# Mosaic Fires not Wildfires? Logistic Lessons from Beetles in South-West Australia.

WA Bushfire Research Forum
University of WA
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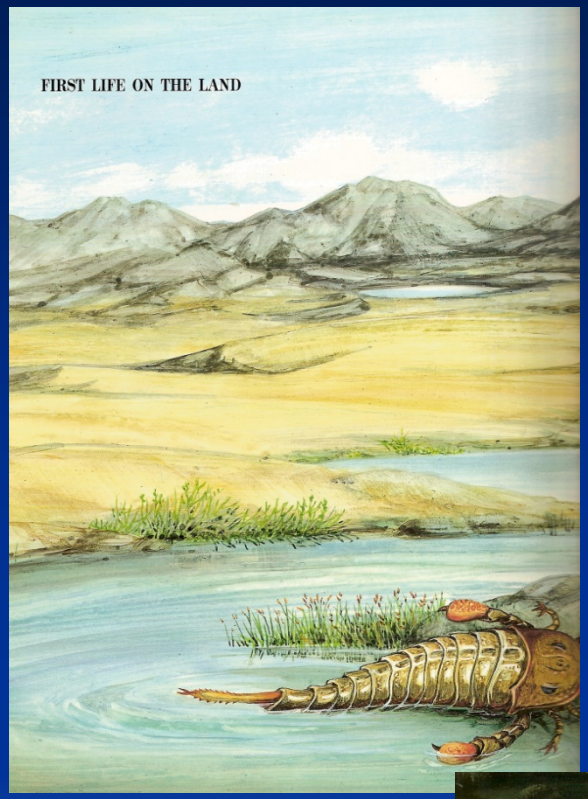
