Plan for Native Bee Species* will

PRIORITY LEVEL	RECOMMENDATION	NOTES
		initiate some of these discussions. Outcomes from the native bee work could feed into further discussions towards developing an agreed approach to profile risk when supporting literature is unavailable.
Increasing movement of people and goods		
1	DAWE to maintain the capacity of border staff to adequately address increasing import and passenger volumes.	The hitchhiking pathway is a high risk for exotic Acacia pests. Hitchhiking pests are difficult to mitigate against pre-border so effective management must ensure adequate border staffing with sophisticated support systems to facilitate more reliable detection on arrival. Many Acacia pests are highly polyphagous. Entry risk is therefore not only correlated to Acacia imports but to a wide range of other goods. Increasing movement of goods and reliance on the automatic tariff coding system exacerbates risks posed by inaccurately profiled commodities and pest occurrence on non-host material, e.g. cars or plastic chairs. There is also a need to continue to support border operations to address the volume of risk material entering Australia through airport passenger baggage and through the post.
Managing diagnostic capacity		
1	AGSOC to maintain capacity in organisations that provide diagnostic services.	This activity falls within the role of SPHD. The EBO should participate in SPHD to ensure diagnostic capabilities and capacity is appropriate for and considers the environmental context. In most cases agricultural and environmental pests will utilise similar diagnostic tools and procedures so opportunities exist for harmonisation.
1	SHPD to review the adequacy of diagnostic arrangements for the ongoing requirements of state departments and formalise these arrangements to include environmental requirements where necessary.	In many states, diagnosis of environmental samples occurs through informal arrangements and is undertaken as a free service. This arrangement results in limitations on the number of samples that can be handled. Formalisation of diagnostic arrangements for environmental samples should occur with consideration of adequate resourcing of diagnostic laboratories to handle increased environmental samples.
Lack of clarity with regard to environmental biosecurity roles among state agencies		
1	DAWE to organise a workshop with the state and territory agencies to highlight the gaps, determine opportunities and formalise understanding of the responsibilities of environmental biosecurity.	Formalisation and clarification of understanding within state agencies regarding environmental biosecurity roles and responsibilities will increase the ownership of responsibility for preparedness planning for the environment and improve the confidence of stakeholders and state agencies in the ability of the system to work for the environment. These workshops would be a good opportunity to continue to strengthen the relationship of the EBO with state and territory agencies.

PRIORITY LEVEL	RECOMMENDATION	NOTES
2	Hold simulation exercises to familiarise responsible parties with the various components of a response under the NEBRA/EPPRD.	Simulation exercises can serve to demonstrate the adequacy of the arrangements under the NEBRA/EPPRD and will also work to familiarise relevant agencies with the processes. Simulations may address aspects such as access to diagnostics, effectiveness of communication channels, chain of command, logistics of responses in a challenging natural landscape or ways that broader stakeholders could be valuably engaged.
Different stakeholder priorities during an incursion affecting Acacias		
2	CEBO to initiate a formal discussion among stakeholders regarding the competing priorities for the protection and preservation of species of environmental significance. The outcome of this work would be an 'agreed' understanding of how the decision-making system works and could potentially involve the development of a matrix that could be used to weigh the alternative viewpoints within the environmental community.	Resource constraints mean that difficult biosecurity decisions are inevitable. Not every incident in the environment will meet the criteria necessary to initiate an emergency response. There is contention among the research and broader community regarding the prioritisation of environmental species for protection. Australia has many experts which have well considered thinking on this topic and the community would benefit from a workshopping of some of the key issues and tensions before an emergency response event so that government and decision-maker approach is congruent with expert reasoning and considers the priorities of the stakeholders. Prior to a workshop, the Department could consider the development of case studies for use in the workshop and broader discussions. The case studies should provide examples of native species that are rare but keystone, common and keystone or rare but limited in distribution. These would be drawn upon to illustrate the pros and cons of protecting endangered vs keystone species.
Difficulty of conducting surveillance in vast, natural ecosystems		
3	DAWE to consider opportunities to expand existing surveillance programs such as the Forestry Surveillance Program, community-based activities or plantation company programs, to target surveillance for additional exotic environmental pests of Acacia.	While this recommendation is important, most of the clear high priority targets for Acacia pest surveillance have at least some level of activity underway (though not necessarily within Acacia environments). PHA believes that priority should be given to engaging the communities at high-risk sites for general surveillance and incidental reporting.
1	DAWE to consider supporting NAQS to expand surveillance activities to include key environmental pests.	Additional pest lists for other environmental taxa would need to be developed to help inform the most appropriate environmental targets.
3	Acknowledging that adequate surveillance in the environmental context requires a combination of general and targeted surveillance, consider supporting local council, Indigenous rangers or related research groups who work in key ecosystems to conduct periodic general surveillance. Prioritise general surveillance at high-risk sites	Prioritising general surveillance at high-risk sites using personnel familiar with the environment within which they are surveying will reduce background noise and reduce the load on diagnostic services. These groups will not need to be trained in the recognition of exotic pests specifically but could be encouraged to report anything that has not been seen in their area

PRIORITY LEVEL	RECOMMENDATION	NOTES
	for exotic pest entry.	previously. This should only be pursued if the diagnostic capacity is in place to identify the organism and a feedback loop included so that participants receive feedback on their report and its significance. Utilising personnel from local councils, Indigenous ranger groups or relevant research groups enables greater coverage of areas than would be possible if only biosecurity staff were leveraged. Utilising consistent key groups and personnel for periodic surveillance enables biosecurity staff to form strong relationships with a few key persons to support improved outcomes and collaboration.
2	EBO to consider engaging Taxonomy Australia to prioritise identification of endemic species at 'high-risk' sites.	A reduction in the undescribed endemics will assist in better decision-making around responses to unusual plant pest detections. Prioritisation of increasing baseline knowledge at sites where a pest incursion is more likely is more valuable than increased baseline knowledge where an exotic pest incursion is unlikely.
Response preparedness planning for environmental biosecurity		
2	EBO to consider development of generic impact mitigation plans for environmental taxa that are ready for implementation in the event of an incursion. Threats could be addressed according to the affected plant part or ecosystem impact.	There are limited options for eradication of a biosecurity incursion in the environment. Thus, it is prudent to invest in impact mitigation options. Consideration of impact mitigation should include options to slow the spread of pests within Australia once they have been detected and are determined to be non-eradicable. Such work could focus on exclusion practices, e.g. better biosecurity for campers, walkers and domestic travel. Investigation into ecosystem 'business' continuity planning is likely to find synergies with existing work by other groups. Biosecurity preparedness aligns with other response planning for the environment, such as the bushfire recovery efforts or threat abatement planning. Work to protect threatened and endangered species, e.g. recovery plans for threatened species where research and management actions are vital to stop the ongoing decline of, and support the recovery of, the listed ecological community may also prove useful in recovery from a biosecurity incident.
Appetite among environmental stakeholders for increased engagement from government		
3	EBO to investigate a mechanism to increase two-way dialogue between government and environmental biosecurity stakeholders regarding the processes and considerations involved in environmental biosecurity decision-making.	This will be essential to avoid conflict between community environmental stakeholders and government. Providing a forum for the concerns of environmental biosecurity stakeholders to be heard would go some way to addressing the current perceptions that government does not

PRIORITY LEVEL	RECOMMENDATION	NOTES
		value environmental biosecurity. An increased understanding of the work that government is doing in environmental biosecurity would also be required to encourage environmental biosecurity stakeholders to participate in increased environmental biosecurity activity.
Targeted communication with key stakeholders		
2	Encourage engagement of state and territory biosecurity staff with the newly formed wattleseed industry working group.	The emerging wattleseed industry is not currently engaged in biosecurity. The newly formed wattleseed industry working group is working to expand the industry. Engagement with this working group would provide an opportunity to embed biosecurity principles within the industry from the outset. Participation in meetings and presentations at workshops would secure the relationship and support two-way dialogue for improved biosecurity outcomes.
Lack of capacity among environmental groups and smaller industries		
3	Encourage state and territory governments to develop relationships with smaller industries that have a link to biosecurity in the environment.	State governments will need to see this as part of their remit in order to undertake this work. Small industries have limited capacity but have good network linkages and could assist in improving information exchange. Neglecting to engage smaller industries in biosecurity awareness and messaging is a risk to the environment and agriculture. Growers and harvesters that are not introduced to biosecurity obligations may become inadvertent risk creators and may not report unusual plant pest symptoms. Engaging these groups is especially important given that they often operate in sparsely populated landscapes where the likelihood of others reporting is low.

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APENDIX 1

Threatened and endangered Acacia species

Table 1: *Acacia species listed on the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) List of Threatened Flora (as of March 2020[14]).*

SPECIES	COMMON NAME	STATUS
Acacia kingiana		Extinct
Acacia prismifolia	Diels' wattle	Extinct
Acacia cochlocarpa subsp. *velutinosa*	Velvety spiral pod wattle	Critically Endangered
Acacia equisetifolia		Critically Endangered
Acacia leptoneura		Critically Endangered
Acacia purpureopetala		Critically Endangered
Acacia unguicula		Critically Endangered
Acacia aprica	Blunt wattle	Endangered
Acacia aristulata	Watheroo wattle	Endangered
Acacia ataxiphylla subsp. *magna*	Large-fruited Tammin Wattle	Endangered
Acacia auratiflora	Orange-flowered Wattle	Endangered
Acacia brachypoda	Western wheatbelt wattle	Endangered
Acacia chapmanii subsp. *australis*		Endangered
Acacia cochlocarpa subsp. *cochlocarpa*	Spiral-fruited Wattle	Endangered
Acacia cretacea	Chalky wattle	Endangered
Acacia enterocarpa	Jumping-jack Wattle	Endangered
Acacia gordonii		Endangered
Acacia imitans	Gibson wattle	Endangered
Acacia insolita subsp. *recurva*	Yornaning wattle	Endangered
Acacia lanuginophylla	Woolly wattle	Endangered
Acacia leptalea	Chinocup wattle	Endangered
Acacia lobulata	Chiddarcooping wattle	Endangered
Acacia pharangites	Wongan gully wattle	Endangered
Acacia pinguifolia	Fat-leaved Wattle	Endangered
Acacia porcata		Endangered
Acacia pygmaea	Dwarf rock wattle	Endangered
Acacia recurvata	Recurved wattle	Endangered
Acacia rhamphophylla	Kundip wattle	Endangered
Acacia ruppii	Rupp's wattle	Endangered

[14] See: Department of the Environment and Energy (2017) Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) List of Threatened Flora. Available from: www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora for more information.

