PROGRAM A

Prescribed Fire in Young Eucalypt Plantations

Is it worth the risk?

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Background

- Project sponsored by Forests NSW
- 26,000 hectare hardwood plantation estate
  - Program started in 1994
  - Sub-tropical location (northern NSW)
  - 5 species
    - Major two are Spotted Gum and Dunn's White Gum
  - Grown for solid-wood products
    - 25-35 year rotation length

Plantation Management Issues

- Plantations distributed widely between Newcastle and the Queensland border
  - Long travel times from operational centres (up to 2 hours)
  - Reduced workforce must cover a greater area

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Plantation Management Issues

- Controlling fuels (grasses) in first 5-7 years is difficult
  - Grazing is standard practice, but cattle feed selectively
  - Grass growth during the peak growing season is more than the cattle can eat
  - Blady grass is unpalatable to cattle but common within plantations and can build up to high fuel loads
- Alternative fuel management methods need to be explored

Project Objective

Determine the stand age/stem size, fuel load, and weather conditions that are appropriate for prescribed burning in order to minimise damage to plantation trees

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Three Components

- Fuel profiling
  - Describe the fuel characteristics within eucalypt plantations
- Fire behaviour
  - Conduct experiments to quantify fire behaviour
  - Compare with existing fire behaviour models
- Fire impacts
  - Quantify stem damage and crown loss for a range of tree sizes and fire intensities

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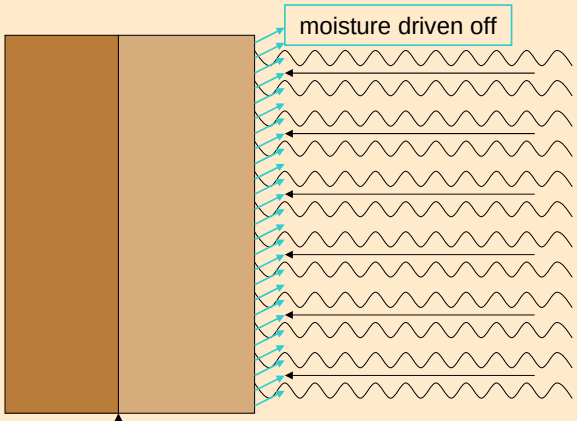
How does bark respond to elevated temperatures?

Phase 1:
Desiccation



Desiccation front penetrates deeper into the bark

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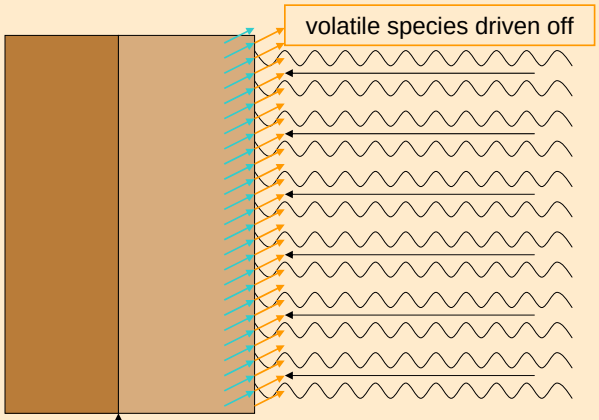
How does bark respond to elevated temperatures?

Phase 2:
Devolatilisation



Devolatilisation front penetrates deeper into the bark

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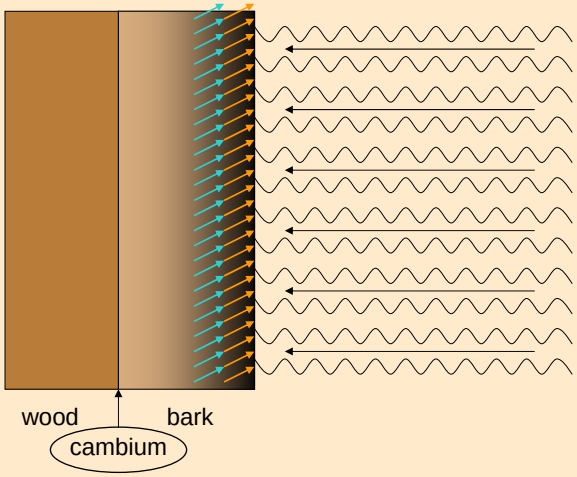
How does bark respond to elevated temperatures?

