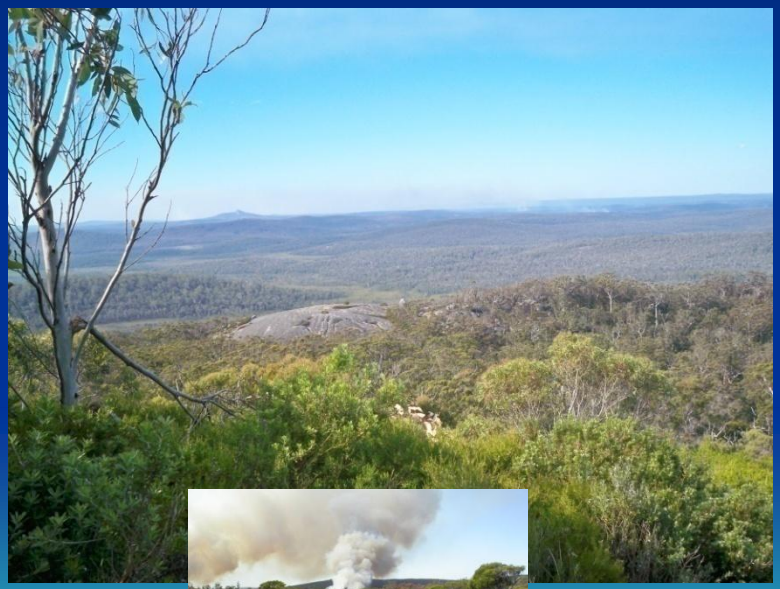
Wildfire or Mosaic Fires? Impacts on Beetles in South-West Australia.

Paul Van Heurck [1, 2]

[1] *Curtin University of Technology, Department of Environment and Agriculture, Perth, Australia.*

[2] *Department of Environment and Conservation, Perth, Australia.*

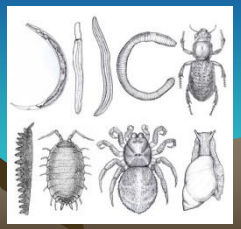


My Talk Contents:

- Ancient Landscape and Highly Diverse Biota:
  - - very old stable geology with eroded infertile and complex soil mosaics.
  - - gradual climate change & south coast wet forests refuges.
  - - ancient relict taxa & global diversity hotspot.
- Wildfire & Climate Change:
  - - co-existence of pyrophilic & relict species in SW forests.
  - - evolution of contrasting “fire tolerances” – 50 years of SW fire research.
- Study Design:
  - - sites and sampling methods – ***ForestCheck***.
  - - operational logistics of fine-grain mosaic burning.
- Early Results:
  - - inventory of study (gamma) beetle fauna.
  - - richness of rare beetles in mosaic and wildfire sites.
- Future PhD Research.

Ancient Landscape of Ice & Fire (245 million years old)

One of Earth's 20 most diverse centres of plant species.



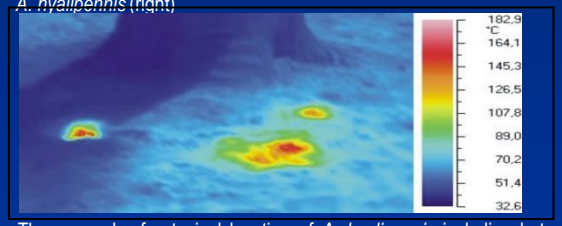
Wildfires & Climate Change

- 403 forest fires in SW in 2009/10.
- 1990 – 2010 above average number of wildfires in southern forests (Warren Bio-region).