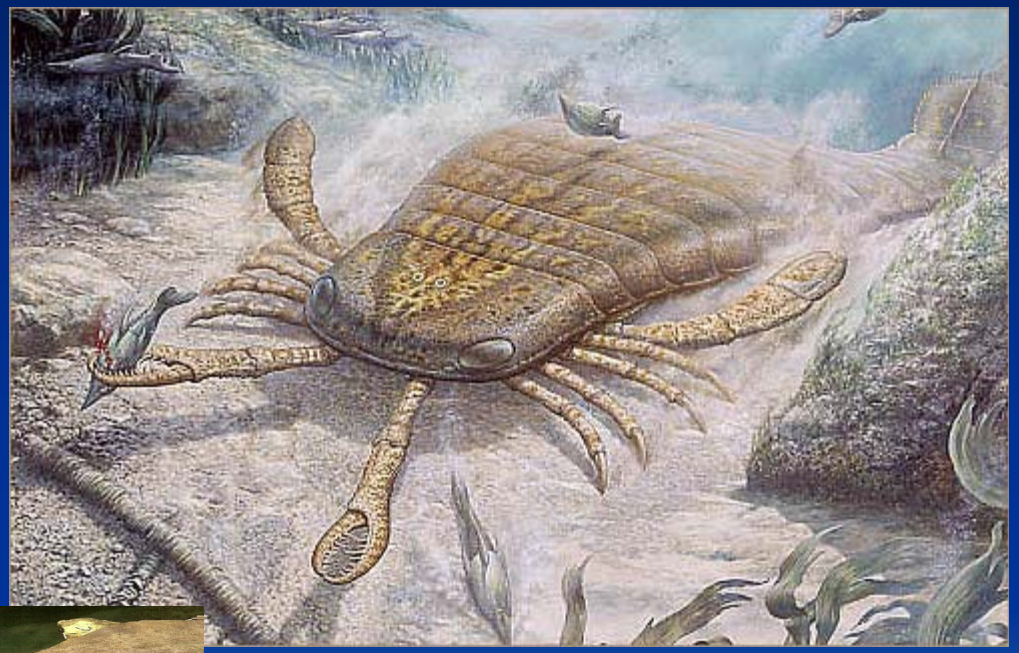
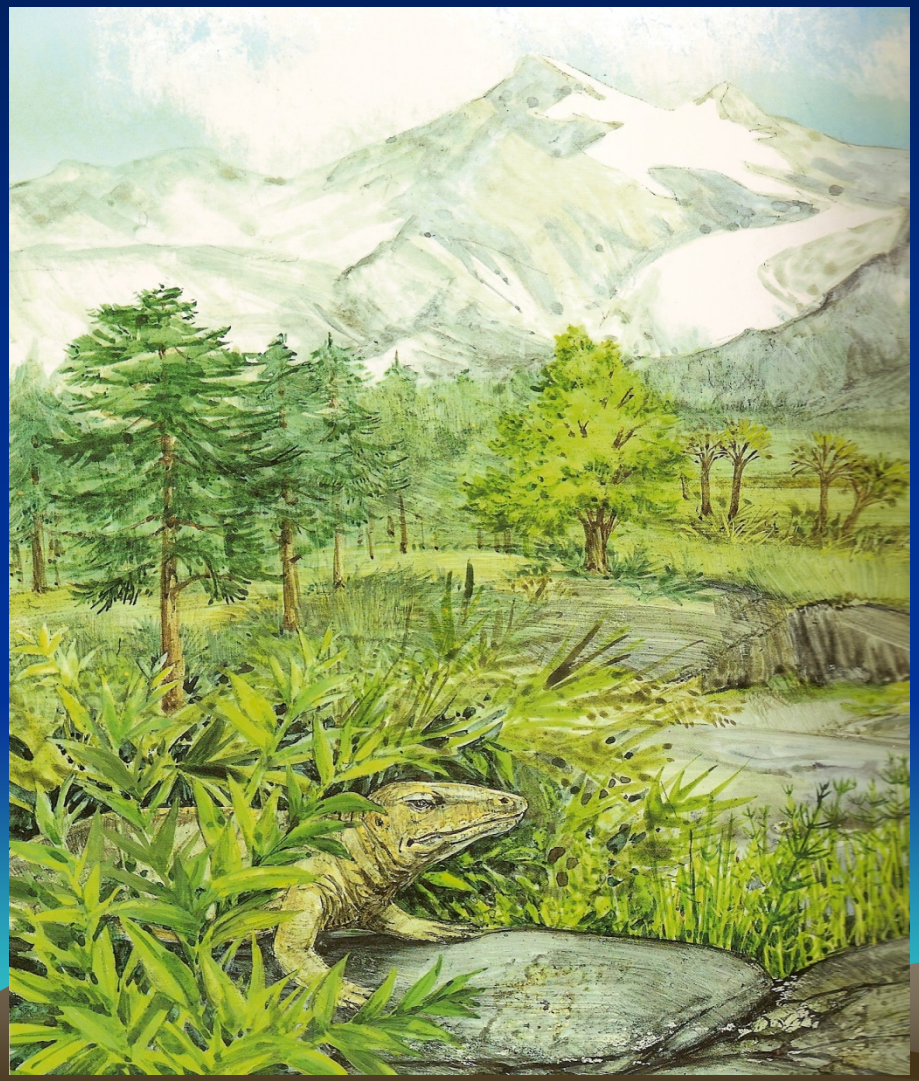
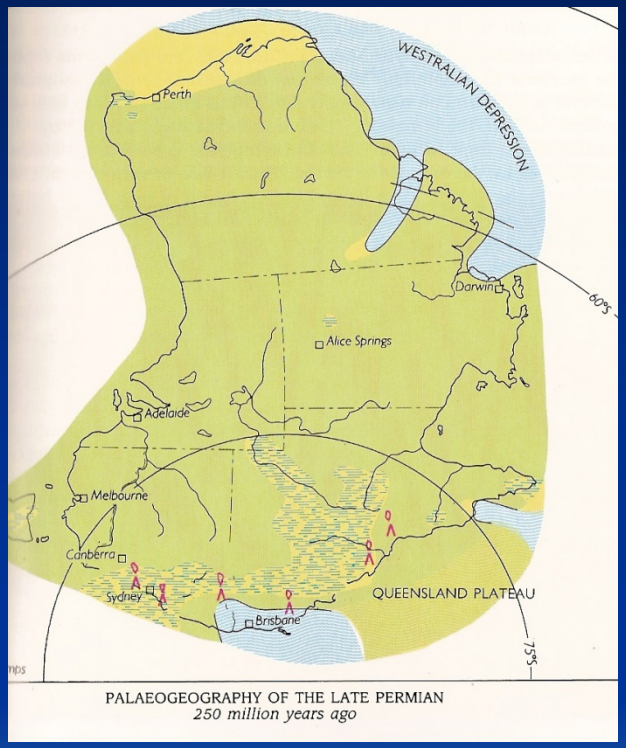
# 420 million years ago:
# Giant Sea-scorpions colonized Kalbarri.

