Cerambycid Beetles: Potential Bio-indicators of Environmental Change Associated with Fire Affected Habitat

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Why cerambycid beetles?

• Highly **abundant** and **diverse** native beetle family

• Multiple feeding habits (**living** and **dead wood**)

• Proven **traps** and **attractants** available to use
Primary Aims

• Assess the potential for using a common group of beetles as bioindicators.

• Determine whether there is a link between habitat affected by fire and the abundance of certain cerambycid beetles.

• Determine whether forest health is associated with cerambycid composition and abundance.

Hypotheses

• The composition of cerambycid beetles is affected by fire regime through changes in habitat.

• Composition of cerambycid beetles is related to indicators of forest health.

Bio-indicator – species, communities or processes that can be used to assess the quality of the environment and changes within it over time
• Bauple long-term fire experiment
• 50km North of Gympie, QLD
• Sub-tropical, warm wet summers, cool drier winters
• Approx. 55-115 m above sea level
• Maintained by Department of Agriculture and Fisheries (DAF)
• Dry sclerophyll eucalypt forest, spotted gum (*Corymbia citriodora* subsp. *variegata*) and co-dominant eucalypt species
Experimental Management Site

- Four fire treatments:
  1. **Annually** – 1952
  2. **Triennially** – 1973
  3. **Unburnt** – 1946
  4. Formally unburnt, **wildfire** – 2006

- Five monitoring plots in each treatment (total 20)

- Experiment approx. **900 ha** (9km²)


- **Low intensity burns**, except the 2006 wildfire
Cerambycid Survey

- Two flight intercept panel traps at each plot
- Positioned randomly in insect flight paths

- One trap baited with a generic cerambycid **pheromone** (3-hydroxy-2-hexanone)
- The other with a **kairomone** lure (ethanol and α-pinene)
• Traps painted with fluon

• Traps hung between two ‘star picket’ posts

• Separated by at least 10 m

• Collection cups filled with 50% propylene glycol solution in water, small volume of detergent
• Traps maintained for **twelve weeks**, with clearances and re-baiting every two weeks

• This was to assist in determining a seasonal variation in cerambycid abundance

• Traps at each plot were rotated each clearance
- Twenty, 100 m long, 10 m wide transects
- Survey recording live trees, dead trees and coarse woody debris
- Tree health measured using a dieback scoring system
Live trees with >10 cm diameter at breast height (DBH):

- Diameter
- Tree species
- Proportion Primary Branch Dieback
- Five Grimes scores:
  1. Crown position
  2. Crown size
  3. Crown density
  4. Dead branches
  5. Epicormic growth

Living Trees

Annual

Triennial

Unburnt

Wildfire
Dead Trees
- Dead trees > 10 cm DBH
- Enabled basal area ($m^2$) to be calculated

Coarse Woody Debris (CWD)
- CWD > 10 cm diameter crossing centre of transect
- Enabled CWD volume to be calculated ($m^3/ha$)
Borer Assessment
<table>
<thead>
<tr>
<th>Cerambycid species</th>
<th>α-pinene + Ethanol</th>
<th>Pheromone</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bethelium tillides</em></td>
<td>1</td>
<td>1428</td>
</tr>
<tr>
<td><em>Adrium sp.</em></td>
<td>11</td>
<td>1111</td>
</tr>
<tr>
<td><em>Bethelium signiferum</em></td>
<td>0</td>
<td>125</td>
</tr>
<tr>
<td><em>Zygocera pruinosa</em></td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td><em>Xylotrechus australis</em></td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td><em>Chlorophorus curtisi</em></td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><em>Coptocercus biguttatus</em></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><em>Rhytophora c.f. vermicularia</em></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><em>Didymocantha sp.</em></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><em>Phoracantha recurva</em></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><em>Phoracantha mastersi</em></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total cerambycid beetles</strong></td>
<td><strong>18</strong></td>
<td><strong>2684</strong></td>
</tr>
</tbody>
</table>
Temporal Cerambycid Beetle Abundance