- Top left: *Wildfire, Renzo Rd. c.20,000 ha. March 2003. Ted Middleton.*
- Right: *Crown Damage, Renzo Rd. October 2005*. *Orchid, Thelymetria jacksonni.*

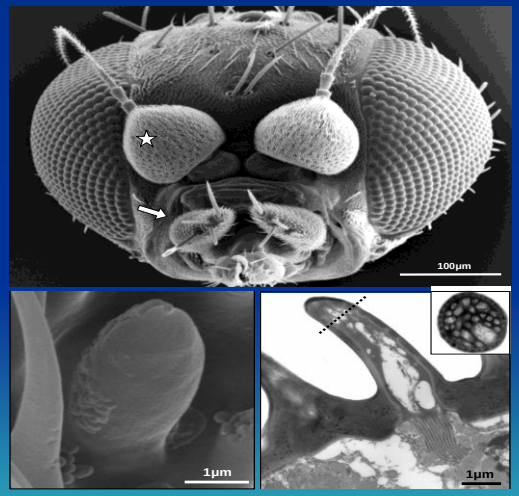
Pyrophilous Invertebrates

Two more fire-adapted species: *H. nearcticus* (left) and *A. hyalipennis* (right)



Thermograph of a typical location of *A. hyalipennis* including hot spots around a Eucalypt tree. Differences in temperature are indicated by colours.

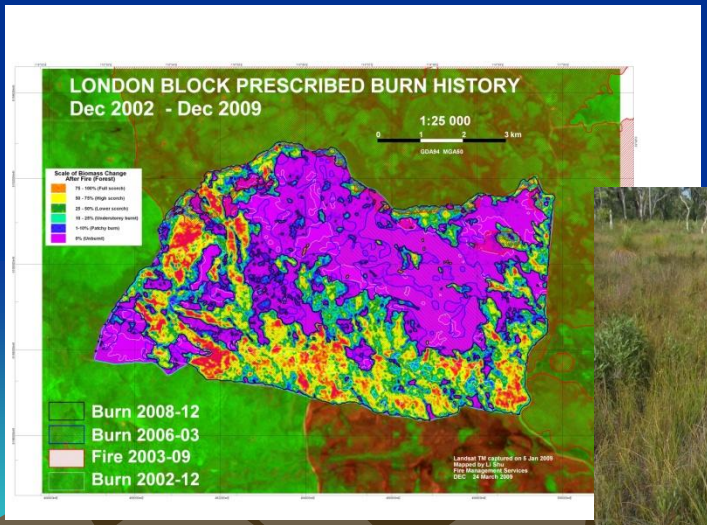
- **Still burning habitats essential to pyrophilic endemic arthropods.**
- **SW invert families contain pyrophilous species dependent on recently burnt habitat.**
- **Flies (Phorid) *Hypocerides nearcticus* & (Therevidae) *Anabarhynchus hyalipennis* oviposit on smoldering logs.**
- **Beetle (Buprestidae) *Merimna atrata* mates & oviposits on logs immediately after fire.**
- **Beetle (Acanthocnemidae) *Acanthocnemus sp.* oviposits around the edge of burning ashbeds.**
- **Evolved specialized infra-Red sensory or smoke detectors.**



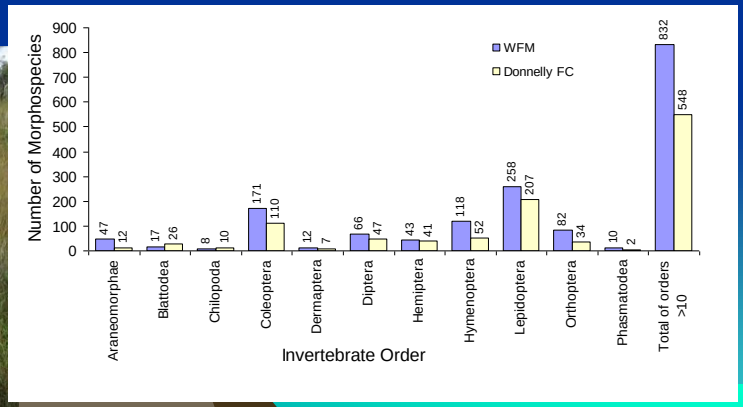
Above: SEM-image of the head of *H. nearcticus*. Antennae (asterisk) and mouthparts (arrow) are depicted. Left: Sensillum basiconicum on the antenna. Right: TEM-image of a longitudinal section through a S. basiconicum. Inserted: Cross-section of the distal part of the receptor. The lumen is filled by densely packed branches of sensory nerve cells.