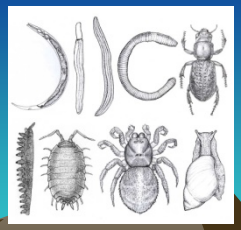


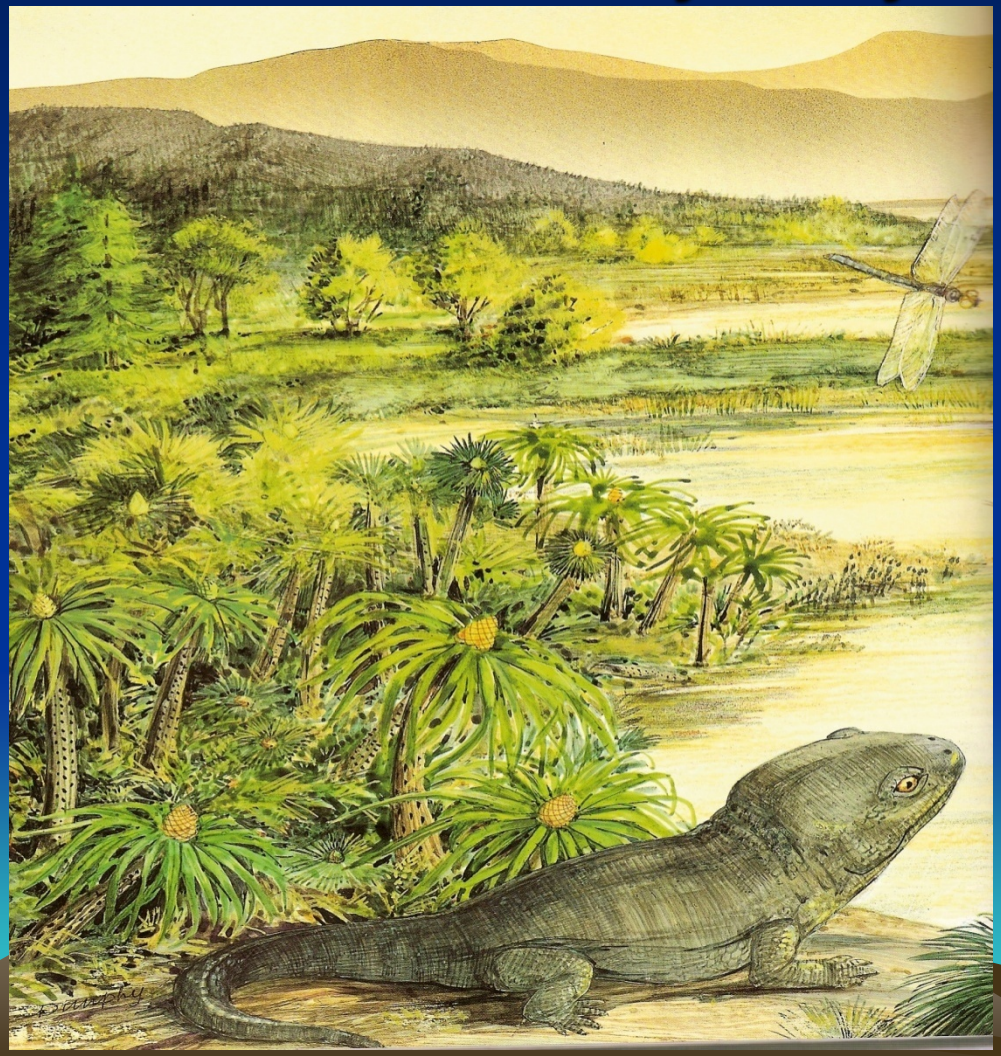
# 260 million years ago: South Polar Coal Swamps