SPECIES	COMMON NAME	STATUS
Acacia sciophanes	Wundowlin wattle, ghost wattle	Endangered
Acacia spilleriana	Spiller's wattle	Endangered
Acacia splendens	Splendid wattle, dandaragan wattle	Endangered
Acacia subflexuosa subsp. *capillata*	Hairy-stemmed Zig-Zag Wattle	Endangered
Acacia terminalis subsp. *terminalis*	Sunshine Wattle (Sydney region)	Endangered
Acacia vassalii	Vassal's wattle	Endangered
Acacia volubilis	Tangled wattle, tangle wattle	Endangered
Acacia whibleyana	Whibley wattle	Endangered
Acacia ammophila		Vulnerable
Acacia anomala	Grass wattle, chittering grass wattle	Vulnerable
Acacia aphylla	Leafless rock wattle	Vulnerable
Acacia araneosa	Spidery wattle, balcanoona wattle	Vulnerable
Acacia attenuata		Vulnerable
Acacia awestoniana	Stirling range wattle	Vulnerable
Acacia axillaris	Midlands mimosa, midlands wattle	Vulnerable
Acacia bynoeana	Bynoe's wattle, tiny wattle	Vulnerable
Acacia caerulescens	Limestone blue wattle, buchan blue, buchan blue wattle	Vulnerable
Acacia carneorum	Needle Wattle, Dead Finish, Purple-wood Wattle	Vulnerable
Acacia constablei	Narrabarba wattle	Vulnerable
Acacia courtii	Northern brother wattle	Vulnerable
Acacia crombiei	Pink gidgee	Vulnerable
Acacia curranii	Curly-bark Wattle	Vulnerable
Acacia denticulosa	Sandpaper wattle	Vulnerable
Acacia depressa	Echidna wattle	Vulnerable
Acacia deuteroneura		Vulnerable
Acacia eremophiloides		Vulnerable
Acacia flocktoniae	Flockton wattle	Vulnerable
Acacia forrestiana	Forest's wattle	Vulnerable
Acacia georgensis	Bega wattle	Vulnerable
Acacia glandulicarpa	Hairy-pod Wattle	Vulnerable
Acacia grandifolia		Vulnerable
Acacia handonis	Hando's wattle, percy grant wattle	Vulnerable
Acacia latzii	Latz's wattle	Vulnerable
Acacia lauta	Tara wattle	Vulnerable
Acacia macnuttiana	Mcnutt's Wattle	Vulnerable
Acacia menzelii	Menzel's wattle	Vulnerable
Acacia peuce	Waddy, Waddi, Waddy-wood,	Vulnerable

SPECIES	COMMON NAME	STATUS
	Birdsville Wattle	
Acacia phasmoides	Phantom wattle	Vulnerable
Acacia pickardii	Birds nest wattle	Vulnerable
Acacia praemorsa	Senna wattle	Vulnerable
Acacia praetermissa	A shrub	Vulnerable
Acacia pubescens	Downy wattle, hairy stemmed wattle	Vulnerable
Acacia pubifolia	Velvet wattle	Vulnerable
Acacia pycnostachya	Bolivia wattle	Vulnerable
Acacia rhetinocarpa	Neat wattle, resin wattle (sa)	Vulnerable
Acacia undoolyana	Undoolya Wattle, Sickle-leaf Wattle	Vulnerable

APPENDIX 2

Biosecurity import conditions for Acacia

Table 1: *Acacia product types for which import conditions are listed in BICON (as at April 2020).*

PRODUCT TYPE	IMPORT PERMIT REQUIRED?	SUMMARY OF CONDITIONS
Sawdust and woodchips	No	• Commercially packaged • If over 5 kg and woodchips greater than 25 mm x 25 mm x 25 mm, a quarantine treatment is required (heat treatment, gamma irradiation or ethylene oxide treatment)
Timber and timber products – wooden products or non-commercial	No	• Must be 'wooden products' (as defined in BICON) • Non 'wooden products' not for commercial use must be less than 200 mm in diameter and subject to inspection on arrival and treatment if necessary
Timber and timber products – commercial, unfinished timber	No	• Require phytosanitary certificate or certification of appropriate quarantine treatment including; methyl bromide, sulfuryl fluoride, ethyl oxide fumigation, heat treatment, kiln drying or gamma irradiation treatment
Timber products – commercial, manufactured wooden articles	Yes	• Packaging must be clean and new • Have 'wooden articles permit' or be accompanied by a phytosanitary certificate or a certificate detailing appropriate treatment application (see above)
Dry herbs for human consumption – personal use	No	• Must be fully dried and not able to be propagated • Packaging must be clean and new • Will be subject to inspection on arrival[15] • If not commercially packaged, must be subject to mandatory hot air treatment[16]
Dry herbs for human consumption – not for personal use	No	• Must be fully dried and not able to be propagated • Packaging must be clean and new • Will be subject to inspection on arrival • Plant parts not sufficiently small enough to allow inspection are subject to mandatory treatment[17] • If the exporting country is a khapra beetle county (as defined in BICON) then a phytosanitary certificate from the country's National Plant Protection Organisation (NPPO) must certify that "*the plant products have been inspected and are free from Khapra beetle*."
Dried herbs not for human consumption	No	• All material broken into small pieces, dried and not capable of propagation, or otherwise subject to treatment[18] • Packaging must be clean and new • If other than *Acacia conicinna* (all parts other than seed, fruit and bark), *A. senegal* (resin, gum) or *Acacia spp*. (root) then an import permit is required or goods must be thoroughly dried, subject to a full unpack and treated with either heat, gamma irradiation or ethylene oxide

[15] If during inspection, biosecurity risk material is found, consignments will be treated according to the Contamination Treatment Guide found on the BICON website (bicon.agriculture.gov.au/BiconWeb4.0).
[16] No less than 85°C for at least 8 hours once the core temperature has been reached.
[17] Methyl bromide 32g/m^3 for 24 hours at 21ºC, or heat treatment, hot air at not less than 85°C for at least 8 hours, or cold storage at -18°C for 7 consecutive days.
[18] Methyl bromide 32g/m^3 for 24 hours at 21ºC, or heat treatment, hot air at no less than 85°C for at least 8 hours, or cold storage at -18°C for 7 consecutive days.

PRODUCT TYPE	IMPORT PERMIT REQUIRED?	SUMMARY OF CONDITIONS
Bark for human consumption	No	• Must be fully dried and not able to be propagated • Packaging must be clean and new • Will be subject to full inspection on arrival and treatment applied if necessary
Powdered herbs for human consumption	No	• Packaging must be clean and new • Will be inspected on arrival • If the product is not commercially prepared and in retail packaging of up to 500 g per package, then each package will be inspected to verify that it is free of biosecurity risk material
Plant material in a solid medium	No	• Packaging must be clean and new • Plant material must be fully embedded and not impervious to air or liquid • May be subject to inspection on arrival
Logs, log cabins and oversized timber- not for processing, pre-approved treatment	No	• Packaging must be clean and new • A phytosanitary certificate must be supplied as evidence of treatment[19]
Logs, log cabins and oversized timber – not for processing, import permit application for non-approved treatment	Yes	• Packaging must be clean and new • Consignments must undergo a pre-approved quarantine treatment as decided by DAWE
Logs, log cabins and oversized timber – for processing, exporting country is United States, United Kingdom, Ireland or other European country	Yes	• Must be accompanied by a phytosanitary certificate declaring that "the timber was harvested from areas free of *Phytophthora ramorum*" or with a heat treatment certificate[20] • Will be stood for a full 24 hours to allow any frass to develop. Timber will then be inspected • After inspection, all consignments are subject to processing to reduce at least one dimension of the timber to less than 200 mm. If necessary, a treatment will then be applied
Logs, log cabins and oversized timber – for processing	Yes	• Will be stood for a full 24 hours to allow any frass to develop. Timber will then be inspected • After inspection, all consignments are subject to processing to reduce at least one dimension of the timber to less than 200 mm. If necessary, a treatment will then be applied
Wooden manufactured articles- commercial	Yes	• Must be treated with appropriate phytosanitary treatment[21] either onshore or offshore • If treated offshore phytosanitary certificate or certificate of appropriate quarantine treatment must be supplied • If diameter exceeds 200 mm then refer to the case for logs, log cabins and oversized timber
Seeds for sowing – permitted species[22],	No	• Packaging must be clean and new • The pelleted seed must be commercially produced and packaged and the

[19] As evidence that the timber has been heat treated to a core temperature of at least 56 °C for at least 30 minutes, or the timber has been gamma irradiated at 25 kGray (2.5 Mrad), or has been fumigated with ethylene oxide at 1200 g/m^3 for 5 hours at 50 ºC; or 1500 g/m^3 for 24 hours at 21 ºC.

[20] Heat treated at 56°C for a minimum of 30 minutes, or kiln dried at a rate of 74°C for 4 to 8 hours.

[21] Ethylene oxide, under an initial vacuum of 50 kilopascals, at a rate of 1500 g/m^3 for 24 hours at 21°C, or 1200 g/m^3 for 5 hours at 50°C, or gamma irradiation at the rate of 25 kGray.

[22] 1050 out of a global total 1067 Acacia species are permitted entry into Australia as seeds. See BICON for list of permitted species (bicon.agriculture.gov.au/BiconWeb4.0).

