Damage Agents
Investment Plan Review

September 2022

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Acknowledgements
The authors gratefully acknowledge the support provided by the following organisations through the in-kind provision of their staff to assist with this review:

Australian Bluegum Plantations, Australian Forest Products Association, Agriculture Victoria, Commonwealth Scientific and Industrial Research Organisation, Forest Wood Products Australia, Hancock Queensland Plantations, WA Plantation Resources, New South Wales Department of Primary Industries, PF Olsen, Plant Health Australia, Queensland Department of Fisheries and Agriculture, Sustainable Timbers Tasmania, University of South Australia, University of the Sunshine Coast, University of Tasmania.

Declarations of interest
Authors of this review declare they have no direct interest in any of the RD&E proposals put forward as part of this review. Participants acknowledge they may receive funding from RD&E proposals considered in this investment plan review.

[1] Previously employed by Plant Health Australia

Background

The vision of the Grower Research Advisory Committee (GRAC)[2] is to "*double the value of Australia's commercial forests by 2040, by fostering an innovation culture in our enterprises, applying world's best practices, collaborating and investing into research and development as appropriate*".

In support of the GRAC Vision, FWPA commissioned a suite of investment plans that provided technical reviews and business cases to guide industry investment in RD&E for the Australian plantation sector from 2019 to 2023, with an outlook to 2028 and beyond to 2040.

A Damage Agents Investment Plan (DAIP)[3] reviewed opportunities for progressing the GRAC Vision through investments in RD&E that reduce the risks of losses from forest damage agents. RD&E into three groups of damage agent categories were considered:

1. long established (native pests, long-established exotic pests, and climate),
2. newly established exotic pests (within the past 1-2 decades) and,
3. exotic pests (not present in Australia).

Discussions through the Forest Health and Biosecurity (FHaB) sub-committee[4] highlighted that initial prioritisation of investments under the DAIP had not been informed by expert opinion. Furthermore, there was need for a review of the DAIP that considered emerging technologies, changing damage agent profiles, new project proposals and the upcoming implementation of a National Forest Pest Surveillance Program.

The Australian Forest Products Association (AFPA), Forest Wood Products Australia (FWPA) and Plant Health Australia (PHA) collaborated to undertake the review.

Review Objectives

This review aims to provide expert-driven recommendations to the GRAC to consider when making investment decisions and, to update the portfolio of RD&E projects and priorities that should be considered in the DAIP. For each of the three damage agent categories this review aimed to:

1. Review status of investment or completion of proposed RD&E projects
2. Provide expert opinion on the prioritisation of existing RD&E projects
3. Provide expert opinion on the prioritisation of newly proposed RD&E projects

Method

Three teleconference workshops were held over a 4-month period through 2021-22 (*Table 1*) and gathered plantation research, forest health and biosecurity experts from across government, industry and the research sectors (*Appendix*). Individual workshops focused on a particular aspect of the review (*Table 1*). Prior to each meeting attendees were provided with a list of projects with an accompanying brief description and asked to provide comment prior to the meeting. At the workshop, a brief background for each project proposal along with out-of-session comments that

[2] An advisory committee to Forest and Wood Products Australia.
[3] Wardlaw, T (2019) *An investment plan for research, development and extension to minimise threats from forest damage agents*. Forest Wood Products Australia, Melbourne, Australia.
[4] A sub-committee of the Grower Chamber of Australian Forest Products Association.

were received, was provided by PHA or directly by the project proponent (if present). This was followed by discussion amongst the review group on the merits of the proposal.

An FWPA call for new research project ideas in November 2021 was used as an opportunity to collate new project proposals not previously identified in the DAIP, so that they too could be reviewed, prioritised and recommended for inclusion into the DAIP by the panel of experts (*Table 3*). Not all new proposals were ranked as some were either already being funded through other processes or insufficient information had been received to properly assess their merit. For the sake of completion these projects are also presented (see *Appendix*).

Using Microsoft Teams polling software, attendees were asked to rate projects High, Medium or Lower priority for investment (*Table 2*;*Table 3*). Attendees were asked to consider the scientific merit of each proposal, its ability to produce results that are directly applicable in an operational sense, minimise damage agent risks or result in increased productivity.

Table 1: Damage Agents Investment Plan review meeting dates and the topics discussed.