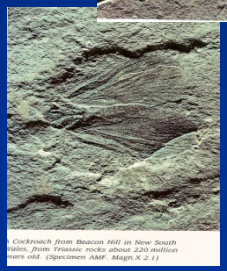




# 225 million years ago: Warm-temperate South Pole, Sydney Basin.

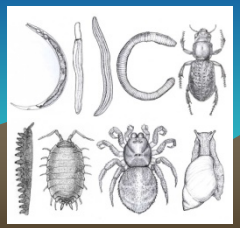


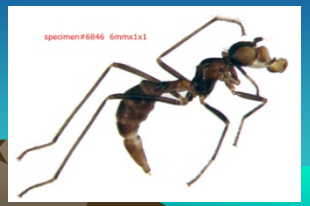


Cockroach from Beacon Hill in New South Wales, from Triassic rocks about 220 million years old. (Specimen AMF. Magn X 2.1)


# Mosaic Landscape from Ice & Fire (245 million years old)

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






# Relict Big-Foot

- *Kumbadjena spp*
- 530 MYO living fossil.
- Predator of rotting log arthropods.
- Possible hot-fire vulnerable habitat.
- High rainfall forests.

# Relict Rolly-Polly Millipede

- *Cynotolepis notabilis*
- 20 MYO rainforests
- Fire vulnerable habitat in deep moist leaf litter.
- High rainfall forests near South coast.

# Relict Ant-mimic Fly


- *Badisis ambulans*
- Panagean ancestor 140 MYO.
- Larvae live inside rare Albany Pitcher plant.
- Habitat lost until plant regrows after fire.
- Caldyanup winter water-logged swampy flats.

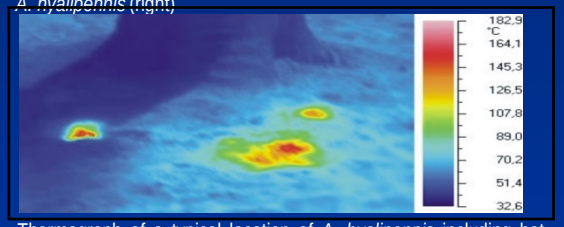
# Wildfires & Climate Change

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

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

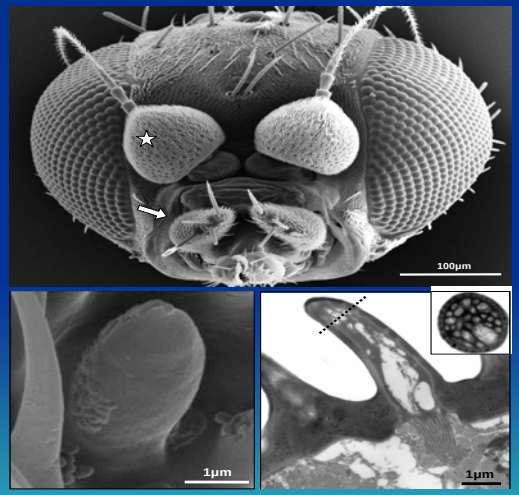
# Pyrophilous Arthropods

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.

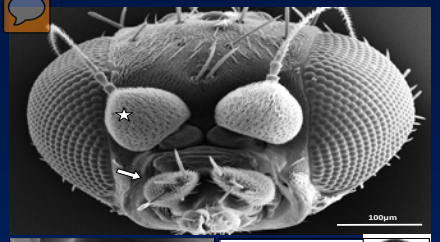
- **Still burning habitats essential to pyrophilic endemic arthropods.**
- **SW invert families contain pyrophilous species dependent on recently burnt habitat.**
- **Flies (Phorid) *Hypocerides nearcticus* & (Therevidae) *Anabarhynchus hyalipennis* oviposit on smoldering logs.**
- **Beetle (Buprestidae) *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.**