PRODUCT TYPE	IMPORT PERMIT REQUIRED?	SUMMARY OF CONDITIONS
pelleted		pellet must consist of inert material only • Must meet Department standards for seed contaminants and tolerances • Will be inspected on arrival and if insect, disease or contaminants are suspected then further action will be required which may include further identification, treatment, export or disposal • If importing as a full container load sea freight and the exporting country is a khapra beetle county (as defined in BICON) then a phytosanitary certificate from the country's NPPO must certify that "*the plant products have been inspected and are free from Khapra beetle*."
Seeds for sowing– permitted species, non-pelleted	No	• Packaging must be clean and new • Must be sampled and analysed for purity by a Department approved seed testing laboratory and be accompanied by an ISTA Orange International Seed Lot Certificate, a Seed Analysis Certificate or NAL Quality Certificate • If seed lot has not been purity tested offshore and is less than 10 kg or contains seeds less than 8 mm in diameter then it will be thoroughly inspected by a biosecurity officer. If any contaminants are found it will be sampled according to ISTA procedures and further action may be required including further identification, treatment, export or disposal. If the seed lot is over 10 kg or contains seeds greater than 8 mm in diameter then sampling according to ISTA procedures is mandatory • Will be inspected on arrival and if insect, disease or contaminants are suspected then further action will be required which may include further identification, treatment, export or disposal • If importing as a full container load sea freight and the exporting country is a khapra beetle county (as defined in BICON) then a phytosanitary certificate from the country's NPPO must certify that "*the plant products have been inspected and are free from khapra beetle*." • If importing as a full container load sea freight then an appropriate phytosanitary certificate must be supplied stating that inspection has occurred and that the consignment is free from biosecurity pests • If arriving as mail or passenger baggage then ISTA testing is not required but label must include full botanical name
Seeds for sowing– permitted species, not genetically modified, organic medium	Yes	Dependent on import permit
Seeds for sowing- permitted species, genetically modified	Yes	Dependent on import permit
Raw seed for human consumption, not genetically modified	No	• If importing as a full container load sea freight and the exporting country is a khapra beetle county (as defined in BICON) then a phytosanitary certificate from the country's NPPO must certify that "*the plant products have been inspected and are free from khapra beetle*." If the exporting country is not a khapra beetle country then the NPPO must certify that the consignment has been inspected and has been found to be free of biosecurity risk material • Seed lots must be processed at an AA class 3.0 facility or must be purity tested and receive an ISTA, NAL or Seed Analysis Certificate. For consignments greater than 10 kg, instead of ISTA sampling and/or ISTA documentation, the importer may elect to have mandatory moist heat treatment • Packaging must be clean and new • Will be inspected on arrival and if insect, disease or contaminants are suspected then further action will be required which may include further

PRODUCT TYPE	IMPORT PERMIT REQUIRED?	SUMMARY OF CONDITIONS
		identification, treatment, export or disposal
Raw seeds for human consumption- permitted species, genetically modified	Yes	Dependent on import permit
Processed grain and seed products for human consumption- cooked and frozen prior to export	No	• Packaging must be clean and new • Must show evidence that the grains or seeds have been cooked in water for a minimum of 3 minutes at 90°C • Must have been continuously maintained at -18 °C or below for a period of at least seven days • Must arrive frozen
Processed grain and seed products for human consumption- other, for personal use	No	• Must be no longer viable • Will be inspected on arrival and if insect, disease or contaminants are suspected then further action will be required which may include further identification, treatment, export or disposal
Processed grain and seed products for human consumption- other, not for personal use	No	• Must be no longer viable • Packaging must be clean and new • Will be inspected on arrival and if insect, disease or contaminants are suspected then further action will be required which may include further identification, treatment, export or disposal • If importing as a full container load sea freight and the exporting country is a khapra beetle county (as defined in BICON) then a phytosanitary certificate from the country's NPPO must certify that "*the plant products have been inspected and are free from khapra beetle*."
Xylella fasitidiosa and *Ceratocystis* spp. hosts for use as nursery stock	-	• Not permitted entry
Xylella fastidiosa and Sudden Oak Death hosts for use as nursery stock	-	• Not permitted entry
Xylella fastidiosa, Sudden Oak Death and *Ceratocystis* spp. hosts for use as nursery stock	-	• Not permitted entry
Sudden oak death hosts for use as nursery stock	-	• Not permitted entry
Plant species that are weeds	-	210 *Acacia* species are not permitted entry as they are regarded as high weediness risk

APPENDIX 3

Threat Summary Table for Australian Acacia species

The information provided in the Threat Summary Tables is an overview of exotic plant pest threats to Australian Acacia species. There were 99 exotic Acacia pests were identified. Summarised information on entry, establishment and spread potentials and impact of the pest are provided where available. Established pests are not covered by Threat Summary Tables but are recorded in Appendix 3: Table 1. Assessments may change given more detailed research and will be reviewed with the Biosecurity Plan on a regular basis.

An explanation of the method used for calculating the overall risk can be found on the PHA website (www.planthealthaustralia.com.au/wp-content/uploads/2013/07/Pest-risk-assessment-for-IBPs-July-2013.pdf).

Table 1: *Threat summary table for Australian Acacia species.*

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
INVERTEBRATES										
Acanthococcus dubius	Scale insect	Bug	hosts from 11 families including: *Acacia oshanesii*, *Vachellia pilispina* (syn. *Acacia pilispina*), Senegalia greggii (syn. *Acacia greggii*), *Artemisia californica*, hibiscus, Ambrosia spp (ragweeds), lupin, lantana, Euphorbea, and others	Above ground plant parts	US, Mexico, French Guiana, Cuba, Brazil	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Acutaspis ramirezi	Scale insect	Bug	*Acacia melanoxylon*	Above ground plant parts	Colombia	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Adoretus versutus	Rose beetle	Btle	Acacia, cashew nut, groundnut, pawpaw, lemon, pummelo, navel orange, taro, yam, common fig, sweet potato, apple, avocado, European pear, rose, radish, aubergine, sugarcane, ginger	Fruit, leaves	Bangladesh, India, Indonesia, Malaysia, Pakistan, Sri Lanka, Madagascar, Mauritius, Reunion, Saint Helena, Seychelles, American Samoa, Cook Islands, Fiji, Samoa, Tonga, Vanuatu, Wallis and Futuna Islands	MEDIUM	MEDIUM	MEDIUM	LOW-MEDIUM	LOW- VERY LOW
Aenetus virescens	Puriri moth	Lep	*Acacia melanoxylon* (Tasmanian blackwood), *Eucalyptus* sp., beech, tea tree, walnut, dogwood, she-oak	Burrows into trunk causing weakening	New Zealand	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Africaspis caffra	Scale insect	Bug	*Acacia oshanesii*, Karroo thorn (*Vachellia karroo* (syn. *Acacia karroo*))	Above ground plant parts	South Africa	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Africaspis muntingi	Scale insect	Bug	*Acacia oshanesii*	Above ground plant parts	South Africa, Namibia	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Aleurodicus dugesii	Giant	Bug	*Acacia longifolia, A. saligna,*	Above ground	US, Mexico, Venezuela,	MEDIUM	HIGH	HIGH	LOW	LOW

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
	whitefly		avocado, bamboo, citrus, taro, eucalyptus, ivy, fig, pelargonium, Geralton wax, avocado, ginger, eucalypts	plant parts	Belize, Costa Rica, El Salvador, Guatemala, Nicaragua, Indonesia, Pakistan (http://www.cabi.org/cpc/datasheet/110081)					
Andaspis bulba	Scale insect	Bug	*Acacia oshanesii*, Karroo thorn (*Vachellia karroo* (syn. *Acacia karroo*))	Above ground plant parts	South Africa, Mozambique	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Andaspis hawaiiensis	Scale insect	Bug	*Acacia oshanesii*, mango, *Albizia lebbeck, Albizia chinensis,* Hydrangea, citrus, jasmine, lychee, peach	Above ground plant parts	Algeria, Barbados, China, Colombia, Cook Islands, Cuba, Ghana, Hawaii, India, Jamaica, Japan, Mozambique, Philippines, South Africa, Taiwan, Sri Lanka, Tanzania, US, Western Samoa, Zimbabwe	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Anisandrus dispar (syn: Xyleborus dispar)	European shot hole borer; pear blight beetle	Btle	Wide host range including firs, wattles, maple, chestnut, alder, birch, cedar, hazel, Tasmanian blue gum, walnut, juniper, apricot, sweet cherry, peach, Hungarian oak, currants, roses, willows, lime, elm, hemlock, grapevine, willow	Stems, whole plant (dieback)	Widespread in Europe, USA, Canada, China, Russia, Mongolia, Algeria, Iran, Azerbaijan, Turkey	LOW	MEDIUM	HIGH	MEDIUM	LOW
Anoplophora chinensis	Citrus trunk borer; citrus longicorn beetle; citrus longhorn beetle	Btle	Polyphagous attacking living trees including: *Acacia decurrens, Acacia mearnsii, Citrus* spp., apple, pear, willow, lychee, fig, poplar, maple, rose	Trunk	China, Japan, Korea, Malaysia, Myanmar, Philippines, Taiwan, Turkey, Vietnam, Italy, Switzerland	HIGH	HIGH	HIGH	HIGH	HIGH
Apate monachus	Black borer	Btle	Over 80 hosts for larval	Stems	India, Israel, Lebanon,	LOW	HIGH	HIGH	MEDIUM	LOW

