RESTORATION-ENGINEERING

A BLENDED SCIENCE-ENGINEERING MODEL

Dr Andrew Guzzomi

School of Engineering

Faculty of Engineering and Mathematical Sciences

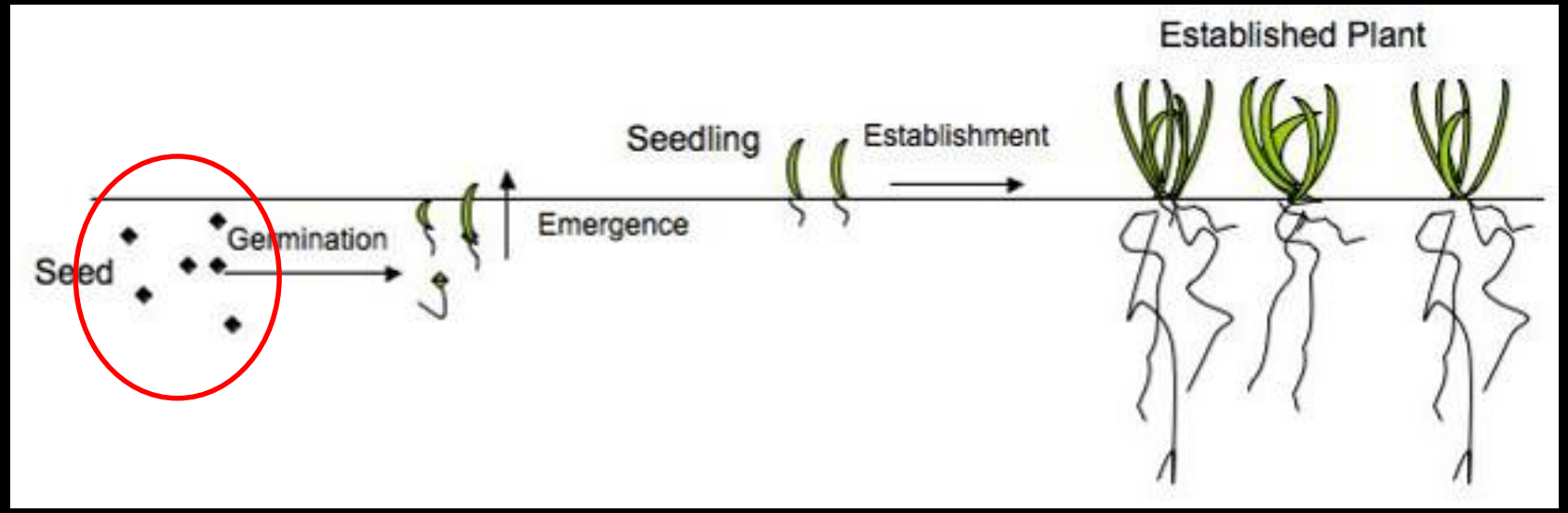
The University of Western Australia

The challenge

- 230,000ha or 2300km^2
- 1100t of seed (i.e. 10 Olympic pools)
- Collection rate: 6t p.a. (i.e. ~200 years to collect)
- Seeding rate: ~6ha/day (i.e. ~120 years to seed)
- Dissemination costs: ~$1500/ha (i.e. ~$350M)

So what's the solution?