Phase 3:
Charring



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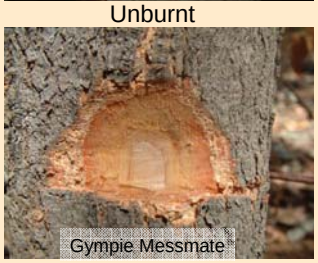
The Brown Line

Unburnt

Exposed to fire



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The Brown Line

Sydney Blue Gum exposed to high intensity fire

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The Brown Line

Dunn's White Gum
4 months after fire

Spotted Gum
5 months after fire

The brown line seems to show the depth to which bark cell death has occurred

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Investigating the relationship between elevated temperature and the brown line

- Utilised fire behaviour plots for this study
- Experiments on two species with different bark types (smooth bark and rough bark)
- Thermocouples attached to four trees within plot.
- Four thermocouples per tree (up-slope, down-slope, right, left)
- Data logger buried near trees

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Thermocouple Arrangement - 2005

Downloading temperature data

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Fire Behaviour Experiments

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Temperature profiles

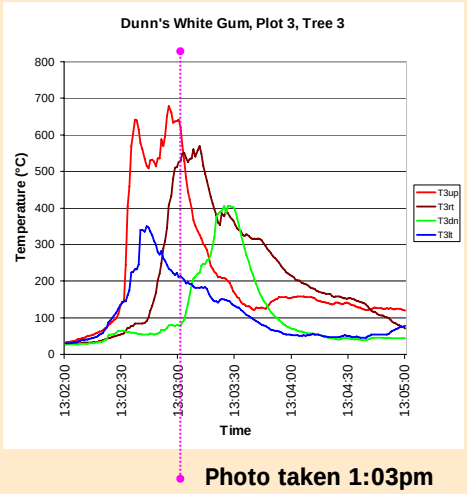

Photo taken 1:03pm

What temperatures are important?

- Death of living tissue - 60ºC
- Boiling point of water - 100ºC
- Devolatilisation - 200ºC ?
- Charring - 300ºC ?

There is a time component to these temperatures

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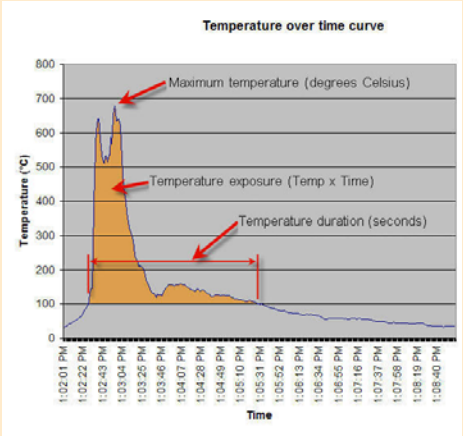
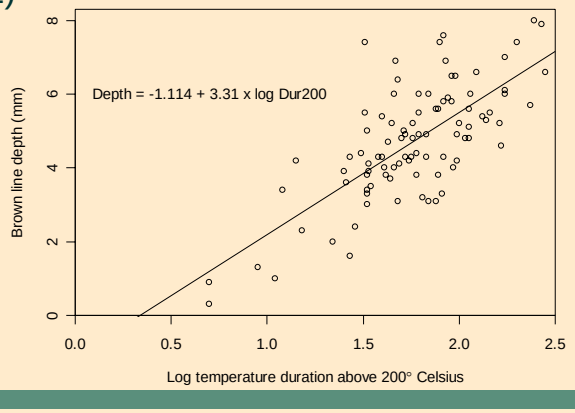
Temperature parameters



Results 2005

Greatest correlation is between brown line depth and log temperature duration above 200°C (r^2=0.52)



No significant difference between the two species

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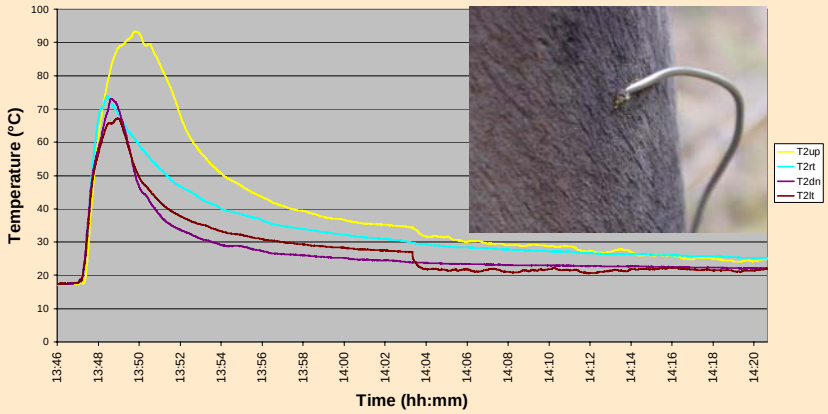
2006 experiments

- Modified thermocouple arrangement
  - Need to know temperature profile within the bark
  - Thermocouple was positioned just underneath bark surface to minimise errors (such as air cooling and heat reflectance of thermocouple)
- Bark moisture content measurements
  - Moisture has a large influence over heat penetration