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
			development. Wattle, neem tree, pigeon pea, locust bean, citrus, African oil palm, apple, mango, peach, guava, apple, Chinaberry, European pear, mahogany, cocoa, grapevine, Indian tamarind		Syria, widespread in Africa, Cuba, Dominican Republic, Guadeloupe, Jamaica, Martinique, Puerto Rico, Saint Kitts and Nevis, Brazil, France, Hungary, Italy, Spain					
Asterolecanium quaesitum	Scale insect	Bug	*Acacia auriculiformis*	Above ground plant parts	Argentina	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Brachypeplus depressus	Nitidulid beetles	Btle	*Acacia*, stored grain (including maize, cowpea, millet), oil palm, cassava roots, yams	Above ground plant parts, seeds	South Africa	LOW	MEDIUM	MEDIUM	UNKNOWN	UNKNOWN
Brachytrupes portentosus	Short tail cricket	Orth	Wide range of hosts including: *Acacia manigum X A. auriculiformis*, shrubs, grasses etc	Root collar	Vietnam	NEGLIGIBLE	LOW	LOW	LOW	NEGLIGIBLE
Cacoecimorpha pronubana	Carnation tortrix	Lep	*Acacia*, maple, carrot, citrus, leek, strawberry, jasmine, avocado, pine, pea, poplar, potato, tomato, cherry, clover, faba bean, broad bean	Leaves, inflorescence	Azerbaijan, Israel, Libya, Algeria, Morocco, South Africa, Tunisia, USA, Albania, widespread in Europe	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Carpophilus bisignatus	Nitidulid beetles	Btle	Acacia	Above ground plant parts	South Africa	LOW	MEDIUM	MEDIUM	UNKNOWN	UNKNOWN
Ceroplastes bruneri	Scale insect	Bug	*Acacia retinodes, A. furcatispina, A. bonariensis, Senegalia riparia* (syn. *Acacia riparia*), *Ceratonia siliqua, Parkinsonia aculeata, Plinia edulis*	Above ground plant parts	Argentina, Bolivia, Colombia, Paraguay, Uruguay	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Ceroplastes confluens	Scale insect	Bug	*Acacia dealbata, Acacia melanoxylon, Acacia bonariensis, Vernonia*	Above ground plant parts	Argentina, Brazil, Jamaica, Uruguay	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
			polyanthes, Celtis ehrenbergiana, Mimesa serrana, Calliandra tweedii, Mimosa bimucronata, Myrsine umbellata							
Coptotermes curvignathus	Rubber termite	Iso	*Acacia mangium, Albizia procera, Araucaria hunsteinii, Eucalyptus* spp., *Ficus elastica, Gmelina arborea, Heavea brasiliensis*, mango, *Pinus* spp., *Salix* spp., *Shorea robusta, Tectona grandis*	Stems and root system	Indonesia, Malaysia	MEDIUM	HIGH	HIGH	LOW	LOW
Cribrolecanium radicicola	Scale insect	Bug	*Acacia auriculiformis, Cassia* spp.	Above ground plant parts	India	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Cryptoparlatoreopsis longispina	Scale insect	Bug	*Acacia cultriformis, Acacia saligna, Acer negundo*	Above ground plant parts	India, Turkey	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Delottococcus aberiae	Scale insect	Bug	Wide host range including: *Acacia oshanesii*, butternut pumpkin, lemon, mandarin, guava, olive, *Protea welwitschii*	Above ground plant parts	Kenya, Mozambique, South Africa, Spain, Swaziland, Tanzania, Zimbabwe	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Delottococcus quaesitus	Scale insect	Bug	*Acacia oshanesii*, Umbrella thorn Acacia (*Vachellia tortilis* (syn. *Acacia tortilis*)), *Senegalia caffra* (syn. *Acacia caffra*), *Vachellia robusta* (syn. *Acacia robusta*), *Vachellia horrida* (syn. *Acacia horrida*), Karroo thorn (*Vachellia karroo* (syn. *Acacia karroo*))	Above ground plant parts	South Africa	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Dentachionaspis lounsburyi	Scale insect	Bug	*Acacia oshanesii, Gymnosporia buxifolia*	Above ground plant parts	South Africa, Zimbabwe	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Drosicha howardi	Scale insect	Bug	*Acacia paradoxa* (syn. *A. armata*), tea, rose, rose of	Above ground plant parts	China, Japan	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
			Sharon (*Hibiscus syriacus*), *Sambucus racemosa*, *Viburnum odoratissimum*, Japanese elm (*Zelkova serrata)*, Tokyo cherry (*Prunus yedoensis*)							
Duplaspidiotus laciniae	Scale insect	Bug	*Acacia melanoxylon*, Fever tree (*Vachellia xanthophloea* (syn. *Acacia xanthophloea*)), Prunus, *Allophylus aldabricus, Sideroxylon inerme*	Above ground plant parts	Mozambique, Seychelles, South Africa	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Euwallacea sp. near fornicatus	Polyphagous Shot Hole Borer	Btle	*Acacia* spp. (including *A. cyclops, A. melanoxylon, A. stenophylla*), *Senegalia visco* (syn. *Acacia visco*), *Vachellia caven* (syn. *Acacia caven*), oaks, maples, sycamore, plan tree, camelia, weeping willow, Red Flowering Gum (*Eucalyptus ficifolia*), kentia palm, kurrajong (*Brachychiton populneus*) and many other trees	Stems and branches	South east Asia, California, Israel	HIGH	HIGH	HIGH	HIGH	HIGH
Ferrisidea dentilobis	Scale insect	Bug	*Acacia oshanesii, Vachellia pennatula* (syn. *Acacia pennatula*)	Above ground plant parts	Mexico	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Fulaspis mazoeensis	Scale insect	Bug	*Acacia oshanesii*, karroo thorn (*Vachellia karroo* (syn. *Acacia karroo*)), *Albizia adianthifolia*	Above ground plant parts	Mozambique, South Africa, Zimbabwe	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Halyomorpha halys	Brown marmorated stink bug	Bug	Very wide host range including *Acacia*, apples, citrus, *Prunus* spp., pear, grape, hazelnut	Above ground plant parts	Europe, Asia, North America. Potential hitchhiker on cars and other goods from infested countries.	MEDIUM	HIGH	HIGH	LOW	LOW

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
Helopeltis fasciaticollis	Tea mosquito bug	Bug	*Acacia mangium*, tea, cotton, cocoa, cashew	Shoots and leaves	Asia, reported from China and Vietnam	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Helopeltis theivora	Tea mosquito bug	Bug	*Acacia mangium*, tea, cotton, cocoa	Shoots and leaves	currently in Indonesia, Malaysia, Philippines (Nair and Sumardi 2000), Bangladesh, India, Myanmar, Singapore, Sri Lanka, Thailand and Vietnam (CABI http://www.cabi.org/cpc/datasheet/26809)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Hemilecanium kellyi	Scale insect	Bug	*Acacia melanoxylon,* Brachystegia		South Africa	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Holotrichia serrata	White grub	Btle	*Acacia*, groundnut, neem tree, pigeon pea, bell pepper, soyabean, rubber, tobacco, rice, sugarcane, tomato, sorghum, teak, wheat, mungbean, maize, jujube, chillies, cotton	Leaves, roots	India, Bangladesh, Sri Lanka	LOW	MEDIUM	HIGH	MEDIUM	LOW
Holotrichia trichophora	White grub	Btle	*Acacia mangium, A. auriculiformis*, *Eucalyptus* spp.	Larvae feed on roots. Adults feed on leaves	reported in Vietnam	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Homalodisca vitripennis (syn. *Homalodisca coagulata)*	Glassy winged sharp shooter	Bug	*Acacia cowleana*, other *Acacia* spp. And a wide range of other plants including *Eucalyptus* spp., grapes, citrus	Above ground plant parts	North America (US and Mexico)	MEDIUM	HIGH	HIGH	LOW	LOW
Hylesia nigricans	Burning moth	Lep	Wide host range including: *Acacia* spp., *Eucalyptus* spp. and other tree species	Leaves	South America (Argentina, Brazil)	LOW	HIGH	HIGH	LOW	VERY LOW

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
Hypomeces squamosus	Gold dust weevil; green weevil	Btle	*Acacia mangium, A. auriculiformis*, Eucalyptus, teak, rice, maize, tobacco, sugarcane, cotton	Larvae feed on roots. Adults feed on leaves	southern and south-eastern Asia. Closest population is Indonesia	MEDIUM	HIGH	HIGH	LOW	LOW
Hypothenemus hampei	Coffee berry borer	Btle	Coffee, maize, pigeon pea (main hosts). cotton, pea, lima bean, peanut, *Acacia* spp. (including *A. decurrens* and *A. ingrata*) (minor/less preferred hosts)	Seeds and seed pods	widespread in tropical North and South America, Africa and Asia. Absent from Australia	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Icerya aegyptiaca	Scale insect	Bug	Wide host range including *Acacia decurrens*, *Albizia saman*, magnolia, pigeon pea, fig and other *Ficus* spp., banana, pear, orange, rose, grapevine	Above ground plant parts	China, Egypt, Micronesia, French Polynesia, Guam, India, Indonesia, Israel, Japan, Kenya, Kiribati, Maldives, Pakistan, Marshall Islands, Northern Mariana Islands, Palau, Philippines, Sri Lanka, Taiwan, Wake Islands, Yemen, Zanzibar	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Icerya travancorensis	Scale insect	Bug	*Acacia decurrens, Casuarina equisetifolia*, guava (*Pisidium guajava*), citrus, Loranthus, *Hypericum mysorense*	Above ground plant parts	India	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Kerria lacca lacca	Scale insect	Bug	Wide host range including *Acacia auriculiformis, A. catechu*, Sweet Acacia (*Vachellia farnesiana* (syn. *A. farnesiana*)), *Albizia* spp., fig, rose, orange, grape, lychee, butternut pumpkin, pecan, mango	Above ground plant parts	Azerbaijan, Bangladesh, Burma, China, Georgia, Guyana, India, Malaysia, Nepal, Pakistan, Sri Lanka, Taiwan	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
Kerria nagoliensis	Scale insect	Bug	*Acacia auriculiformis*, *Senegalia catechu* (syn. *Acacia catechu*), Sweet Acacia (*Vachellia farnesiana* (syn. *A. farnesiana*)), *Flemingia macrophylla*, *Ziziphus mauritiana*, *Schleichera oleosa*	Above ground plant parts	India	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Kotochalia junodi (syn. *Acanthopsyche junodi*)	Wattle bagworm	Lep	*Acacia mearnsii*, *A. decurrens* and other *Acacia* spp.	Leaves	South Africa	NEGLIGIBLE	LOW	LOW	LOW	NEGLIGIBLE
Lecanodiaspis dendrobi	Scale insect	Bug	Wide host range including: *Acacia mangium*, teak, fig, black mulberry, mandarin	Above ground plant parts	Argentina, Brazil, Colombia, Guatemala, Guyana, Honduras, Mexico, Uruguay, Venezuela	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Ledaspis mashonae	Scale insect	Bug	*Acacia mearnsii*, *Uapaca kirkiana*, *Uapaca nitida*	Above ground plant parts	Malawi, Zimbabwe	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Lepidosaphes belutchistana	Lepidosaphes belutchistana	Bug	Hosts include *Acacia oshanesii*, oleander, *Periploca aphylla*, *Prosopis cineraria*	Above ground plant parts	India, Iran, Pakistan	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Lepidosaphes granati	Lepidosaphes granati	Bug	*Acacia cultriformis*, oaks, pomegranate, fig, *Rhamnus oleoides*, elms, hawthorn (*Crataegus monogyna*)	Above ground plant parts	Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Hungary, Iran, Italy, Morocco, Sicily, Turkey, Ukraine	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Lepidosaphes ussuriensis	Lepidosaphes ussuriensis	Bug	Wide host range with hosts in 11 families. Affected hosts include *Acacia oshanesii*, Persimon, korean chestnut (*Castanea crenata*), grapevine, *Prunus* spp.	Above ground plant parts	China, Japan, Nepal, Pakistan, Russia, South Korea	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