Use seeds more efficiently at scale



1 - 5% typical

James *et al.* (2011), *J. of App. Ecol.*

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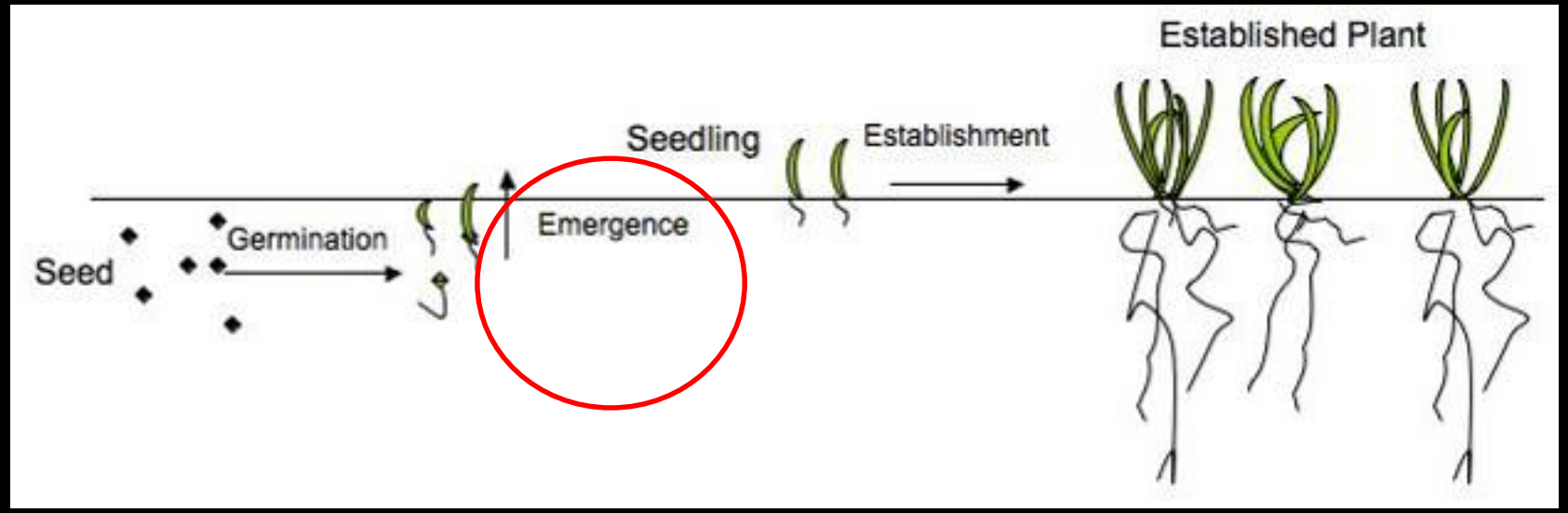


1 - 5% typical

James *et al.* (2011), *J. of App. Ecol.*

The challenge

- Get tangled
- Are bulky
- Difficult to process

Flash flaming of native seeds to improve land restoration

THE UNIVERSITY OF WESTERN AUSTRALIA

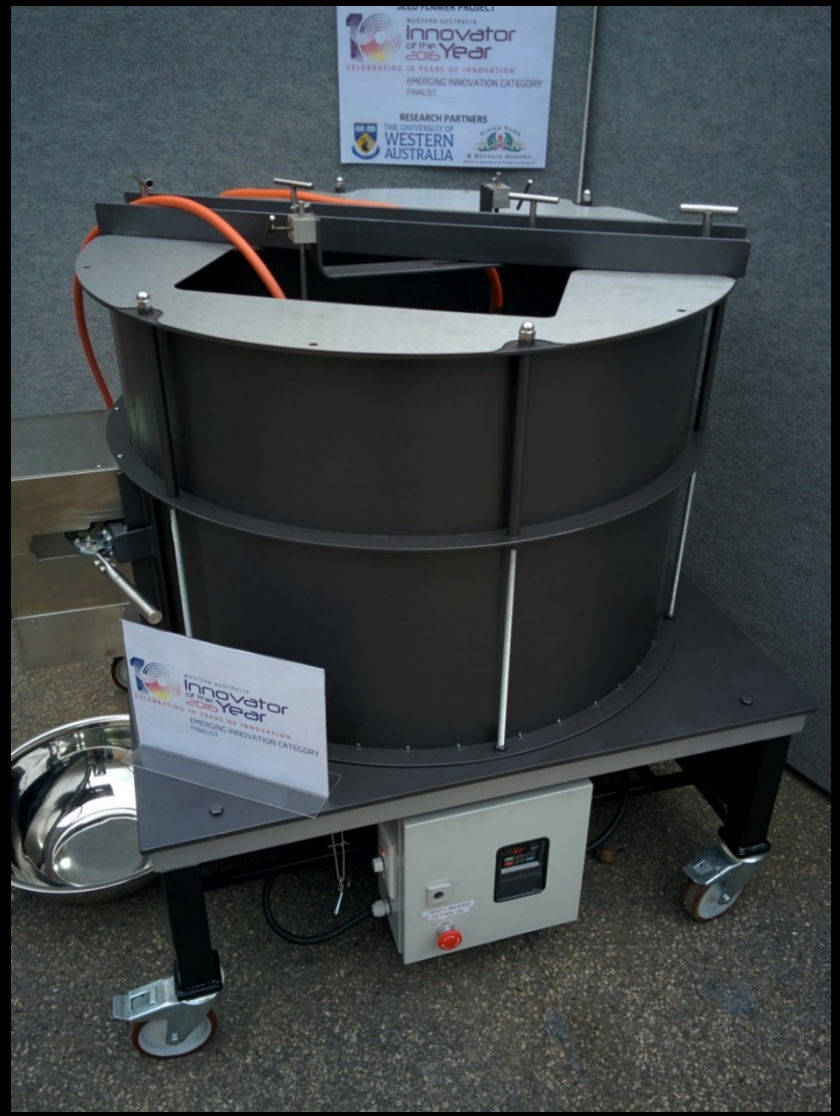
WESTERN AUSTRALIA Innovator of the Year 2016