Walpole Fire Mosaic study:

- 25km north-east of Walpole.
- London block “mosaic” burnt Sept 2002, Feb 2006 & Dec 2008.
- Surprise block wildfire burnt March 2003.
- 18 FC grids in 3 fire regimes :
  - -Mosaic - London block.
  - -No-planned burn - Surprise West.
  - -Prescribed burnt – Surprise East.
- FORESTCHECK (FC) trapping from Dec. 2004 to Dec. 2009.
- Relict & Gondawanan Affinity taxa collected.
- Species composition of 27 Orders similar to FC Donnelly area (see Fig. below).

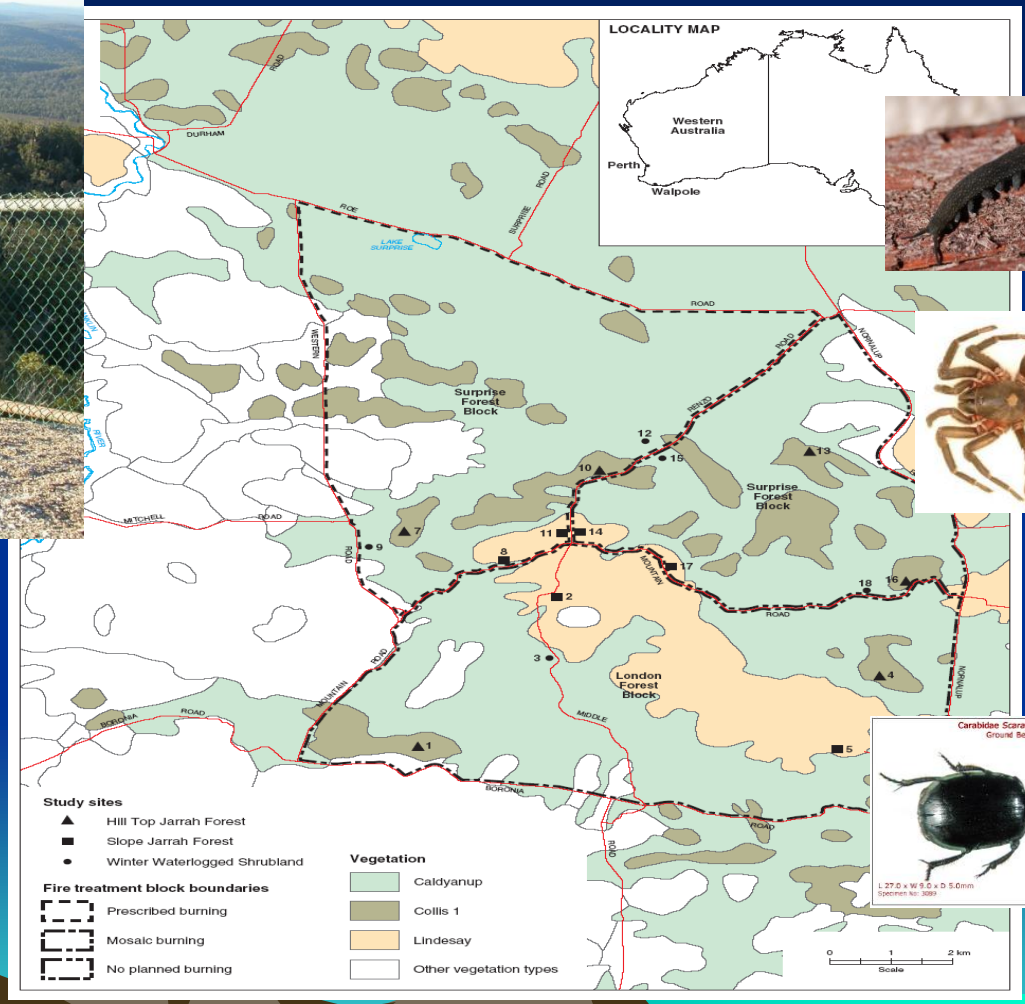


London block mosaic pattern established after 3 burns, with many widespread patches ranging in age from 9 months to over 25 years (see unburnt purple in Landsat image).