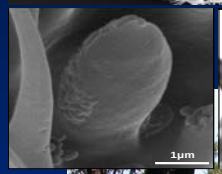


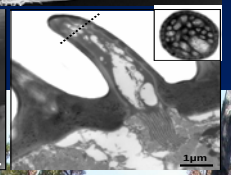

Above: SEM-image of the head of *H. nearcticus*. Antennae (asterisk) and mouthparts (arrow) are depicted. Left: Sensillum basiconicum on the antenna. Right: TEM-image of a longitudinal section through a S. basiconicum. Inserted: Cross-section of the distal part of the receptor. The lumen is filled by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

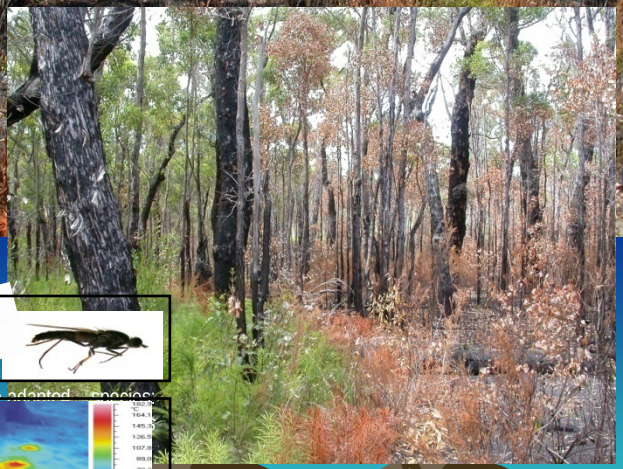
# Walpole Forest Mosaic

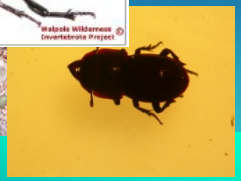
## Patchy burnt:
## Sept 2002, Feb 2006 & Dec 2008



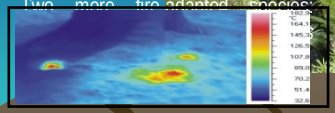



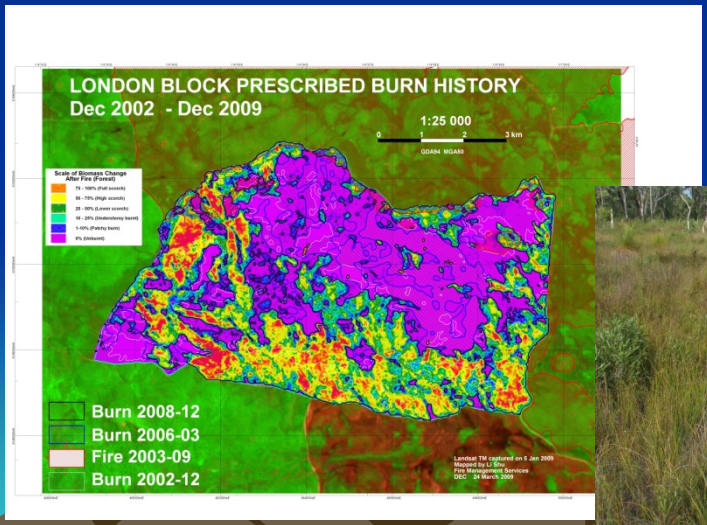



Two more fire adapted species:

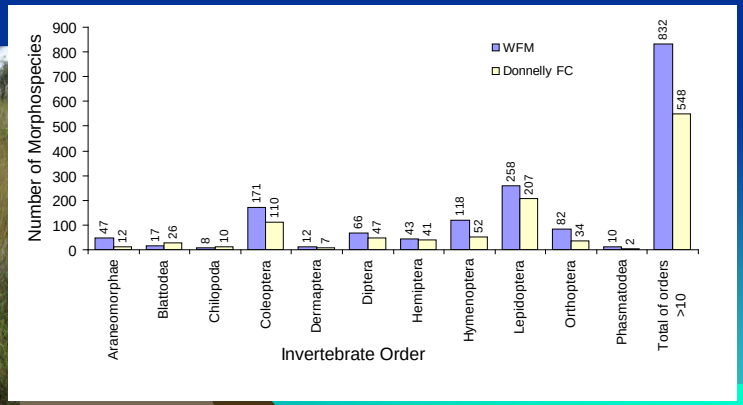


# Walpole Fire Mosaic study:

- 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).