CELEBRATING 10 YEARS OF INNOVATION

EMERGING INNOVATION CATEGORY WINNER

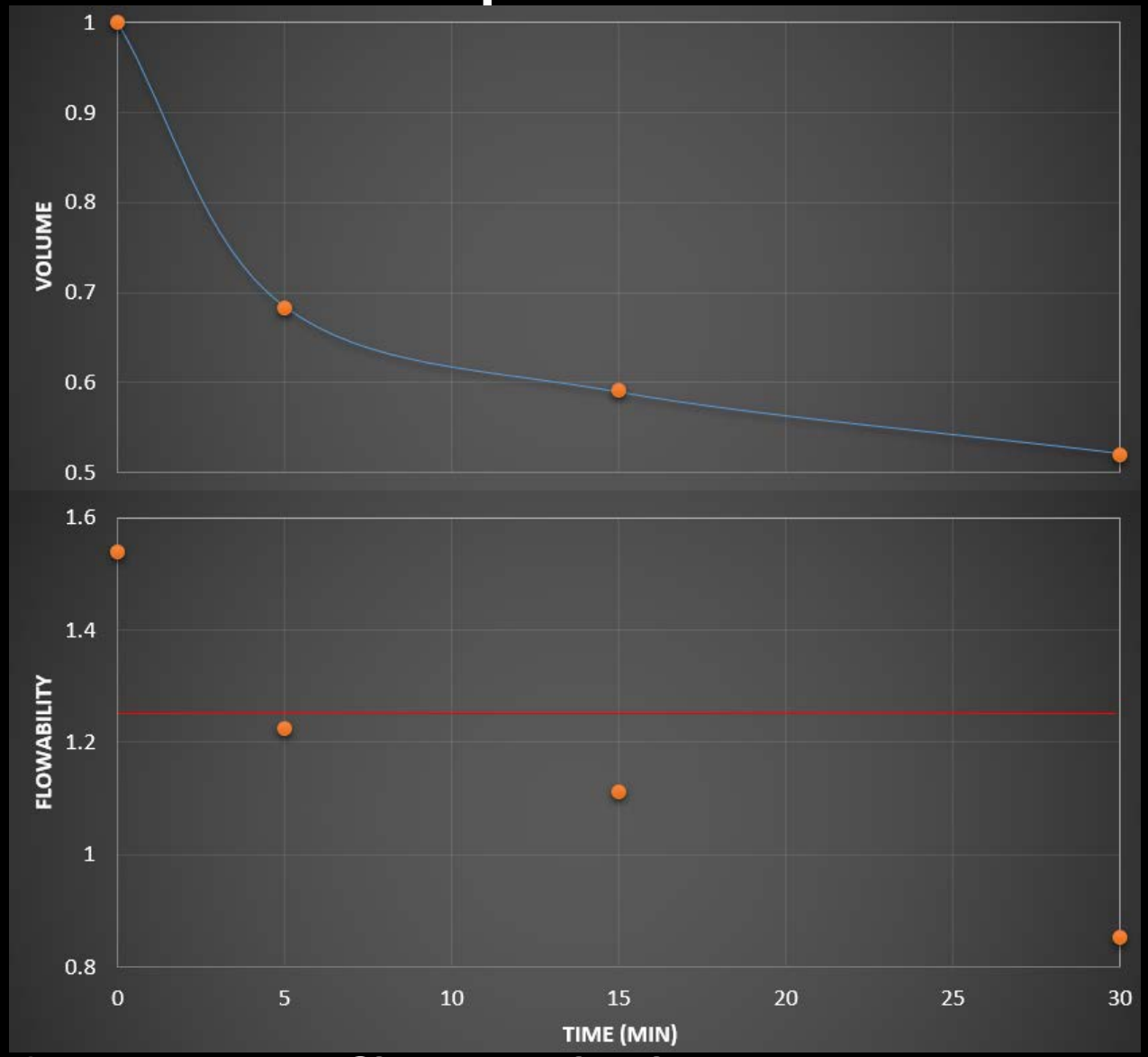
BOTANIC GARDENS & PARKS AUTHORITY

The innovation



flash flaming

The innovation improves



bulk density, flowability & germination

The innovation improves

Without innovation

With innovation

coatability

Multidisciplinary expertise

5 year collaboration

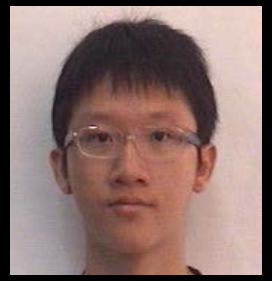
- UWA - Engineering
  - Agricultural Engineering
  - Manufacturing capacity in-house
  - Research Development & Innovation office (UWA RDI)
- BGPA - Science
  - 30 years experience in restoration

Multidisciplinary team

UWA Engineering

Dr Andrew Guzzomi
Agricultural Engineer
Lead Engineer

Monte Masarei
Mechanical Engineer
PhD Candidate



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Masters student

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Senior Research Scientist
Seed Science

