Managing the health of plantation eucalypts in Tasmania

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Outline of presentation

• Current status of eucalypt plantation estate in Tasmania
• Summary of main pest threats
• Approach to management
• Looking forward
Current status of the eucalypt plantation estate in Tasmania

**Privately owned - 169,000 ha** (Private Forests Tasmania 2015-16 Annual Report):

- New Forests (Managed by Forico) – 100,000 ha progressive harvest & replant (6,300 ha replanted in 2016)
- Managed by IFarm (taken over by PF Ohlsen) – 27,000 ha
- Independent private (SFM + PFT) - 42,000 ha

**Publicly owned – 57,000** (Forestry Tasmania 2015-16 Annual Report)

Mature estate transitioning from 1\textsuperscript{st} to 2\textsuperscript{nd} rotation
Main pest threats

Forest health surveillance data 1998-2009 (Forestry Tasmania plantations)
Overlap with productive potential

Overlap with threats: (i) severe defoliation by eucalypt leaf beetles
Overlap with threats: (ii) severe damage by browsing mammals
Approaches to management

- Pest-specific management
  - Proactive
  - Forest health surveillance
  - General monitoring

Number of reports

- Browsing mammals
- Chrysomelids
- Copper deficiency
- Drought (post-establishment)
- Gonipterus
- Mycosphaerella
- Phytophthora cinnamomi
- Nutrient deficiency (general)
- Drought (transplant)
- Wind (windthrow)
- Armillaria
- Uraba
- Frost
- Autumn gum moth

Graph showing the number of reports for different pest-related issues.
Pest-specific management: Mammal browsing IPM (circa. 2008)

- Non-lethal tactics (seedling stockings)
- Culling (shooting / trapping with free-feeding)
- Regular monitoring (damage / growth)

**Browsing management tool**

PDA-based tool to efficiently capture browsing damage and seedling growth

![Graph showing tree height and seedling growth over time](image)

- Rufous
- Bennets
- Possum
- Others
- Tree Ht (cm)
- Shoot
- 1080
- Trap
- FFeed
- Monitor
- % browsed
- % severe

Seedlings browsed (%)
Pest-specific management: Leaf beetle IPM

- Population monitoring
- Models

- Pre-control sample
- Initial sample

- Control decision

- Summer emergence of adults
- Eggs
- 1st instar larvae (L1)
- 2nd instar larvae (L2)
- 3rd instar larvae (L3)
- 4th instar larvae (L4)
- Pupae
- Teneral adults

- Spring/summer dispersal of adults
- Over-wintering adults

- Majority of predation by natural enemies
- Responsible for the majority of the defoliation damage

- Models:
  - Site
  - Stand
  - Inputs
  - Control costs
  - Stumpage rates
  - Discount rates

- Control decision:
  - Spring/summer dispersal of adults
  - Over-wintering adults
Leaf beetle IPM: Initial period 1992-2000

- Plantations 2-6 y.o.
  - Population monitoring

- Models
  - Control decision not quantitative

- Control decision
  - Control

- Models
  - Summer emergence adults
  - Eggs
  - 1st instar larvae (L1)
  - 2nd instar larvae (L2)
  - 3rd instar larvae (L3)
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- Spring/summer dispersal of adults
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- Major of predation by natural enemies
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Leaf beetle IPM: Economic injury model 2000-2010

Plantations 2-6 y.o.

Population monitoring

Pre-control sample

Initial sample

Models

Control decision based on economic injury level

Control decision

Spring/summer dispersal of adults

Over-wintering adults

Summer emergence adults

Eggs

1st instar larvae (L1)

2nd instar larvae (L2)

3rd instar larvae (L3)

4th instar larvae (L4)

Pupae

Teneral adults

Majority of predation by natural enemies

Responsible for the majority of the defoliation damage

Population monitoring

Pre-control sample

Initial sample

Control decision

Majority of predation by natural enemies

Responsible for the majority of the defoliation damage
Mid-rotation chronic thin crowns

High levels (>50%) of defoliation linked to large drop in growth rates

- Develops in plantations older than the age range targeted by the IPM
Mid-rotation chronic thin crowns: new research findings

1. Risk of above-threshold populations (Sophie Edgar BSc (Hons))
   - Landscape, stand, topographic and climatic factors as predictors of above-threshold populations
   - Elevation >550m and within 10 km of native grassland best predictors of the likelihood of above-threshold leaf beetle populations

2. Intensive shoot monitoring (Karl Wotherspoon & Sue Jennings)
   - Feeding by recently emerged beetles (after overwintering) removed most of Oct-Dec new seasons leaves in thin crown plantations