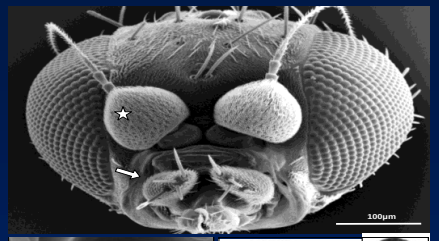
Site Design

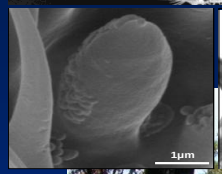
25 Km NE of Walpole, 10 Km E of Mt Frankland

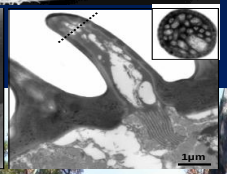


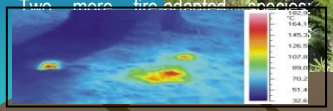
Forest Mosaic

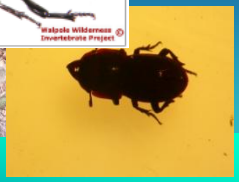
April 2009







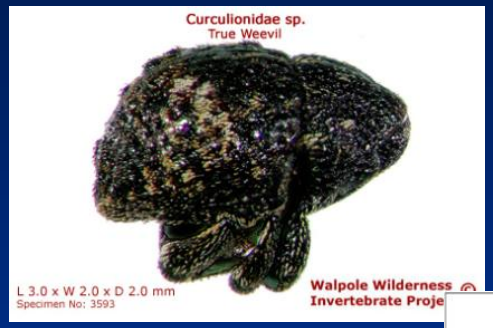


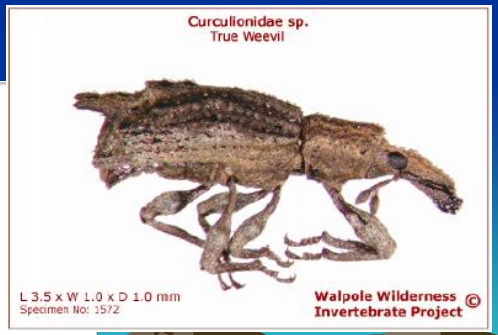


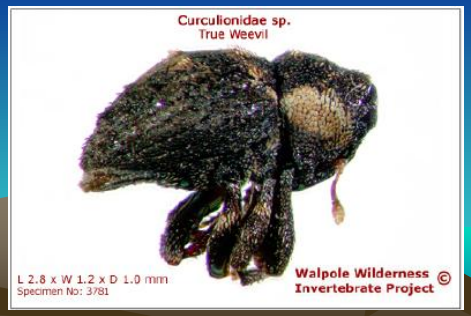
Beetle Fauna

- An estimated total of 29,100 invertebrate individuals sorted.
- 445 total (Gamma) beetle richness morphospecies.
- 220 singletons (49.4%).
- 82 doubletons (18.4%).
- 143 tripletons or common (32.1%).

Unique Beetles of Mosaic or Wildfire







- beetles 26% of 11.3 million extant species on Earth.
- beetles 9.9 to 21.5% of Walpole invertebrates collected Dec 2004 to Oct 2010.
- Small beetles (<10mm length) 90% of 445 beetles mspp.
- 97 singletons unique to Mosaic.
- 64 singleton unique to Wildfire.
- “Unique” beetles only collected once, therefore possible Short Range Endemics (100 x 100 km).

The End (for now).