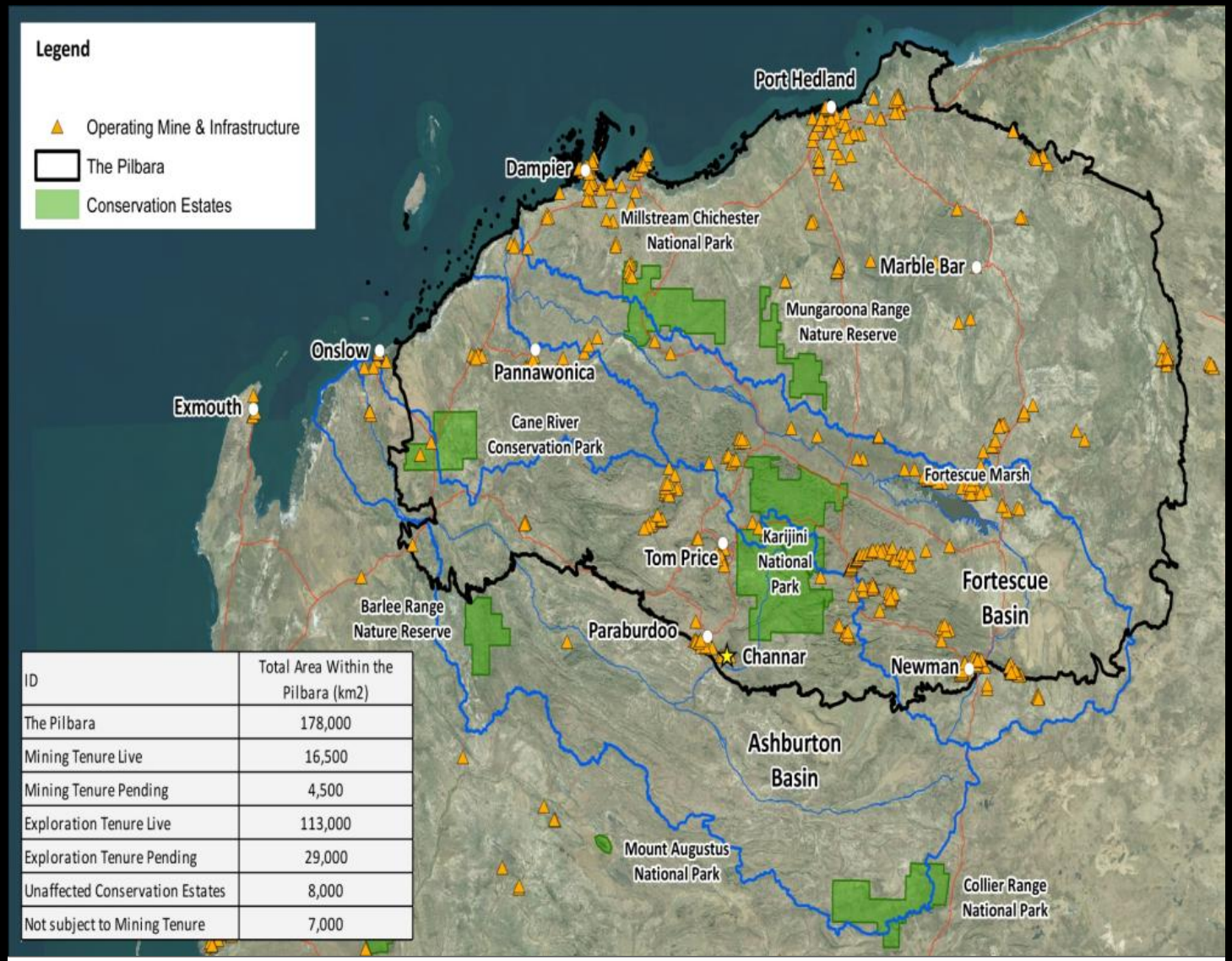
US Team

Dr Matthew Madsen
Seed technology

Dr Jeremy James
Plant Biologist

Dr Scott Abella
Applied Ecologist

So what?