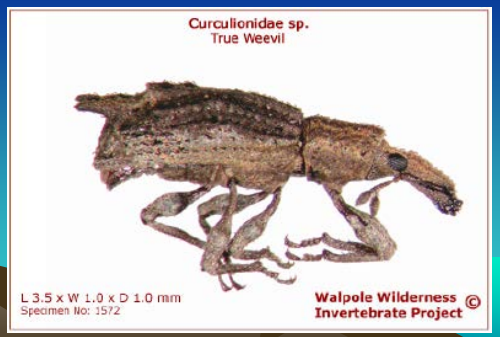

London block mosaic pattern established after 3 burns, with many widespread patches ranging in age from 9 months to over 25 years (see unburnt purple in Landsat image ).



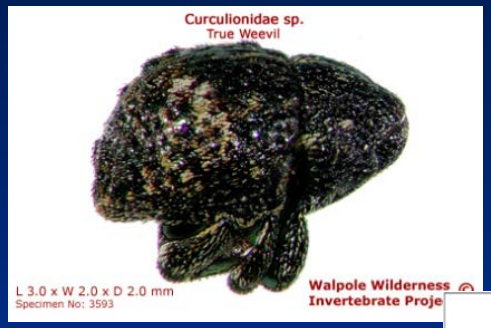
# Mini Beetles < 10mm

# Walpole Mosaic Beetles:
## Oct 2005 to Oct 2010

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

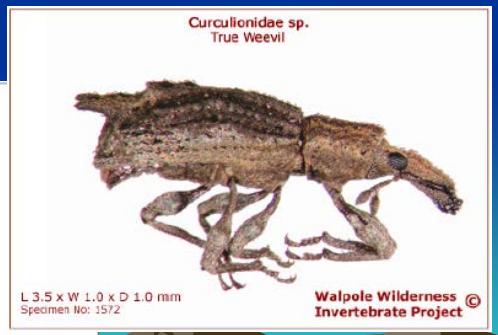



# Unique Beetles of Mosaic or Wildfire







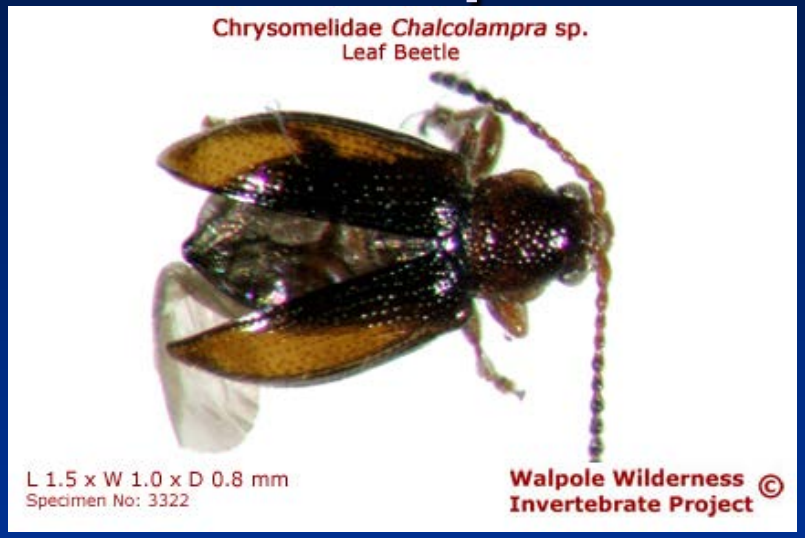


- 97 (21.8%) singletons unique to Mosaic (only collected here).
- 64 (14.4%) singleton unique to Wildfire.
- Small beetles (<10mm length) 90% of 445 beetles mspp.
- beetles 9.9% to 21.5% of Walpole invertebrates collected.
- beetles 26% of 11.3 million extant species on Earth.
- “Unique” beetles only collected once, therefore possible Short Range Endemics (100 x 100 km).