Biodiversity Component 1:
Mosaic Unique Diversity

Family	Singletons Richness	Singleton Richness per Family (%)	Walpole Percent Richness (%)
Curculionidae	13	13.4	16.9
Staphylinidae	9	9.3	10.3
Chrysomelidae	11	11.3	7.6
Pselaphidae	2	2.1	6.9
Leiodidae	7	7.2	5.6
Carabidae	2	2.1	5.4
Scarabaeidae	2	2.1	4.5
Elateridae	5	5.2	4.0
Nitidulidae	1	1.0	2.7
Tenebrionidae	2	2.1	2.5
Lathridiidae	2	2.1	2.2
Remainder	41	42.3	31.2

Biodiversity Component 1:
Wildfire Unique Diversity

Family	Singletons Richness	Singleton Richness per Family (%)	Walpole Percent Richness (%)
Curculionidae	17	22.7	16.9
Staphylinidae	3	4.7	10.3
Chrysomelidae	7	10.9	7.6
Pselaphidae	2	3.1	6.9
Leiodidae	3	4.7	5.6
Carabidae	3	4.7	5.4
Scarabaeidae	2	3.1	4.5
Elateridae	2	3.1	4.0
Nitidulidae	1	1.6	2.7
Tenebrionidae	1	1.6	2.5
Lathridiidae	0	0.0	2.2
Remainder	23	35.9	31.2

Biodiversity Component 1:
Mosaic + Wildfire Uniques

Family	Singletons Richness	Guild (%)	Singleton Richness per Family (%)	Walpole Percent Richness (%)
Curculionidae	30	a	40.0	16.9
Staphylinidae	12	d	26.1	10.3
Chrysomelidae	18	b	52.9	7.6
Pselaphidae	4	e	12.9	6.9
Leiodidae	10	g	40.0	5.6
Carabidae	5	def 13.0	20.8	5.4
Scarabaeidae	4	abc 32.4	20.0	4.5
Elateridae	7	i	38.9	4.0
Nitidulidae	2	k	16.7	2.7
Tenebrionidae	3	kl 3.1	27.3	2.5

Biodiversity Component 1: Taxonomic Diversity

* Note: % species in family Australia wide (Lawrence and Britton 1991).

Family	Walpole Richness (mspp)	Walpole Percent Richness (%)	*Australia Percent Richness (%)
Curculionidae	75	16.9	21.3
Staphylinidae	46	10.3	5.7
Chrysomelidae	34	7.6	10.6
Pselaphidae	31	6.9	3.2
Leiodidae	25	5.6	0.5
Carabidae	24	5.4	8.9
Scarabaeidae	20	4.5	10.6
Elateridae	18	4.0	2.8
Nitidulidae	12	2.7	1.1
Tenebrionidae	11	2.5	5.3
Lathridiidae	10	2.2	0.2
Remainder	139	31.2	29.8

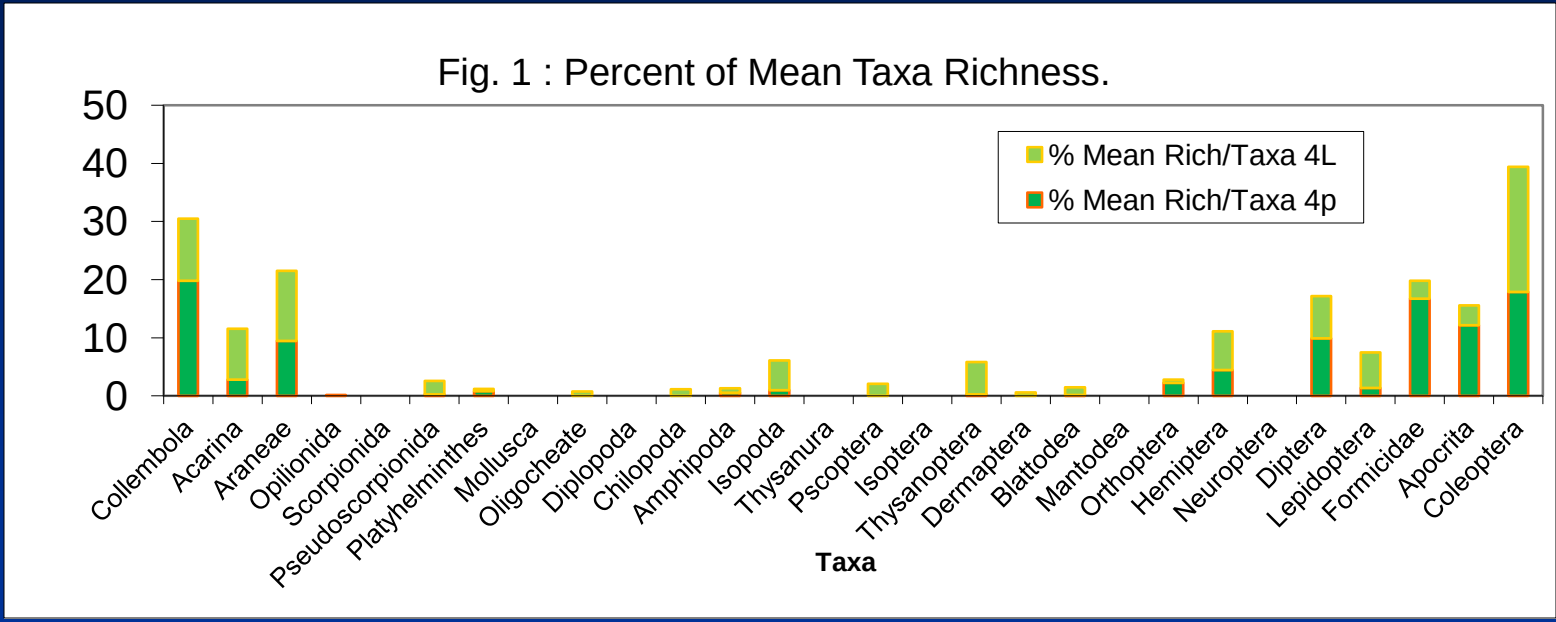
Biodiversity Component 2: Structural Diversity