3. Growth-impact plots (Karl Wotherspoon & Tim Wardlaw)
   - Severe (>50%) defoliation at the beginning and end of the growing season linked to ca. 95% reduction in CAI
   - Growth rates recover well the season after refoliation of chronically thin crowns
Leaf beetle IPM: Risk-based IPM 2011

- Plantations 4-12 y.o. in medium-high risk areas
- Population monitoring
- pre-Control sample
- Control decision based on economic injury level OR Population Present (areas with thin crowns)
- Control decision
- Control decision based on economic injury level
- OR Population present (areas with thin crowns)
- Spring/summer dispersal of adults
- Summer emergence adults
- Eggs
- 1st instar larvae (L1)
- 2nd instar larvae (L2)
- 3rd instar larvae (L3)
- 4th instar larvae (L4)
- Pupae
- Teneral adults

- Responsible for the majority of the defoliation damage
- Majority of predation by natural enemies
- Population monitoring
- Initial sample
- Control
- Models

- Models
- Population monitoring
- Pre-control sample
- Initial sample
- Control
- Control decision
Leaf beetle IPM: The “integrated” part

Typically about 20% of initially above-threshold populations don’t require spraying because of natural controls (including weather events)

Majority of predation by natural enemies

Responsible for the majority of the defoliation damage
Financial analysis of Leaf beetle IPM

Operational IPM provides strong financial benefit (BCR ≈ 7) when used in an established plantation estate.

Research contributed to 2/3 total expenditure (1974-2034).

A couple of less common pests / diseases that can cause severe damage

Autumn gum moth

Foliar fungal diseases
Approaches to management

- Pest-specific management
  - Proactive
- Forest health surveillance
  - General monitoring
  - Reactive

Number of reports

- Browsing mammals
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Autumn gum moth

- Late-season defoliation – long-term impact on productivity (high mortality)
- Difficult to predict when / where outbreaks will occur
  - general surveillance too hit and miss;
  - not sufficiently common to justify expense of pest-specific monitoring;
- Ideal candidate for pheromone trapping to detect pest presence as a trigger for more intensive monitoring
- Pheromones identified and field efficacy verified but not yet taken through to operational use.

Data from David de Little

Walker et al. (2009) *Journal of Chemical Ecology*, **35**: 1411-1422
**Foliar fungal diseases**

*Teratosphaeria pseudonubilosa* (split from *T. nubilosa* = *Mycosphaerella nubilosa*)

*Teratosphaeria eucalypti* (= *Septoria pulcherrima*, *Kirramyces eucalypti*, *Phaeopleospora eucalypti*)

*Puccinia psidii*
**T. nubilosa: climatic suitability for disease**

- **Smithton**: milder winters provide stronger overlap between new foliage production and moist conditions
- **Nabowla**: moist conditions and new foliage production coincide with occasional years of abnormally high summer rainfall

T. nubilosa growth impact

- Growth rates rapidly recover from single severe epidemic;
- Superior wood properties of *E. globulus* may be sufficient to compensate for greater MLD susceptibility.

Glasshouse screening of the susceptibility of Tasmanian eucalypt species to *Puccinia psidii*

Inter- and intraspecific differences in rates of *P. psidii* susceptibility
- 30 species + 2 subspecies
- 85 provenances
- >1000 parent trees sampled

**Fig. 4** Different ITs observed among seedlings raised from a seed lot of *Eucalyptus globulus*:
L–R: HR (0), R (1-C), MR (22+C), S (3+) and VS (4)

Susceptibility of Tasmanian eucalypt species to *Puccinia psidii*

Phylogenetic effect: *Symphyomyrtus* has more resistance to myrtle rust than *Eucalyptus*

Conditions in southern Australia sub-optimal for epidemic *P. psidii* disease

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*Teratosphaeria nubilosa* + *Puccinia psidii* co-occurring in *E.globulus* progeny trial. *T. nubilosa* causes more severe damage.


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Indigenous foliar pathogens (*Teratosphaeria* spp.) are likely more damaging to eucalypts than *P. psidii* in southern Australia (and NZ)

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No natural spread into native plant communities (yet)
Concluding remarks

1. Can manage main pest threats effectively and it is economically viable to do so
Concluding remarks

2. **Severe damage can occur** – BUT consequences are worse on sites at the edge of the climate envelope of species
Concluding remarks

3. Pest and disease management will continue to evolve as:
   • new threats appear;
   • plantation estate changes (age-class, choice of species / genotypes, sites change, products change);
   • refinements are made to address sub-optimal management or changes to the tools available for management;

NEED TO MAINTAIN CORE EXPERTISE