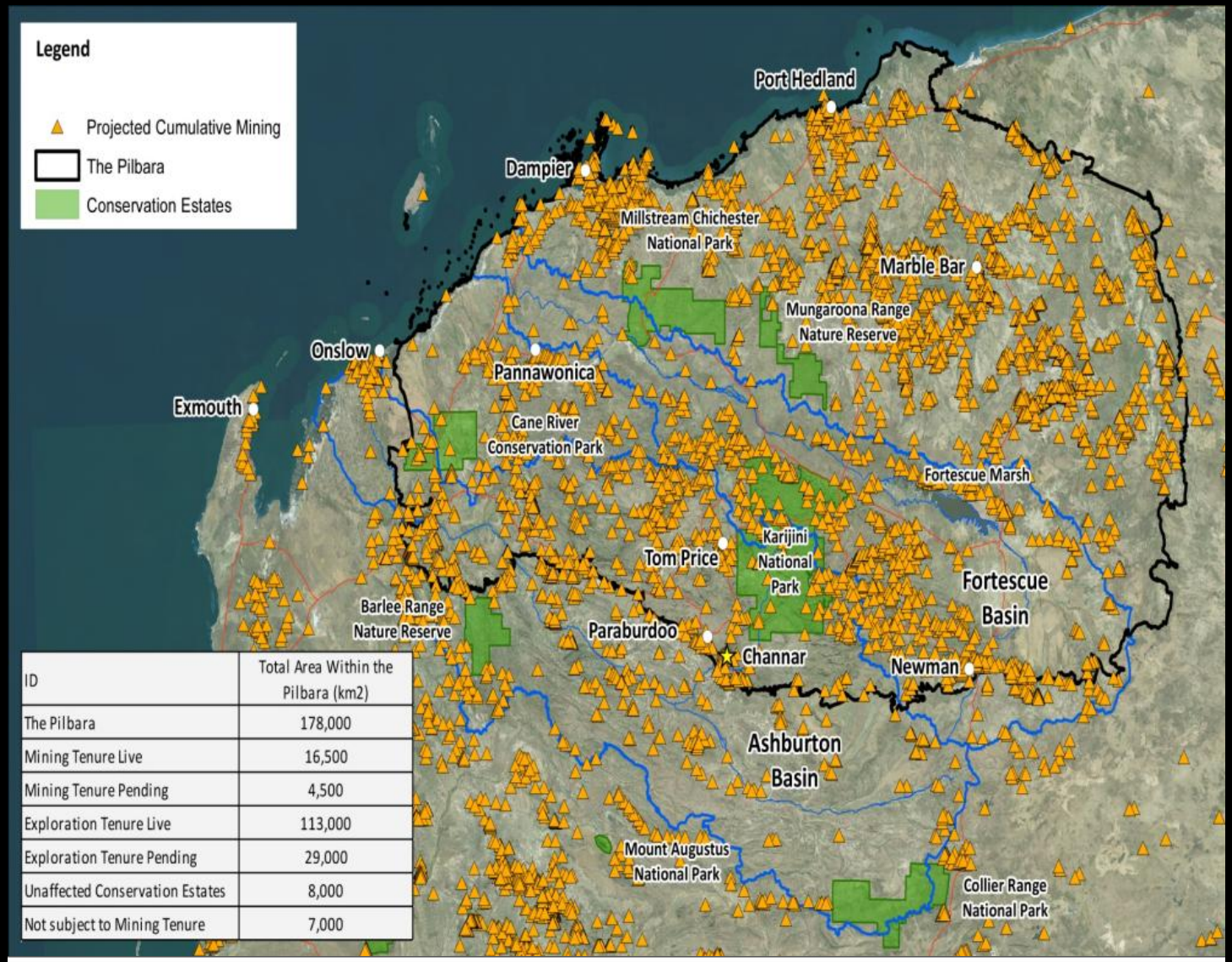


ID	Total Area Within the Pilbara (km2)
The Pilbara	178,000
Mining Tenure Live	16,500
Mining Tenure Pending	4,500
Exploration Tenure Live	113,000
Exploration Tenure Pending	29,000
Unaffected Conservation Estates	8,000
Not subject to Mining Tenure	7,000

Mines Source: Department of Mines and Petroleum, Mindex database: "Site _Stage" = Operating

Tenure Source: Australian Government Department of the Environment , Pilbara IBRA Region ; Department of Mines and Petroleum, Tenement database ; and The Department of Environment and Conservation, DEC Managed Lands & Waters

So what?



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The impact

- Can’t change area
- Reduce t/ha ~8 fold (5% ➔ 40%)
- Reduce collection to decades
- Increase seeding rate: ~5 fold (= 20 years)