Results 2006

- Under-bark temperatures

Dunn's White Gum, Plot 7, Tree 2, 8/8/06



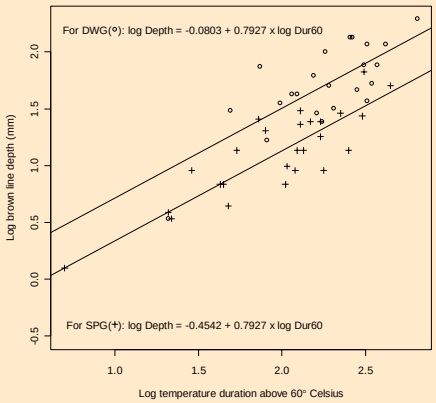
Results 2006

Greatest correlation is between log brown line depth and log temperature duration above 60°C (r^2=0.79)

Very little variation in live bark moisture content for either species.

Average around 60%.

The brown line indicates the depth of bark cell death



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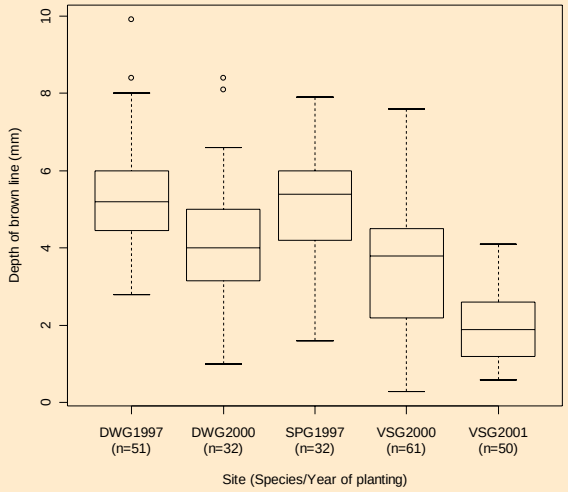
Results 2005/6 - brown line depth



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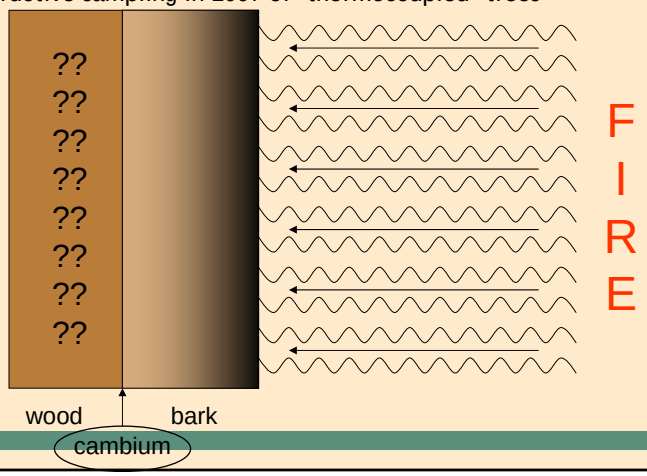
Results 2007

- How do elevated temperatures affect wood quality?
  - Destructive sampling in 2007 of 'thermocoupled' trees



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Results 2007

Spotted Gum

Diameter:
8 cm
Bark thickness:
11 mm
Brown line depth:
4 mm
(measurements at time of burn)

Photo taken 21 months after burn

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Results 2007

Spotted Gum

Diameter:
15.7 cm
Bark thickness:
13 mm
Brown line depth:
6 mm
(measurements at time of burn)

Photo taken 21 months after burn

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Results 2007

Spotted Gum

Diameter:
7.9 cm
Bark thickness:
8 mm
Brown line depth:
3 mm
(measurements at time of burn)

Photo taken 9 months after burn

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Results 2007

Dunn's White Gum

Diameter:
15.5 cm
Bark thickness:
12 mm
Brown line depth:
5 mm
(measurements at time of burn)

Photo taken 21 months after burn

Results 2007

Dunn's White Gum

Diameter:
8.9 cm
Bark thickness:
12 mm
Brown line depth:
4 mm
(measurements at time of burn)

Photo taken 21 months after burn

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Results 2007

- Can stem mortality be predicted from the ratio between brown line depth and bark thickness?

Dead stem:

DBH	– 6.5 cm
Bark thickness	– 8 mm
Brown line depth	– 5 mm
Ratio	– 0.62

Further research on thinner barked stems or longer duration fires needed

Conclusion

- Assessment of brown line depth following fire can provide an early indication of future wood quality issues.
  - Rule of thumb: if brown line depth is less than 50% of bark thickness, there will be no effect on wood quality.
- Does low intensity burning cause the formation of kino veins (or fire scars) in young eucalypts?
  - No. Rule of thumb: bark thickness should be greater than 10mm on average to be safe.

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Conclusion

Is prescribed burning in young eucalypt plantations worth the risk?

For wood quality…

YES!

For growth rate…

Undecided!

Further results to come…stay tuned

Acknowledgements

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