# Unique to Patchy Mosaic

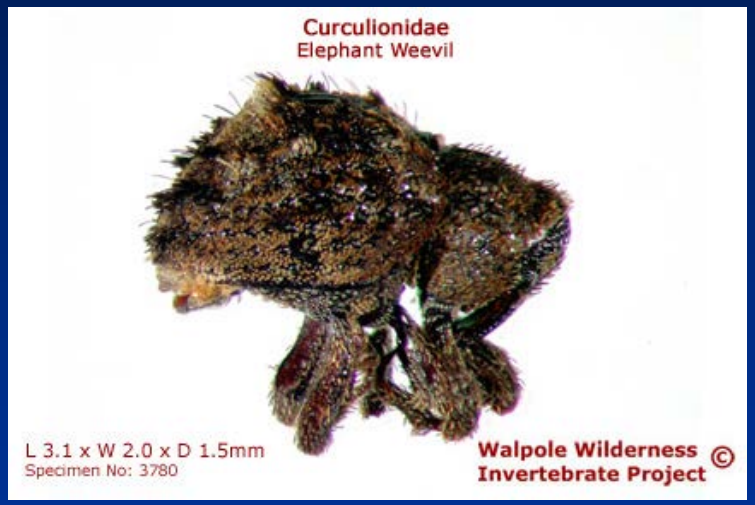

- Leiodids 7 species.
- *Eublackburniella sp.*
- Larvae feed on fungi on rotting logs.
- Site 1, Mt Roe N.P.
- New species recently described from Tasmania (Perkovsky 1994).
- Possible bio-indicator of large logs.

# Unique to Patchy Mosaic



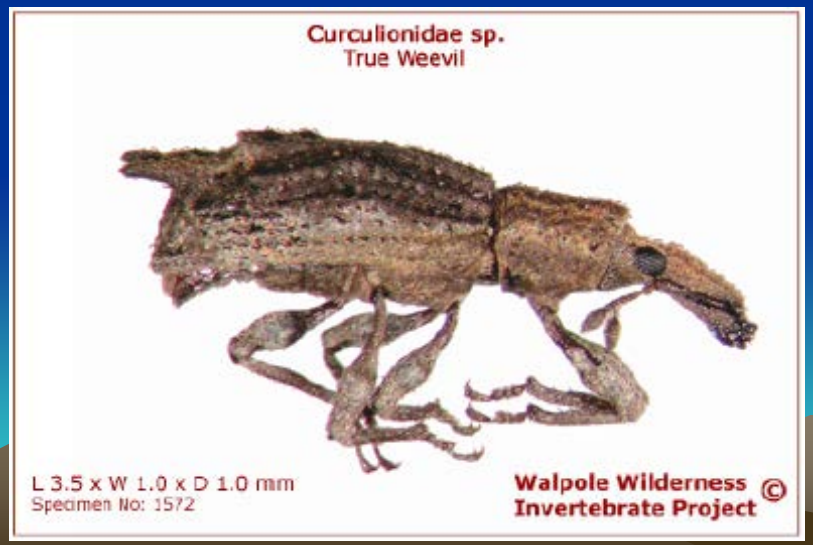

- Chrysomelids 11 spp
- *Chalcolampra sp.*
- Larvae herbivorous.
- Site 1, Mt Roe N.P.
- (Reid 2006).

# Unique to Wildfire




- Curculionids 17 spp
- Herbivores favoured by regrowth of sedges & shrubs.
- Site 8, Oct 2009 Mt Roe N.P.
- Aust weevils +6000 spp .
- (Lawrence & Britton 1991).

# Vital Attributes of Uniques?


- Habitat fire age?
- Larval habitat?
- Juvenile period?
- Adult dispersal?
- Adult breeding sites?
- SW distribution?
- Up-dated Table.