Workshop	Date	Attendees	Topics reviewed
1	14/12/2021	22	Long Term damage agents
2	11/01/2022	20	Newly established & not yet established damage agents
3	10/03/2022	20	New proposals

Outcomes from all three meetings were compiled and drafted into this summary report with all stakeholders afforded the opportunity to provide final comments.

Outcomes

A draft of this report was reviewed by workshop participants and their comments were considered in finalisation of the report.

Outcomes of the workshop are set out in Tables 2 and 3.

Table 2: Prioritisation of existing RD&E projects within Damage Agents Investment Plan. Research Project Topics were scored High, Medium or relatively Lower priority.

Damage Agent	Code	Research Theme	Research Project	2018 score	2022 score	Comment
Long established	1.1.1	Drought Induced Damage	Drought-risk - retrospective analysis	Medium	Medium	
	1.1.2	Drought Induced Damage	Delivering surveillance products	Medium	High	Change focus - 95% agreed that surveillance products should deliver outputs applicable to any damage not just drought. New projects should be proposed.
	1.2.1	Climate change - adapting to heatwaves	Understanding and managing the threat from heatwaves	Medium	Medium	
	1.3.1	Maintaining effective management procedures	Sirex biocontrol - nematode inoculation / tropical pines	High	Medium	
	1.3.2	Maintaining effective management procedures	AgDisp parameterisation for drift / canopy permeability – focus on canopy permeability of eucalypts; and drone application.	High	Medium	AgDisp used by Forest Pest Management Research Consortium
	1.3.3	Maintaining effective management procedures	Gonipterus biocontrol	Medium	High	Several projects funded in recent years
	1.3.4	Maintaining effective management procedures	Risk-based model for mammal browsing	High	Medium	
	1.3.5	Maintaining effective management procedures	Review Teratosphaeria research	High	Medium	A synthesis of current knowledge important, but 35% wanted more Control RD&E, 30% more Impacts RD&E. New projects should be proposed.
Newly Established	2.1.1	Myrtle rust diagnostics and pathways	Myrtle rust diagnostics and pathways	High	Medium	Current project will guide any future investment requirements. Some elevated impacts on eucalypts post fire (black butt) and associated with extended La Nina wet (Gympie messmate) but in general the impact from the current strain has been minor. Threats

Damage Agent	Code	Research Theme	Research Project	2018 score	2022 score	Comment
						emerging from Brazil but pathways risks will be better understood from the existing project. Some issues around the rapid diagnostic tool being developed in the US – possible false positives. Other tools being developed in Australia yet to be tested.
	2.1.2	Giant pine scale biocontrol	Giant pine scale biocontrol	High	Medium	
Not Established	3.1.1	Reducing the risk of exotic threats through improved surveillance	Collate historical forest pest data	High	Medium	
	3.1.2	Reducing the risk of exotic threats through improved surveillance	Guidelines to determine pest status (native or exotic)	High	Medium	
	3.1.3	Reducing the risk of exotic threats through improved surveillance	Conduct forest specific national blitz surveys	Medium	High	
	3.2.1	Reducing the risk of exotic threats through improved surveillance	Review diagnostic capability	Medium	Medium	
	3.2.2	Reducing the risk of exotic threats through improved surveillance	Develop National Diagnostic Protocols for forest HPPs	High	Lower	Potential government co-investments for forest HPPs that are also National Priority Pests
	3.2.3	Reducing the risk of exotic threats through improved surveillance	Develop diagnostic methods and tools	High	High	
	3.3.1	Reducing the risk of exotic threats through improved surveillance	Review forest surveillance capability / capacity	High	-	Government has undertaken reviews. Forest industry capacity recognised as low.
	3.3.2	Reducing the risk of exotic threats through improved surveillance	Develop National HPP Surveillance Protocols	Medium	Lower	Potential government co-investments for forest HPPs that are also National Priority Pests. Unsure if pest specific approach is useful.
	3.3.3	Reducing the risk of exotic threats through improved surveillance	Support general surveillance for HPPs	Medium	Medium	
	3.4	Reducing the risk of exotic threats through improved surveillance	Data integration	Medium	-	Ongoing in NFPSP, exotic surveillance
	4.2.4	Reducing the risk of exotic threats through improved surveillance	Design an optimised National Forest Pest HRSS Program / Consultation workshops	Medium	-	Completed
	3.5.1	Reducing the risk of exotic damage agents not amenable to surveillance	Review threats not amenable to surveillance	Medium	Medium	
	3.5.2	Reducing the risk of exotic damage agents not amenable to surveillance	Develop and implement import or border control activities	-	Medium	Government responsibility

Table 3: Prioritisation of new RD&E projects for inclusion into the Damage Agents Investment Plan. Projects were ranked from 3-1, with 3 being higher priority and 1 lower priority projects.

Damage Agent	Research Theme	Research Project	Brief context	2022 score	Comments
Long established	Maintaining effective management procedures	Forest health information system	Lack capability to easily collate a national snapshot of pest and diseases status. Benefits: 1. prioritising investment towards high impact pests. 2. provide pest status data that protects market access.	Medium	Suggest AFPA or PHA to guide and bring together FHS stakeholders across industry, government and CSIRO. Could be bundled as a component of the web portal project below.
	Maintaining effective management procedures	Remote sensing options using free satellite data for digital surveillance, Review of satellite high-res options, Species specific test cases	Remote sensing data can be costly to obtain or process, several solutions are possible. Benefits: 1. Obtain 'free' satellite data that provides information applicable to managements. 2. Guide fit-for-purpose remote sensing solutions dependent on management objective.	High	
	Maintaining effective management procedures	Tree metrics from drone observations including TLD	Quantifying leaf disease damage and inventory metrics still done mostly at a plot level or with transect or drive-by surveys. Benefits: 1. Can obtain whole of compartment or plantation level data for tree height or crown damage index. 2. Better correlate damage indices with growth impacts.	Medium	
	Maintaining effective management procedures	IPM in globulus (Green Triangle and WA) - Gonipterus, Autumn Gum Moth, leaf beetles	Unrestricted chemical usage for pest control over large, forested areas is impractical, expensive and lacks social licence Benefits 1. natural enemy control. 2. targeted chemical usage. 3. socially acceptable / defensible.	Medium	
Not Established	Reducing the risk of exotic threats through improved surveillance	Develop a web portal to provide a central, easily accessible point for information to support forest biosecurity surveillance and biosecurity awareness	Several sources available nationally. Lack capability to easily obtain curated, up to date and nationally consistent forest pest information. Benefits 1. nationally consistent information 2. easily curated and maintained by participants 3. able to produce material tailored to stakeholder (e.g. growers or public)	Medium	This project could be bundled with Forest Information system above. That is, have a system that holds both forest health and biosecurity information.

Damage Agent	Research Theme	Research Project	Brief context	2022 score	Comments
	Reducing the risk of exotic threats through improved surveillance	Conduct pest and pathway risk analyses for forest HPPs and identify surveillance gaps based on existing surveillance activities across the biosecurity continuum	More pathway data and improved models are required. Underpins the NFPSP. Benefit 1. enables design of NFPSP activities to be undertaken where there is highest risk of exotic pest introduction	Medium	Suggest holding off in 2022-23 as government "*Biosecurity commons*" initiative may resolve issue
	Reducing the risk of exotic threats through improved surveillance	Develop Incursion Preparedness Plans for HPPs		High	Suggest holding-off in 2022-23 as NFPSP develops and all stakeholders better understand the needs.
	Reducing the risk of exotic threats through improved surveillance	Determining the distribution of *Pseudocercospera* needle blight in Australia and the threat to pine plantation and developing diagnostics to rapidly identify this needle blight pathogen	Lack of distribution knowledge and effective diagnostic. Benefits 1. enables assessment of the current impacts 2. enables mapping of pest-free areas for market access 3. ability to screen nursery or export stocks	High	
	Reducing the risk of exotic threats through improved surveillance	Optimisation and implementation of environmental DNA metabarcoding (HTS) to support forest biosecurity surveillance	Currently lack this capability. Benefits 1. quickly distinguish between morphologically similar native and exotic species 2. ability to detect species in mixed environmental samples independently of sampling the actual pest	High	Current diagnostics can take time due to lack of capacity, but also due to lack of tools to help speed up the process. This potentially delays an ID.
	Reducing the risk of exotic threats through improved surveillance	Develop and validate rapid diagnostic tools for endemic forestry pathogens	Currently lack this capability. Benefits 1. Rapidly distinguish between endemic foliar pathogens. 2. Methods/protocols could also be leveraged or used to detect exotics.	High	Current diagnostics can take time due to lack of capacity, but also due to lack of tools to help speed up the process. This potentially delays an ID.
	Reducing the risk of exotic threats through improved surveillance	Optimising pest and pathogen trapping grids to support forest biosecurity surveillance	Current trapping grids are based on estimated risk of incursion in an area, and resource capacity to service the traps. Benefits 1. Optimise the number and placement of traps to the relevant exotic pest risk areas.	High	Suggest holding off in 2022-23 as government "*Biosecurity commons*" initiative may resolve issue. Should be bundled with pest spread modelling proposed below.
	Reducing the risk of exotic threats through improved surveillance	Implementing remote sensing and artificial intelligence to support forest biosecurity surveillance	Prior and during a response knowing where all potential tree hosts are is critical. Current methods of detecting hosts are time consuming, resource intensive and inaccurate. Benefit 1. Improved ability to detect all tree hosts of interest 2. Improved ability to monitor some tree host changes over time (e.g., loss of canopy, stress)	High	

Damage Agent	Research Theme	Research Project	Brief context	2022 score	Comments
	Reducing the risk of exotic threats through improved surveillance	Implementing pest spread modelling to support forest biosecurity surveillance	NIFPI project demonstrated capability to conduct pest spread modelling at a regional level (i.e., GT), need to roll this out to all major cities (i.e., points of entry). Benefit: 1. ability to set up trapping grids in locations where exotic pest are most likely to be found.	Medium	Suggest holding off in 2022-23 as government "*Biosecurity commons*" initiative may resolve issue. Should be bundled with trapping grid proposed above.
	Not in investment plan – new theme = Reducing the risk of exotic threats through improved biosecurity responses	Social Science surveys of acceptance of biosecurity control measures in urban environments, including tree destruction	Biosecurity responses are being held up by perceived lack of social licence for tree destruction and chemical usage in urban areas. Benefits 1. Timely biosecurity incident responses 2. Improved understanding of social licence barriers and enablers concerning biosecurity response methods.	High	

Discussion

Rankings provided by the panel of experts in 2022 were only slightly more conservative than those given by the GRAC in 2018 (*Table 2*). For projects already included in the DAIP, experts assigned greater priority to projects that addressed surveillance or diagnostic capacity gaps (projects 1.1.2 / 3.1.2 and project 3.2.3 respectively). This trend was reflected in the new projects not previously part of the DAIP (*Table 3*).

The authors acknowledge that the methodology used is unlikely to capture all perspectives of the importance or merit of a project. Additional new project ideas presented, in some instances, were not sufficiently developed for the experts to be able to rate their importance.

We highlight that priority rankings should not be the only consideration for the GRAC. Several projects, while highly ranked by both GRAC and the expert panel (e.g., 3.1.2 or 3.1.3) are unlikely to be successful until diagnostic capabilities are improved (i.e., projects 3.2.3). Similarly, projects ranked "Lower" should not be deemed unimportant, but simply of a lower priority and should be delayed until other capacity or capability issues are resolved.

Despite these considerations, the results presented in this brief review, accurately capture a snapshot of expert opinion regarding the merits of the RD&E projects proposed within the DAIP.

As these proposals are brought to the GRAC, members are advised to consider:

- the priority rankings provided by technical experts (*Table 2*; *Table 3*)
- the context and justification for the existing projects that are provided in the original *DAIP*[5].
- the context and justification for the new projects provided (*Table 3*)

[5] https://www.fwpa.com.au/images/RDE_Investment_Plans/Damage_Agents-IPNF.pdf

Appendix

Panel of experts

The panel of experts assembled for this review comprised a mix of industry, government and research practitioners or subject matter experts.

Table 4: Damage Agents Investment Plan review meeting attendees and their affiliations.

Attendee#	Org	Sector	Meeting 1	Meeting 2	Meeting 3
Allie Muneri	PF Olsen	Industry	✓	✓	✓
Angus Carnegie	NSW DPI	Government	✓	✓	✓
Ben Bradshaw	ABP	Industry	✓		✓
Caroline Mohammed	UTas	Research			✓
Conrad Trollip	Ag Vic	Government	✓	✓	✓
Danielle Wiseman	IPMG	Industry	✓	✓	✓
Darian Schultz	PF Olsen	Industry	✓		
David Smith	Ag Vic	Government	✓	✓	✓
Dianne Patzel	UniSA	Research	✓	✓	✓
Francisco Tovar	PHA	Independent	✓	✓	✓
Gavin Hunter	CSIRO	Research	✓	✓	
Geoff Pegg	QDAF	Government	✓	✓	✓
Helen Nahrung	USC	Research	✓	✓	✓
Ian Last	HQP	Industry	✓	✓	✓
Janet McDonald	QDAF	Government		✓	✓
Jim O'Hehir	UniSA	Research	✓		
Jodie Mason	FWPA	Industry	✓	✓	
Joel Turner	PF Olsen	Industry	✓	✓	
Karl Wotherspoon	STTAS	Industry	✓	✓	✓
Michael Ramsden	HQP	Industry			✓
Louise Shuey	QDAF	Government	✓	✓	✓
Matthew de Jongh	AFPA	Industry	✓	✓	
Phil Lacy	PF Olsen	Industry	✓	✓	✓
Richard Hyett	AFPA	Industry			✓
Sam Van Holsbeeck	USC	Research	✓	✓	✓
Simon Lawson	USC	Research	✓	✓	✓
		Total	22	20	20

Further RD&E proposals

All project ideas that came to the attention of the expert panel but were not rated in terms of their priority for investment, are summarised below. Projects were not assessed because they are either already being funded, or they were not sufficiently developed for the experts to be able to rate their merit.

Damage Agent	Research Theme	Project Description	Comments
Long Established	Maintaining effective management procedures	Forest Pest Management Research Consortium	Separately funded
	Maintaining effective management procedures	Control of Teratosphaeria Leaf Disease (TLD) with systemic fungicides	Funded through Forest Pest Management Research Consortium
	Maintaining effective management procedures	Control of Brassica in Eucalypt Plantations post-planting	Funded through Forest Pest Management Research Consortium
	Maintaining effective management procedures	Pine and Eucalypt plantations/Acacia spp./Clopyralid	Funded through Forest Pest Management Research Consortium
	Reducing the risk of exotic threats through improved surveillance	Develop awareness material for forest biosecurity and surveillance for key stakeholders	Achieved through FWPA "Developing surveillance" project and ongoing in NFPSP
	Reducing the risk of exotic threats through improved surveillance	Establish and maintain a forest diagnostic node within the National Plant Biosecurity Diagnostic Network that integrates forest pest diagnostics with currently available diagnostic processes and networks in State or National diagnostic laboratories	PHA advised that this is unnecessary, considering the lack of forest specific diagnostic personnel. Better off simply ensuring forest specialists are members of the current network.
	Reducing the risk of exotic threats through improved surveillance	Develop forest biosecurity training framework & modules	Achieved through FWPA "Developing surveillance" project and ongoing in NFPSP
Not established	Reducing the risk of exotic threats through improved surveillance	Developing in-field isothermal molecular diagnostic assays for exotic forest pathogens	Idea, insufficient detail
	Reducing the risk of exotic threats through improved surveillance	Rapid population genomic pipelines to a certain genetic potential of invasive pathogens and	In development, insufficient details

Damage Agent	Research Theme	Project Description	Comments
		infer their origin and spread pathways	
	Reducing the risk of exotic threats through improved surveillance	Forest pest blitz survey and diagnostic - determine what is present to enable more rapid detection of new pests/pathogens	This is in investment Plan 3.1.3, insufficient details
	Reducing the risk of exotic threats through improved surveillance	Safeguarding Indigenous-led forestry in northern Australia	Separately funded
	Reducing the risk of exotic threats through improved surveillance	Review pathogens already present in Australia using herbaria and molecular samples (to stop having to run around every time we find something new)	This is in investment Plan 3.1.1, insufficient details
	Reducing the risk of exotic threats through improved surveillance	Big list review of all potential threats as in other industries biosecurity plans	Idea, insufficient detail
Other	Other - not in investment plan	Improving nursery health and standards to reduce risk of pests and disease establishment and improve establishment	Separately funded
	Other - not in investment plan	Microbiome Management: Leveraging advances in microbiome research to deliver cost-effective tools to boost resilience and productivity of pines throughout their production lifecycle	Covered in soil microbiome investment plan.
	Other - not in investment plan	Determining the causal agent of Eucalypt decline in SW Victoria	Idea, insufficient detail
	Other - not in investment plan	Use of biocontainment facilities to undertake pre-emptive research on exotic or newly established exotic forest pathogens	Idea, insufficient detail
	Other - not in investment plan	National Action Plan for Pests of Trees and Timber	Separately funded