Family	Rank Mm^3	Body Length range (mm)	Body Length mean (mm)	Body Volume mean (mm^3)
Curculionidae	4	0.8 – 22.6	6.3	114.0
Staphylinidae	8	0.8 - 7.8	3.2	1.5
Chrysomelidae	6	1.2 – 12.6	3.3	24.9
Pselaphidae	10	0.7 – 2.6	1.5	0.5
Leiodidae	9	0.9 – 2.4	1.8	1.4
Carabidae	3	1.2 – 20.2	7.9	120.9
Scarabaeidae	1	2.4 – 19.1	7.7	176.5
Elateridae	5	2.9 – 17.5	7.6	65.9
Nitidulidae	7	1.8 – 3.8	2.7	3.5
Tenebrionidae	2	1.2 – 18.1	9.7	158.4
Lathridiidae	11	0.8 – 1.5	1.2	0.13
Remainder	7	0.6 – 14.0	3.2	9.1

Biodiversity Component 3: Functional Diversity

Family	Larval Trophic guild	Adult Trophic guild	Walpole Percent Richness (%)	*Australia Percent Richness (%)
Curculionidae	phytophagous	phytophagous	16.9	21.3
Staphylinidae	predators	predators	10.3	5.7
Chrysomelidae	phytophagous	phytophagous	7.6	10.6
Pselaphidae	predators	predators	6.9	3.2
Leiodidae	mycophagous	mycophagous	5.6	0.5
Carabidae	predators	predators	5.4	8.9
Scarabaeidae	phytophagous onthophagous	phytophagous onthophagous	4.5	10.6
Elateridae	various	various	4.0	2.8
Nitidulidae	saprophagous	saprophagous	2.7	1.1
Tenebrionidae	saprophagous	saprophagous	2.5	5.3
Lathridiidae	mycophagous	mycophagous	2.2	0.2
Remainder	various	various	31.2	29.8

Litter & Pitfall Invertebrates



- An estimated total of 29,100 invertebrate individuals sorted from 1144 samples.
- Invertebrate richness of litter 3 times pitfalls (t***<0.0016, n=12).
- Beetle (Coleoptera) richness 9.9% - 21.5% of total richness.

Structural Diversity & Rarity

- Other SW forest studies monitor macro-beetles & inverts > 10mm.
- Walpole beetle fauna – 445 mspp.
- 28 mspp singletons >10mm (12.7%).
- 7 mspp doubleton > 10mm (8.5%).
- 14 mspp common > 10mm (9.8%).
- Macro-beetles about 10% of entire Walpole beetle fauna.