- Reduce dissemination costs: ~100fold = $10/ha (i.e. ~$3.5M)

Seed flamer

THE UNIVERSITY OF WESTERN AUSTRALIA

BOTANIC GARDENS & PARKS AUTHORITY

1 NATIVE SEED

tangle

bulky

difficult to process

2 FLASH FLAMING

End Users – Billion Dollar Industry

Regulatory drivers

Restoration Ecology – Trillion Dollar Industry

WA

"Farming lands"

Exploration

Approvals

"Mining"

Closure

U.S.

"Wild Fires"

Middle East

"Desert lands"

5 RESTORATION

4 SEED SUPPLIERS

Mechanisation

Enablement technologies

Bulk density

Flowability

Improved geometry

3

1. *What's the problem*
2. *What's the solution*
3. *What's it enable*
4. *Who's the consumer*
5. *Who's the beneficiary*

WESTERN AUSTRALIA Innovator of the Year 2016

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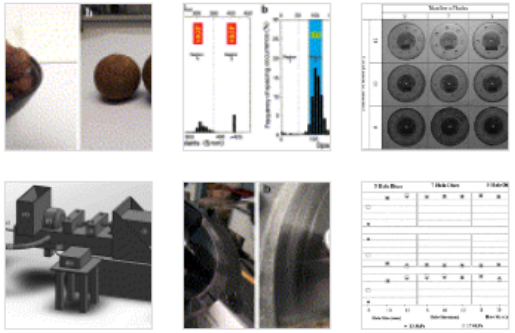
EMERGING INNOVATION CATEGORY WINNER

Engineering techniques to improve performance

Outline

Show full outline

Figures (9)



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ELSEVIER

Biosystems Engineering

Volume 115, Issue 2, June 2013, Pages 171-183

Research Paper

Precision metering of *Santalum spicatum* (Australian Sandalwood) seeds

Dylan St Jack, Dianne C. Hesterman, Andrew L. Guzzomi

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https://doi.org/10.1016/j.biosystemseng.2013.03.004

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The development of a seed metering device to mechanise the seed-sowing process for sandalwood is reported. Amongst the mass flow and precision type seed meters considered, the 'vacuum disc' type precision meter was deemed most suitable. A vSets vacuum disc seed meter was modified to accommodate seeds whose diameter ranged from 13.5 to 23.5 mm. Nine custom made discs were tested over three vacuum levels. The discs were analysed for their ability to achieve a seed spacing of 200 mm at a ground speed of 4 km h^{-1}. Accuracy was measured using the performance indices from ISO 7256/1-1984(E) as well as a modified coefficient of precision (CP3) index. Tests of twenty seven unique configurations were conducted with a sample of three hundred seeds. It was found that more than half of the configurations could singulate the seeds to a singulation level of 94%. Discs with seven 10 mm or 12 mm diameter holes, run at 17 kPa were found to be the most accurate configurations for the conditions considered and demonstrate that mechanisation of sandalwood seed sowing is possible.

Engineering techniques to improve performance

Engineering techniques to improve performance




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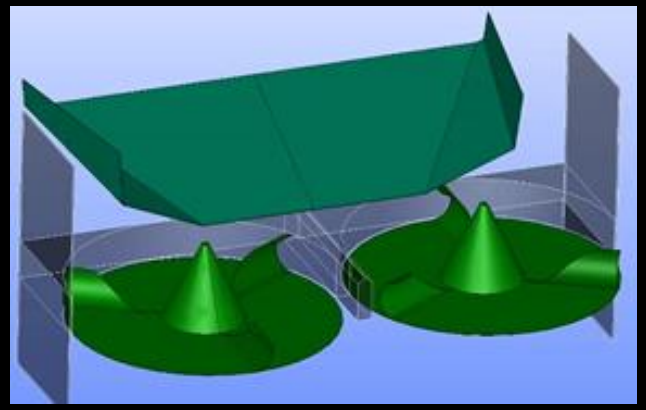

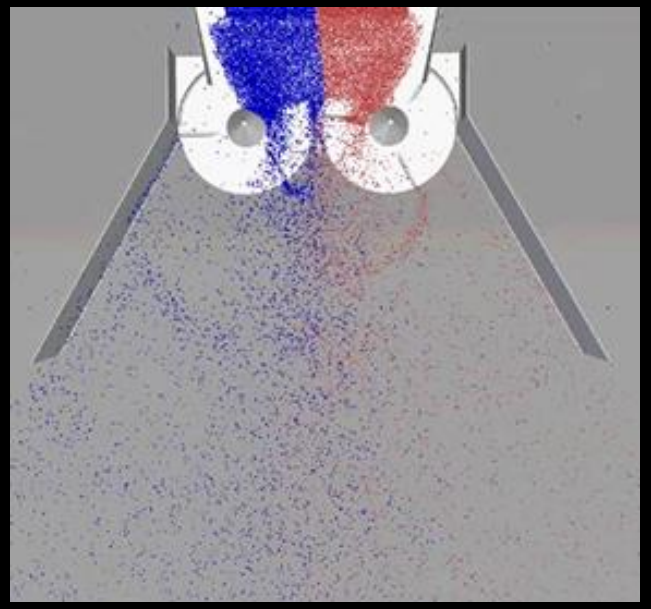

ROESNER

MARSHALL MULTISPREAD

Australian Government
Department of Industry, Innovation and Science

Business

Entrepreneurs' Programme - Innovation Connections

Engineering techniques to improve performance

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- *Global Innovation Linkages* project grant (GIL53873) “Eco-engineering solutions to improve mine-site rehabilitation outcomes”

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