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Lepidosaphes yanagicola	Lepidosaphes yanagicola	Bug	Wide host range with hosts in 13 families. Affected hosts include *Acacia oshanesii, Tilia americana, T. japonica, Morus alba*, Willows (*Salix* spp.), *Albizia julibrissin*	Above ground plant parts	China, Russia, Japan, South Korea, US	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Lygidolon laevigatum	Lygidolon laevigatum	Bug	*Acacia mearnsii* and other *Acacia* spp.	Above ground plant parts	south Africa	LOW	MEDIUM	MEDIUM	MEDIUM	LOW
Lymantria dispar	Lymantria dispar	Lep	Very wide host range including *Acacia* spp. (including *A. baileyana, A. longifolia, A. koa*), *Eucalyptus* spp., birch, oak, maple, pines, beech, larch, *Prunus* spp., apple, pear, elms, *Senegalia greggii (*syn. *Acacia greggii*), *Vachellia farnesiana* (syn. *Acacia farnesiana, A. pinetorum*), *Vachellia tortuosa* (syn. *Acacia tortuosa*), *Senegalia wrightii* (syn. *Acacia wrightii*)	Leaves	Widespread in Europe, Asia, some areas of the US, as well as northern Africa (Algeria, Morocco, Tunisia)	MEDIUM	HIGH	HIGH	HIGH	HIGH
Malekoccus acaciae	Malekoccus Acaciae	Bug	*Acacia oswaldii, A. asak*	Above ground plant parts	Saudi Arabia	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Melanaspis inopinata	Melanaspis inopinata	Bug	Wide host range including: *Acacia oshanesii*, pear, oaks, walnut	Above ground plant parts	Armenia, Cyprus, Egypt, Greece, Iran, Iraq, Israel, Italy (including Scilly and Sardinia), Lebanon, Pakistan, Turkey	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Microcerotermes dubius	Microcerotermes dubius	Iso	Various tree hosts including *Acacia mangium*	Stems	Malaysia	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Myllocerus undatus	Myllocerus	Btle	*Acacia auriculiformis*, bottle	Leaves	India, Sri Lanka and	MEDIUM	HIGH	HIGH	MEDIUM	MEDIUM

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	undatus		brush, citrus, coconut, fig, longan, loquat, lychee, peach, mango, citrus, tropical almond (*Terminalia catappa*), oaks, various figs, *Syzygium* spp., and a range of other plants		Florida in US					
Namibia spinosa	Namibia spinosa	Bug	*Acacia oshanesii, Vachellia erioloba* (syn. *Acacia erioloba*)	Above ground plant parts	Nambiar, South Africa	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Nasutitermes matangensis	Nasutitermes matangensis	Iso	Various tree hosts including *Acacia mangium*	Stems	Malaysia	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Neocoelostoma xerophila	Neocoelostoma xerophila	Bug	*Acacia auriculiformis, Vachellia aroma* (syn. *Acacia aroma*); *Vachellia astringens* (syn. *Acacia atramentaria*), Sweet Acacia (*Vachellia farnesiana* (syn. *A. farnesiana*)), *Vachellia macracantha* (syn. *Acacia macracantha*), *Anadenanthera peregrine*, Parkinsonia praecox	Above ground plant parts	Argentina, Bolivia, Brazil, Paraguay	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Neopinnaspis harperi	Neopinnaspis harperi	Bug	Wide host range including *Acacia melanoxylon, A. longifolia*, walnut, black walnut, avocado, magnolia, willow, Prunus, fig	Above ground plant parts	Hawaii, Japan, Taiwan, US	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Orthezia urticae	Orthezia urticae	Bug	Hosts from 28 families. *Acacia oshanesii* affected. Other hosts include Rosa, Pyrus, Rubus, Vicia, Vitis, Lavandula and others	Above ground plant parts	widespread in Europe, Middle east, central Asia and in reported from China	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Pachypasa capensis	Brown lappet moth; Cape lappet	Lep	*Acacia* spp. (including Acacia *cyclopis, Acacia mearnsii, Acacia saligna*), Karroo thorn	Above ground plant parts	South Africa	LOW	MEDIUM	MEDIUM	NEGLIGIBLE	NEGLIGIBLE

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	moth		(*Vachellia karroo* (syn. *Acacia karroo*)), *Pinus* spp., Bitou bush (*Chrysanthemoides monilifera*), Eucalypts							
Phalera grotei	Grote's buff tip moth	Lep	Hosts include *Acacia auriculiformis*	Leaves	southern Asia from India to Indonesia	LOW	MEDIUM	MEDIUM	MEDIUM	LOW
Philaenus spumarius	Meadow spittle bug; Meadow frog hopper	Bug	Wide host range including: olives, *Acacia* spp., lucerne, clovers, vetch, and many other hosts	Above ground plant parts	Widespread in the northern hemisphere including: Europe, Asia and North America. Also occurs in New Zealand	LOW	MEDIUM	MEDIUM	UNKNOWN	UNKNOWN
Platypus pseudocupulatus	Ambrosia beetle	Btle	Various including *Acacia crassicarpa* (note actually feeds on fungi that grow on the walls of galleries bored into living or freshly cut trees)	Stems	Malaysia	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Bug	Polyphagous across 88 genera in 38 plant families including *Acacia* spp., eucalyptus, pineapple, papaya, mango, maize, capsicum, tomato, lychee, citrus	Leaves, fruit	North America, South America, tropical parts of Southern Asia. In Torres Strait	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Pteroma plagiophleps	Bag worm	Lep	*Acacia mangium*, Gum Arabic tree (*Vachellia nilotica* (syn. *A. nilotica*)), *A. auriculiformis*, Eucalyptus, *Terminalia catappa*, *T. indica* and other tree hosts	Leaves	Indonesia, Vietnam, Bangladesh, India, Malaysia, Sierra Leone	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Russellaspis pustulans pustulans	Scale insect	Bug	Wide host range including: *Acacia decurrens*, Sweet Acacia (*Vachellia farnesiana* (syn. *A. farnesiana*)), Gum Arabic tree	Above ground plant parts	Widespread in Africa, Asia, Central, South, and North America. Closest populations are	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

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			(*Vachellia nilotica* (syn. *A. nilotica*)), *Albiza lebbeck*, pigeon pea, gardenia, citrus, *Prunus* spp., eucalyptus, oak, grapevine, apple, tea		in PNG, Indonesia and New Caledonia					
Schistocerca gregaria	Desert locust	Locu	*Acacia*, pigeon pea, cotton, citrus, barley, cassava, date-palm, sugarcane, sesame, sorghum, wheat, grapevine, maize	Leaves, inflorescence, seeds	Widespread in Asia, the Middle East, Africa, Caribbean, Venezuela, France, Portugal, Spain	NEGLIGIBLE	VERY LOW	MEDIUM	MEDIUM	NEGLIGIBLE
Scirtothrips aurantii (exotic biotypes)	South African citrus thrips	Thri	Polyphagous across more than 50 plant species including lemon, navel orange, mango, asparagus, grevillea, *Acacia*, tea, cotton, macadamia, banana, castor bean, grapevine, pomegranate, silky oak, groundnut, glory lily, macadamia	Fruit, leaves, growing points	widespread in Africa (Angola, Cape Verde, Egypt, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Reunion, Senegal, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zimbabwe) and Yemen. Introduced into Australia, where it is only reported on Mother of Millions (Bryophyllum and Kalanchoe)	HIGH	HIGH	HIGH	LOW	LOW
Speiredonia retorta	Comma moth	Lep	*Acacia mangium*, *Albizia* spp.	Leaves	Southern Asia including South Korea, Vietnam, Malaysia	LOW	LOW	LOW	LOW	NEGLIGIBLE
Stictococcus coccineus	Scale insect	Bug	*Acacia oshanesii*	Above ground plant parts	Uganda	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Tachardina aurantiaca	Yellow lace scale	Bug	Wide host range including *Acacia auriculiformis, A. sphaerocephala*, pigeon pea (*Cajanus cajan*), *Ziziphus*	Above ground plant parts	Indonesia, Malaysia, Singapore, Thailand, Christmas Island	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE

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			jujuba, Z. mauritiana, citrus							
Tetraleurodes acaciae	Acacia whitefly	Bug	*Acacia baileyana, Acacia koa, Acacia linifolia* (syn. *Acacia linearis*), *Acacia melanoxylon, Acacia pravissima, Vachellia collinsii* (syn. *Acacia collinsii*), *Albizia* spp., *Calliandra* spp., capsicum, *Cassia* spp., *Erythrina* spp., soybean, common bean, wisteria	Above ground plant parts	US, Mexico	MEDIUM	HIGH	HIGH	LOW	LOW
Toumeyella fontanai	Scale insect	Bug	*Acacia oshanesii*	Above ground plant parts	Mexico	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Valanga nigricornis	Javanese grasshopper	Orth	*Acacia mangium*, oil palm, rubber, and a range of trees and shrubs	Leaves	southern Asia including Thailand, Malaysia, Indonesia, Philippines, Singapore, Indonesia	LOW	MEDIUM	HIGH	LOW	VERY LOW
Waxiella egbara	Scale insect	Bug	*Acacia decurrens, Albizia lebbeck, Albizia saman, Brachystegia spiciformis,* Pigeon pea (*Cajanus cajan*), *Prosopis juliflora, Pterocarpus santalinoides, Melia azedarach*	Above ground plant parts	Angola, Congo, Cote d'Ivory, Gabon, Ghana, Kenya, Malawi, Namibia, Nigeria, Saudi Arabia, South Africa, Tanzania, Uganda, Zimbabwe	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Waxiella erithraea	Scale insect	Bug	*Acacia oshanesii*	Above ground plant parts	Eritrea	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Waxiella mimosae mimosae	Scale insect	Bug	*Acacia verticillata* (prickly moses), *Acacia asak*, Gum arabic tree (*Vachellia nilotica* (syn. *A. nilotica*)); Red Acacia (*Vachellia seyal* (*Acacia seyal*)); Umbrella thorn Acacia (*Vachellia tortilis* (syn. *Acacia tortilis*)); Karroo thorn	Above ground plant parts	Algeria, Angola, Egypt, Saudi Arabia, Israel	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE

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			(*Vachellia karroo* (syn. *Acacia karroo*)), Albizia, casurina, Tamarix							
Waxiella subsphaerica	Scale insect	Bug	Four plant families affected. *Acacia dealbata* listed as a host	Above ground plant parts	Angola, Cameroon, Congo, Cote d'Ivory, Gabon, Madagascar, Mozambique, Tanzania, Zambia, Zimbabwe	LOW	MEDIUM	LOW	NEGLIGIBLE	NEGLIGIBLE
Xylosandrus compactus	Shot-hole borer; Black twig borer	Btle	Broad host range across over species including *Acacia auriculiformis, A. mangium, A. koa,* Sweet Acacia (*Vachellia farnesiana* (syn. *A. farnesiana*)), Albizia lebbeck, tea, coffee, cocoa, cinnamon, macadamia, mango, avocado, pine, oak and African mahogany	Stem	Widespread including: Cambodia, China, East Timor, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, US, Brazil, Peru, parts of Central America, much of Africa, Italy, Fiji, New Zealand, Samoa, Solomon Islands, American Samoa	HIGH	HIGH	HIGH	MEDIUM	MEDIUM
Xystrocera festiva	Albizia borer	Btle	*Acacia auriculiformis*, Sengon (*Paraserianthes falcataria* (main host)) Gum Arabic tree (*Vachellia nilotica* (syn. *A. nilotica*)), *Senegalia catechu* (syn. *Acacia catechu*), *Acacia mangium*, *A. mangium* × *A. auriculiformis*, *Albizia chinensis, Albizia lebbeck, Albizia sumatrana, Caliandra callothyrsus, Enterolobium cyclocarpum, Pithecelobium*	Trunk and stems	Indonesia, Vietnam	MEDIUM	HIGH	HIGH	HIGH	HIGH

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			jiringa, P. dulce, Parkia peciosa and *Samanea saman*							
Zeuzera coffeae	Coffee borer	Lep	*Acacia auriculiformis, A. mangium*, *Eucalyptus deglupta, E. urophylla, Casuarina equisetifolia, Melaleuca cajuputi*, coffee, sandalwood, citrus, teak, tea, cotton	Twigs, branches, stems	Thailand, Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka, Taiwan, Vietnam, Papua New Guinea	HIGH	MEDIUM	MEDIUM	LOW	VERY LOW
Zulubius acaciaphagus		Bug	*Acacia mearnsii*	Seeds	South Africa	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
PATHOGENS										
Ceratocystis albifundus (with vector)	Ceratocystis wilt	Fun	*Acacia mearnsii, A. decurrens, Senegalia caffra* (syn. *Acacia caffra*), *Protea* spp., various native woody plants in South Africa in 7 genera	Whole plant-rapid wilt and death	Southern Africa (including South Africa, Kenya, Tanzania) On A. mearnsii in Uganda (Roux & Wingfield 2001). On A. mearnsii in Zambia and Malawi (Farr, D.F., & Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved October 3, 2017, from https://nt.ars-grin.gov/fungaldatabases). Also Uganda	MEDIUM	HIGH	HIGH	HIGH	HIGH
Ceratocystis albifundus (without vector)	Ceratocystis wilt	Fun	*Acacia mearnsii, A. decurrens, Senegalia caffra* (syn. *Acacia caffra*), *Protea* spp., various native woody plants in South Africa in 7 genera	Whole plant-rapid wilt and death	Southern Africa (including South Africa, Kenya, Tanzania) On A. mearnsii in Uganda (Roux & Wingfield 2001). On A. mearnsii	LOW	HIGH	HIGH	HIGH	MEDIUM

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
					in Zambia and Malawi (Farr, D.F., & Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved October 3, 2017, from https://nt.ars-grin.gov/fungaldatabases). Also Uganda					
Ceratocystis manginecans (syn. *Ceratocystis acaciavora)*	Ceratocystis wilt	Fun	*Acacia mangium, A. crassicarpa*, citrus, cacao (*Theobroma cacaomango*), mango (*Mangifera indica*), Duku (*Lansium parasiticum*), rubber tree (*Hevea brasiliensis*) and *Eucalyptus* spp.	Stems	Indonesia, Malaysia, Oman, Pakistan, Vietnam	MEDIUM	HIGH	HIGH	HIGH	HIGH
Cercospora acaciae-mangii		Fun	*Acacia mangium*	Leaves	Thailand	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Fusarium euwallaceae (with vector)		Fun	55 host genera in US. *Acacia mangium* reported as a host	Whole plant (wilt)	US, Israel, Asia	HIGH	HIGH	HIGH	HIGH	HIGH
Fusarium euwallaceae (without vector)		Fun	55 host genera in US. *Acacia mangium* reported as a host	Stem (wilt)	US, Israel, Asia	LOW	LOW	LOW	HIGH	LOW
Ganoderma philippii	Red root rot; tea root rot	Fun	*Acacia mangium, A. crassicarpa*, and other *Acacia* spp., cacao, tea, coffee, rubber, mangosteen, clove (*Syzygium aromaticum*), *Syzygium* spp.	Roots	Indonesia, Bangladesh, China, India, Myanmar, Sri Lanka, Vietnam, Central African Republic, Congo, Democratic Republic of the Congo, Cote d'Ivory, Gabon, Nigeria, Brazil, New Caledonia, Papua New Guinea, Solomon Islands	LOW	LOW	MEDIUM	MEDIUM	VERY LOW

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Meloidogyne ethiopica	Root-knot nematode	Nem	Wide host range including *Acacia mearnsii*, maize, kiwi fruit, watermelon, chili, common bean, tomato, potato, lettuce, grapevine	Roots	Greece, Turkey, Brazil, Turkey, Ethiopia, Kenya, Mozambique, South Africa, Tanzania, Zimbabwe, Brazil, Chile, Peru	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Phytophthora acaciae		Fun	*Acacia mearnsii*	Stems, branches (gummosis)	Brazil	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Phytophthora ramorum	Sudden oak death	Phth	Wide host range including oaks etc., *Acacia melanoxylon* has been shown to be mildly susceptible in pathogenicity studies (Ireland et al. 2012)	Leaves	US and Europe, India	HIGH	HIGH	HIGH	MEDIUM	MEDIUM
Poria hypobrunnea (syn. *Rigidoporus hypobrunneus)*	Heart rot	Fun	*Acacia mangium*, *Citrus* spp., rubber, cocoa	Stems	Indonesia. Malaysia, Ghana	LOW	LOW	LOW	LOW	NEGLIGIBLE
Psuedolagarobasidium acaciicola		Fun	*Acacia cyclops*	Roots	South Africa, Vietnam	LOW	LOW	LOW	LOW	NEGLIGIBLE
Rigidoporus microporus (syn. *Rigidoporus lignosus)*	White rot	Fun	Wide host range including *Acacia mangium*, mango, rubber, cacao, cassava, tea, citrus, Indian coral tree (*Rigidoporus microporus*), coffee	Stems, roots	Tropical Africa, North, Central and South America, Pacific Islands and southern Asia including: Indonesia, Brunei, India, Malaysia, Myanmar, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam, Angola, Benin, Cameroon, Central Africa Republic, Congo, Demographic Republic of the Congo, Cote D'Ivory, Equatorial	LOW	LOW	LOW	LOW	NEGLIGIBLE

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
					Guinea, Ethiopia, Gabon, Ghana, Kenya, Nigeria, Sierra Leone, Uganda, Mexico, parts of United States, Costa Rica, Dominican Republic, Guatemala, Trinidad and Tobago, Argentina, Brazil, PNG, Vanuatu, Solomon Islands, American Samoa New Zealand (Fungal databases)					
Tinctoporellus epimiltinus	Brown rot	Fun	*Acacia mangium,* Araucaria, Camellia, Castanopsis, Casuarina, Eucalyptus, Eugenia, Fraxinus, Metrosideros, Psidium, Quercus, Syzgium etc but does not mention *Acacia* spp.	Stems	Hawaii, PNG, Japan, West Indies, Japan, Indonesia	LOW	LOW	LOW	LOW	NEGLIGIBLE
Xylella fastidiosa subsp. multiplex (with vector)	Xylella	Bac	Wide host range including *Acacia dealbata*, *Prunus* spp., rosemary, hebe, pecan, almond, blueberry, elm, peach, pigeon pea, plum and a wide range of other species.	Whole plant	Europe, North America. Reported on Acacia in Europe	HIGH	HIGH	HIGH	HIGH	HIGH
Xylella fastidiosa subsp. multiplex (without vector)	Xylella	Bac	Wide host range including *Acacia dealbata*, *Prunus* spp., rosemary, hebe and a wide range of other species.	Whole plant	Europe, North America. Reported on Acacia in Europe	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE
Xylella fastidiosa subsp. pauca (with vector)	Xylella	Bac	Wide host range including: *Acacia saligna*, *Grevillea juniperina*, Lavender, *Myrtus communis*, oleander, olive,	Whole plant	Europe, North America. Reported on Acacia in Europe	HIGH	HIGH	HIGH	HIGH	HIGH

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	HOSTS	PLANT PART AFFECTED	CURRENT DISTRIBUTION OF PEST	ENTRY POTENTIAL	ESTABLISHMENT POTENTIAL	SPREAD POTENTIAL	IMPACT	OVERALL RISK
			coffee, citrus, *Prunus* spp., grapevine, Westringia							
Xylella fastidiosa subsp. pauca (without vector)	Xylella	Bac	Wide host range including *Acacia saligna, Grevillea juniperina*, Lavender, *Myrtus communis*, oleander, olive, *Prunus* spp., grapes, westringia	Whole plant	Europe, North America. Reported on Acacia in Europe	LOW	LOW	LOW	NEGLIGIBLE	NEGLIGIBLE

Established pests affecting Australian Acacia species

As Acacia are widespread in Australia there are a number of established pests that have been reported as damaging to Australian *Acacia* species. For example, the endangered *Acacia chapmanii* subsp. *australis* and the fat-leaved wattle (*Acacia pinguifolia*) are threatened by the established pathogen *Phytophthora cinnamomi* (Department of the Environment and Energy 2007; 2012a).

Table 2 (below) provides a list of the more significant established pests (including both pests that evolved in Australia and those that have been introduced and subsequently established in Australia) that affect Australian *Acacia* species. This list is not meant to be exhaustive, instead it is designed to highlight examples that can be drawn on when developing future biosecurity awareness and communications material.

Table 2: *Established pests of Acacia of biosecurity significance.*

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
INVERTEBRATES							
Agrotis ipsilon	Black cutworm	Lepidoptera (Moth)	*Acacia* spp.	Australia, Vietnam	Foliage and stems	Leaf and stem feeding pest of nursery stock (ie seedlings)	Wylie et al., (1997)
Carpophilus hemipterus	Dried fruit beetle	Coleoptera (Beetle)	*Acacia* spp., fig, date, stone fruit	Australia South Africa, United States (California)	Above ground plant parts	Vector of *Ceratocystis albifundus* in Africa (Health et al., 2009), pest of dried fruit in Unite States (Bartelt et al., 1992)	Health et al., 2009); Bartelt et al., (1992)
Dasineura rubiformis	Midge	Diptera (Fly)	Many Australian *Acacia* spp. have been reported as hosts including: *A. mearnsii, A. parramattensis, A. irrorata, A. deanei, A. leucoclada, A. constablei*	Australia, South Africa	Flowers	Causes galls to form on flowers stopping seed set. Trialled as a possible biocontrol in South Africa (Impson et al., 2008)	Impson et al., (2008)
Eurema hecabe		Lepidoptera (Moth)	*Acacia mangium*	Australia, Vietnam	Foliage	Leaf feeder, mainly on nursery stock	Wylie et al., (1997)
Euwallacea fornicatus (Syn. *Xyleborus fomicatus*)	Pin hole borers	Coleoptera (Beetle)	*Acacia mangium*	Australia, Indonesia	Twigs	Attacks small branches causing twigs to break (Nair and Sumardi 2000)	Nair (2000)
Gryllotalpa africana	Mole cricket	Orthoptera (cricket)	*Acacia mangium, A. auriculiformis*	Australia, Asia, Africa, North and South America	Seedlings	Feed on young seedlings and shoots cutting them off at night	Thu et al., (2010)
Melanterius maculates	Acacia weevil	Coleoptera (Beetle)	*Acacia* spp. including: *Acacia dealbata, A. decurrens, A. mearnsii*	Australia, South Africa	Seeds	Seed feeding weevil. Used as biocontrol in South Africa (Wingfield et al., 2011)	Wingfield et al (2011)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
Ochrogaster lunifer	Bag shelter moth	Lepidoptera (Moth)	*Acacia* spp. including: *A. acuminata, A. pendula, A. aneura*	Australia	Foliage	Serious defoliator of Raspberry jam wattle (*Acacia acuminata*) (Van Schagen et al., 1992), which is used as host plants for Australian sandalwood (Commonwealth of Australia 2013)	Van Schagen et al., (1992); Commonwealth of Australia (2013)
Trichilogaster Acaciaelongifoliae	Gall wasp	Hymenoptera (Wasp)	*Acacia longifolia*	Australia, South Africa	Branches	Gall forming wasp. Used as biological control of *A. longifolia* in South Africa and trialled in Portugal	Marchante et al., (2011)
Xylosandrus crassiusculus	Granulate ambrosia beetle; Asian ambrosia beetle	Coleoptera (Beetle)	*Acacia* spp. (including: *A. mangium, A. koa*), *Eucalyptus* spp., coffee, mango, papaya, teak, rubber, mahogany, tea, crape myrtle	Australia, Equatorial Africa, India, Sri Lanka, China, Malaysia, Japan, Indonesia, Papua New Guinea, Hawaii, and southern parts of the United States	Twigs, branches, stems	Females bore into twigs and branches (2-30cm in diameter). Cause wilting, dieback, shoot breakage, reduced vigour	Thu et al., (2010)
Xystrocera globosa	Lebbek borer	Coleoptera (Beetle)	*Acacia mangium*	Australia, Malaysia, India, Sri Lanka, NW Australia, Thailand, Philippines, Egypt, Mauritius and Hawaii	Stems	Stem borer, plantation pest	Wylie et al., (1997)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
PATHOGENS AND NEMATODES							
Atelocauda digitata	Phyllode rust	Fungus	*Acacia aulacocarpa, A. auriculiformis, A. crassicarpa, A. koa, A. leptocarpa, A. mearnsii, A. mangium, A. polystachya*	Australia, Papua New Guinea, China, Hawaii, Indonesia, New Zealand	Foliage	Causes blisters and malformation of leaves/phyllodes, growing tips, fruit. Infections in young trees can cause the death of the main stem and cause loss of apical dominance. Can be a significant problem in nurseries and young plantations overseas. Pathogen is widespread in Australia	Old et al., (2000)
Botryodiplodia theobromae	Root disease	Fungus	*Acacia auriculiformis, A. mangium, A. crassicarpa*	Australia, India	Roots	Root disease	Sharma and Florence (1996)
Botryosphaeria dothidea	Botryosphaeria canker	Fungus	*Acacia mearnsii*	Australia, South Africa	Stems	Causes canker and die back. Trees may break at canker site. Tends to affect stressed trees (including drought stressed, insect damaged or pruning damaged trees) (FAO 2007)	FAO (2007)
Cephaleuros virescens	Algal leaf spot	Algae	*Acacia* spp.	Worldwide between 32ºN and 32ºS, including Australia.	Foliage	Minor issue. Occurs on stressed plants under high humidity (Old et al 2000)	Old et al., (2000)
Colletotrichum gloeosporioides	Colletotrichum foliar spot	Fungus	*Acacia* spp. including: *A. aulococarpa, A. crassicarpa,*	Australia, Florida, Vietnam and Thailand	Foliage	Leaf spots and pod spots	Old et al., (2000), Old et al., (1996)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
			A. auriculiformis, A. mangium				
Cylindrocladium quinqueseptatum	Foliar spot	Fungus	*Acacia auriculiformis, A. mangium, Eucalyptus* spp.	Australia, India	Foliage	Leaf spots	Sharma and Florence (1996)
Endoraecium auriculiforme		Fungus	*Acacia auriculiformis*	Australia (NT)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium bicinctum		Fungus	*Acacia fasciculifera*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium carnegiei		Fungus	*Acacia dealbata*	Australia (NSW)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium digitatum		Fungus	*Acacia notabilis*	Australia (SA)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium disparrimum		Fungus	*Acacia disparrima*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium falciforme		Fungus	*Acacia falciformis*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium irroratum		Fungus	*Acacia irrorata*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium maslinii		Fungus	*Acacia daphnifolia*	Australia (WA)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium parvum		Fungus	*Acacia leiocalyx*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts	McTaggart et al.,

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
						affected	(2015)
Endoraecium peggii		Fungus	*Acacia holosericea*	Australia (NT)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium phyllodiorum		Fungus	*Acacia aulacocarpa*	Australia (Qld, NSW)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium podalyriifolium		Fungus	*Acacia podalyriifolia*	Australia (NSW, Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium tierneyi		Fungus	*Acacia harpophylla*	Australia (Qld)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium tropicum		Fungus	*Acacia tropica*	Australia (NT)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium violae-faustiae		Fungus	*Acacia crassicarpa, A. aulacocarpa, A. difficilis*	Australia (Qld, NT)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Endoraecium walkerianum		Fungus	*Acacia penninervis*	Australia (NSW)	Foliage	Rust, limited information on impact other than hosts affected	McTaggart et al., (2015)
Exserohilum rostratum	Foliar spot	Fungus	*Acacia auriculiformis*	Australia, India	Foliage	Leaf spot	Sharma and Florence (1996)
Ganoderma lucidum	Root rot	Fungus	*Acacia auriculiformis*	Australia, India	Roots	Root disease	Sharma and Florence (1996)
Glomerella cingulata (Ana. *Colletotrichum gloesporioides*)	Colletotrichum foliar spot	Fungus	*Acacia* spp. including *A. saligna* (Syn. *A. cyanophylla*),	Australia, United States, Papua New Guinea and India	Foliage	Foliar spots and tip necrosis reported (Old et al 2000), causes anthracnose	Old et al., (2000); Barnard and Schroeder (1984)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
			A. aulacocarpa, A. crassicarpa, A. auriculiformis			symptoms on foliage, especially in nurseries (Barnard and Schroeder 1984)	
Macrophomina phaseolina	Dieback	Fungus	*Acacia auriculiformis*	Australia, India	Roots	Root disease	Sharma and Florence (1996)
Mycosphaerella acaciigena (Ana. *Pseudocercospora acaciigena*)		Fungus	*Acacia mangium. Eucalyptus* spp.	Native to North-eastern Queensland & Southern Papua New Guinea. Also occurs in Venezuela.	Foliage	Leaf spots form along the length of the leaf. Black raised ascomata form on both sides of the leaf. More of a nursery issue than a field pest	Crous et al., (2004)
Mycosphaerella citri	Greasy spot	Fungus	*Acacia manigum*	Widespread in the tropics including Australia, South Africa, Asia	Stems	Leafspots reported on Acacia in Thailand. Infections were intermixed with *M. thailandica* and *C. acaciaemangii*	Crous et al, (2004)
Mycosphaerella thailandica (Ana. *Pseudocercospora thailandica*)		Fungus	*Acacia mangium. Musa* spp., *Eucalyptus* spp.	Native to North-eastern Queensland & Southern Papua New Guinea. Reported in Australia on *Musa.* On eucalypt in Thailand and Laos. Also reported from Brazil, Mozambique, West Indies, Cameroon	Foliage	Causes leaf spots. Bigger issue in nurseries than in the natural environment	Crous et al., (2004)
Phanerochaete salmonicolor (Syn. *Corticium salmonicolor*)	Pink disease	Fungus	*Acacia mearnsii, A. crassicarpa*	Australia, Indonesia	Stems	Cankers and dieback are caused by this disease	FAO (2007)
Phellinus noxius	Brown rot; heart rot	Fungus	*Acacia mangium*	Widespread occurring in Australia,	Roots	Causes brown rot, die back and poor growth	Mohammed et al., (2006)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
				North and South America, Asia, Europe and Africa			
Phytophthora cinnamomi	Dieback	Oomycete	Wide host range of 1000 species including: *Acacia* spp. (including the endangered *Acacia chapmanii* subsp. *australis* and *Acacia pinguifolia*; and the critically endangered *A. whibleyana* and the vulnerable *A. rhetinocarpa*)	Australia, Indonesia	Stems	Causes significant die back and plant death. The Endangered *Acacia chapmanii* subsp. *australis* and the Fat-leaved Wattle (*A. pinguifolia*) are threatened by *Phytophthora cinnamomi (Pc) (*Department of the Environment and Energy, 2007; 2012a). Pobke (2007) considers that *Pc* is a possible risk to the endangered *A. pinguifolia* (and presumably, the critically endangered *A whibleyana* and the vulnerable *A. rhetinocarpa*). Velzeboer et al (2005) (cited in Pobke, 2007), rate the critical habitat of these species as being within either Low (*A. rhetinocarpa* & *A. whibleyana*) or Medium to Low (*A. pinguifolia*) *Pc* Management Zones in SA. Note, there is no evidence that any of these 3 species have been directly affected by Pc to date	Department of the Environment and Energy (2007); Department of the Environment and Energy (2012a); Velzeboer et al., (2005); Pobke (2007)
Phytophthora frigida	Phytophthora	Oomycete	*Acacia decurrens, A. mearnsii*, *Eucalyptus smithii*. *E. duni* and *Eucalyptus* spp.	Australia (NSW), South Africa, Brazil (CABI; Fungal data bases).	Roots, stem	Reported to cause gumosis in Brazil and root and collar rot in South Africa	Forest Phytophthoras of the World (2017)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
Phytophthora palmiviora	Black canker	Oomycete	*Acacia mangium*	Australia, South Africa, New Zealand	Foliage	Canker disease	Nair (2000)
Uromycladium acaciae	Acacia rust	Fungus	*Acacia mearnsii, A. decurrens, A. terminalis*	Australia, New Zealand	Foliage	Causes leaf spots, stem deformation, defoliation, gummosis, stunting and die back in South Africa	McTaggart et al., (2015)
Uromycladium alpinum	Acacia rust	Fungus	*Acacia baileyana, A. dealbata, A. mearnsii; A. buxifolia, A, dallachiana, A. decora, A. implexa, A. linifolia*	Australia, Timor-Leste, Philippines, Brazil, South Africa	Foliage	Distortion and chlorosis of new flush of leaves/phyllodes in spring. Reported to cause seedling losses in New Zealand nurseries	Dick (2009)
Uromycladium fusiporum	Acacia rust	Fungus	*Acacia salicina*	Australia, New Zealand	Foliage	Rust fungus	McTaggart et al., (2015)
Uromycladium maritimum	Acacia rust	Fungus	*Acacia floribunda, A. longifolia, A. notabilis, A. sophoae*	Australia, New Zealand	Foliage	Causes leaf lesions. Not economically important in New Zealand	Dick (2009)
Uromycladium notabile	Acacia rust	Fungus	*Acacia* including: *A. baileyana, A. binervata, A. dealbata, A. decurrens, A. elata, A. farnesiana, A. mearnsii, A. notabilis, A. parramattensis, A. pruinosa, A. penninervis, A. pycnantha, A. rubida, A. verticillata*	Australia, New Zealand	Foliage	Galls cause stem and shoot malformation and in some cases, can cause plant death	Old et al., (2000)
Uromycladium robinsonii	Acacia rust	Fungus	*Acacia melanoxylon, A. longifolia*	Australia, New Zealand	Foliage	Small galls form on leaves/phyllodes, can cause defoliation and die-back. Generally, not a significant issue but isolated outbreaks can cause extensive die-	Dick (2009)

SCIENTIFIC NAME	COMMON NAME	LIFE FORM	ACACIA AND RELATED HOSTS	DISTRIBUTION	PLANT PART AFFECTED	IMPACT	RELEVANT REFERENCES
						back in plantations	
Uromycladium simplex	Acacia rust	Fungus	*Acacia pycnantha, A. brachybotrya*	Australia, Papua New Guinea, Indonesia, New Zealand, South Africa	Foliage	Rust fungus	McTaggart et al., (2015)
Uromycladium tepperianum	Gall rust	Fungus	120 *Acacia* spp. have been recorded as hosts[23]. *The related Albizia fulva; Albizia montana; Falcataria moluccana; Paraserianthes falcataria* are also affected	Occurs in parts of Australia, New Caledonia, New Zealand, South Africa, Asia (including Indonesia, Papua New Guinea and East Timor)	Foliage	Galls cause stem and shoot malformation and in some cases, can cause plant death. Used as a biocontrol of *Acacia saligna* in South Africa (Old et al., 2000). Reported to potentially reduce seed set and are therefore a threat to some endangered species such as *Acacia enterocarpa* (Department of the Environment and Energy 2012b)	Old et al., (2000); Department of the Environment and Energy (2012b); Farr and Rossman (2018)

[23] *Acacia* spp. hosts include: *A. acanthoclada; A. aciphylla; A. acuaria; A. acuminata; A. acutata; A. ancistrophylla; A. aneura; A. armata; A. beauverdiana; A. biflora; A. bivenosa; A. blakelyi; A. brachyphylla; A. bynoeana; A. calamifolia; A. cochlearis; A. cochlocarpa; A. cometes; A. coolgardiensis; A. cunninghamii; A. cupularis; A. cyclops; A. daviesioides; A. decurrens; A. dielsii; A. diffusa; A. divergens; A. duriuscula; A. erinacea; A. erioclada; A. estrophiolata; A. extensa; A. filifolia; A. flavescens; A. fragilis; A. genistifolia; A. glaucoptera; A. gonophylla; A. hakeoides; A. harpophylla; A. hastulata; A. holosericea; A. implexa; A. intricata; A. ixiophylla; A. jibberdingensis; A. juniperina; A. kempeana; A. kochii; A. lasiocalyx; A. latior; A. leiocalyx; A. leptoneura; A. leptopetala; A. ligulata; A. ligustrina; A. linophylla; A. longifolia; A. longiphyllodinea; A. marramamba; A. mearnsii; A. melanoxylon; A. menzelii; A. merrallii; A. microcarpa; A. multispicata; A. myrtifolia; A. neurophylla; A. nigricans; A. nigripilosa; A. nyssophylla; A. obliqua; A. oswaldii; A. paradoxa; A. pendula; A. penninervis; A. prainii; A. pycnantha; A. ramulosa; A. resinomarginea; A. restiacea; A. riceana; A. rigens; A. rossei; A. rostellifera; A. rotundifolia; A. salicina; A. saligna; A. scirpifolia; A. sclerosperma; A. sibina; A. siculiformis; A. signata; A. spathulifolia; A. sphacelate; ; A. spinescens; A. spirorbis; A. Stowardii; A. stricta; A. sulcata; A. tanumbirinensis; A. teretifolia; A. tetragonophylla; A. torulosa; A. tratmaniana; A. trigonophylla; A. trineura; A. triptycha; A. truncata; A. tysonii; A. ulicifolia ; A. ulicina; A. urophylla; A. verniciflua; ; A. verticillata; A. vomeriformis; A. wattsiana; A. wilhelmiana; A. xerophila* (Farr and Rossman, 2018).

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