Total Number of Cerambycid Beetles

<table>
<thead>
<tr>
<th>COLLECTION PERIOD</th>
<th>NUMBER OF INDIVIDUALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>681</td>
</tr>
<tr>
<td>2</td>
<td>690</td>
</tr>
<tr>
<td>3</td>
<td>506</td>
</tr>
<tr>
<td>4</td>
<td>428</td>
</tr>
<tr>
<td>5</td>
<td>234</td>
</tr>
<tr>
<td>6</td>
<td>152</td>
</tr>
</tbody>
</table>

Temperature

- T.Max (°C)
- T.Min (°C)
Temporal Variation in Abundance

Cerambycid Beetles

Means followed by different letters differ significantly at the critical LSD level.

Bethelium tillides

Adrium sp.
Treatment Variation in Species Abundance

Total Cerambycid Beetles

Means followed by different letters differ significantly at the critical LSD level.

Bethelium tillides

Bethelium signiferum
Temporal & Treatment Variation in Species Richness

Temporal Variation

Means followed by different letters differ significantly at the critical LSD level.
## Borer Assessment

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Common Name</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Corymbia intermedia</em></td>
<td>Red Bloodwood</td>
<td>1</td>
</tr>
<tr>
<td><em>Eucalyptus fibrosa subsp. fibrosa</em></td>
<td>Broad-leaved Ironbark</td>
<td>1</td>
</tr>
<tr>
<td><em>Lophostemon confertus</em></td>
<td>Brush Box</td>
<td>6</td>
</tr>
<tr>
<td><em>Cyclophyllum coprosmoides</em></td>
<td>Coastal Canthium</td>
<td>1</td>
</tr>
<tr>
<td><em>Eucalyptus tereticornix</em></td>
<td>Forest Red Gum</td>
<td>4</td>
</tr>
<tr>
<td><em>Eucalyptus siderophloia</em></td>
<td>Grey Ironbark</td>
<td>1</td>
</tr>
<tr>
<td><em>Alphitonia excelsa</em></td>
<td>Red Ash</td>
<td>1</td>
</tr>
<tr>
<td><em>Angophora leiocarpa</em></td>
<td>Smooth Barked Apple</td>
<td>1</td>
</tr>
<tr>
<td><em>Corymbia citriodora subsp. variegata</em></td>
<td>Spotted Gum</td>
<td>5</td>
</tr>
<tr>
<td><em>Lophostemon suaveolens</em></td>
<td>Swamp Box</td>
<td>15</td>
</tr>
<tr>
<td>Unknown 1</td>
<td>Unknown 1</td>
<td>1</td>
</tr>
<tr>
<td>Unknown 2</td>
<td>Unknown 2</td>
<td>1</td>
</tr>
<tr>
<td><em>Eucalyptus acmenoides</em></td>
<td>White Mahogany</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>3</td>
</tr>
<tr>
<td>Triennial</td>
<td>15</td>
</tr>
<tr>
<td>Unburnt</td>
<td>21</td>
</tr>
<tr>
<td>Wildfire</td>
<td>13</td>
</tr>
</tbody>
</table>
Redundancy Analysis

Treatments

- Annual
- Triennial
- Unburnt
- Wildfire
- Adrium Sp.
- B. tillides
- B. signiferum

Other Variables

- Live Tree BA
- CWD Volume
- Crown Size
- Dead Branches
- N
- Radiation
- Relative Humidity max.
Conclusions

• Composition (abundance and species richness) of cerambycid beetles affected by fire regime
• This was mostly driven by the response of the three most abundant species trapped

• Link between fire-affected habitat and abundance of three main species collected at the site
• A measure (Grimes score) of tree health was associated with abundance of one species in particular

• Some cerambycid species show good potential to be used as indicators of forest habitat change associated with fire, and to a lesser extent tree health

• Longer term studies are needed to verify/expand on these findings, possibly also investigating other beetle families, such as scolytids (bark beetles) and platypodids (Ambrosia beetles)
Acknowledgments

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• University of the Sunshine Coast (USC)

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