# Biodiversity Component 1:
# Mosaic Unique Diversity

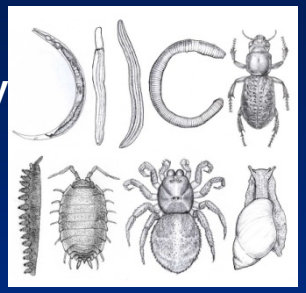
| Family | Singletons Richness | Singleton Percent Richness (%) | Walpole Percent Richness (%) |
|---|---|---|---|
| Curculionidae | 13 | 13.4 | 16.9 |
| Staphylinidae | 9 | 9.3 | 10.3 |
| Chrysomelidae | 11 | 11.3 | 7.6 |
| Pselaphidae | 2 | 2.1 | 6.9 |
| Leiodidae | 7 | 7.2 | 5.6 |
| Carabidae | 2 | 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 Percent Richness (%) | Walpole Percent Richness (%) |
|---|---|---|---|
| Curculionidae | 17 | 26.6 | 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 |

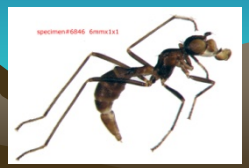
# Lessons from Short Range Endemics:

## Forest Relicts & Pyrophilic Specialists



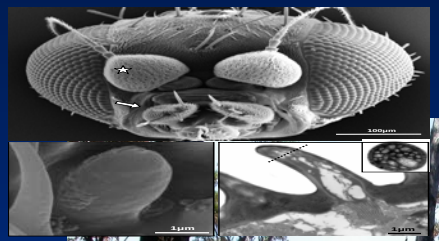
- **Earthworms – very high species turnover-widespread in SW forests – collected by Wills.**
- **Onychophora – log specialist-wide spread SW forests – collected by WAM Amanda Reid, FC, WFM.**
- **Millipedes (Diplopoda) – Walpole, Stirlings and Cape Range - Melinda Moir WAM, FC, WFM.**
- **Slaters (Isopoda) – logs-Manjimup- FC Danti (thesis 2008), WFM.**
- **Snails (Gastropoda) – widespread- collected by FC, WFM, Nuyts.**
- **Scorpions, Pseudoscorpions, Harvestmen & Spiders – litter, logs, rock outcrops - WAM , FC, WFM, Nuyts.**
- **Dragonfly (Western Petalura) – Darling Scarp headwaters of upper valleys - DEC- Barrett & Williams (1996)**
- **Earwig Fly (Mecoptera) – widespread in SW forest- Ian Abbott et al. - collected by FC & WAM.**
- **S.R.E. Beetles – Curculionids- Amycterines, Carabids – collected by FC, BCR, WFM, Nuyts.**
- **SRE Flies – Micropezidae – Albany Pitcher plant – collected by Nuyts survey.**
- **SRE Ants – Bullants, new Nuyts species – BCR, WFM, Nuyts, Heterick.**
- **Pyrophilic Species – short post-fire window of activity-collected by FC, BCR, WFM.**
- **Fire Sensitive Beetles – Lucanids- long unburnt logs- collected by FC, WFM**
- **FC = Forest Check ; WFM = Walpole Fire Mosaic; WAM = WA Museum; BCR = Bushfire Co-operative.**

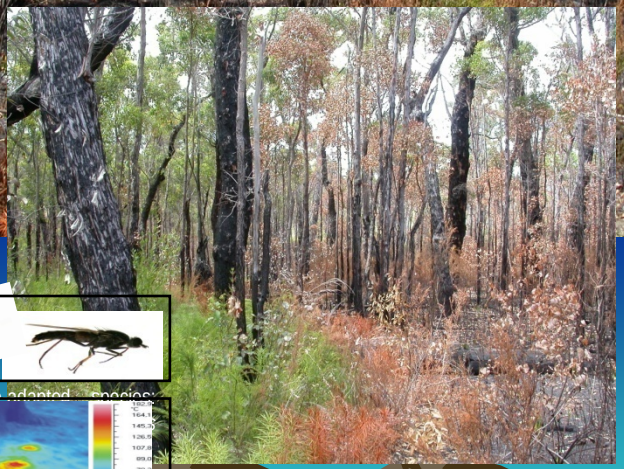


# Diversify Patch Fire Age!

## The End (for now)!





Two more fire adapted species: