The role of fire in plant conservation in fragmented wheatbelt reserves

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SW WA: a global biodiversity hotspot

- Southwest Australian Floristic Region
  - 1 of 25 global biodiversity hot spots
  - Only global hot spot in Australia
  - 7000 + taxa of vascular plants
  - ~ 50% endemic to floristic region
  - Fire-prone landscape
  - Fire is a key process driving vegetation composition, health and recruitment
  - Many plants possess traits that enable them to persist following fire

Responses to fire - resprouters

- Resprouters
  - Many adult plant survive fire
  - Resprout from above or below-ground organs
  - Less dependent on recruitment after fire, so often less vulnerable to changes in fire regimes in the short term
- Examples
  - Mallee *Eucalyptus*, *Xanthorrhoea,* many *Dryandra*

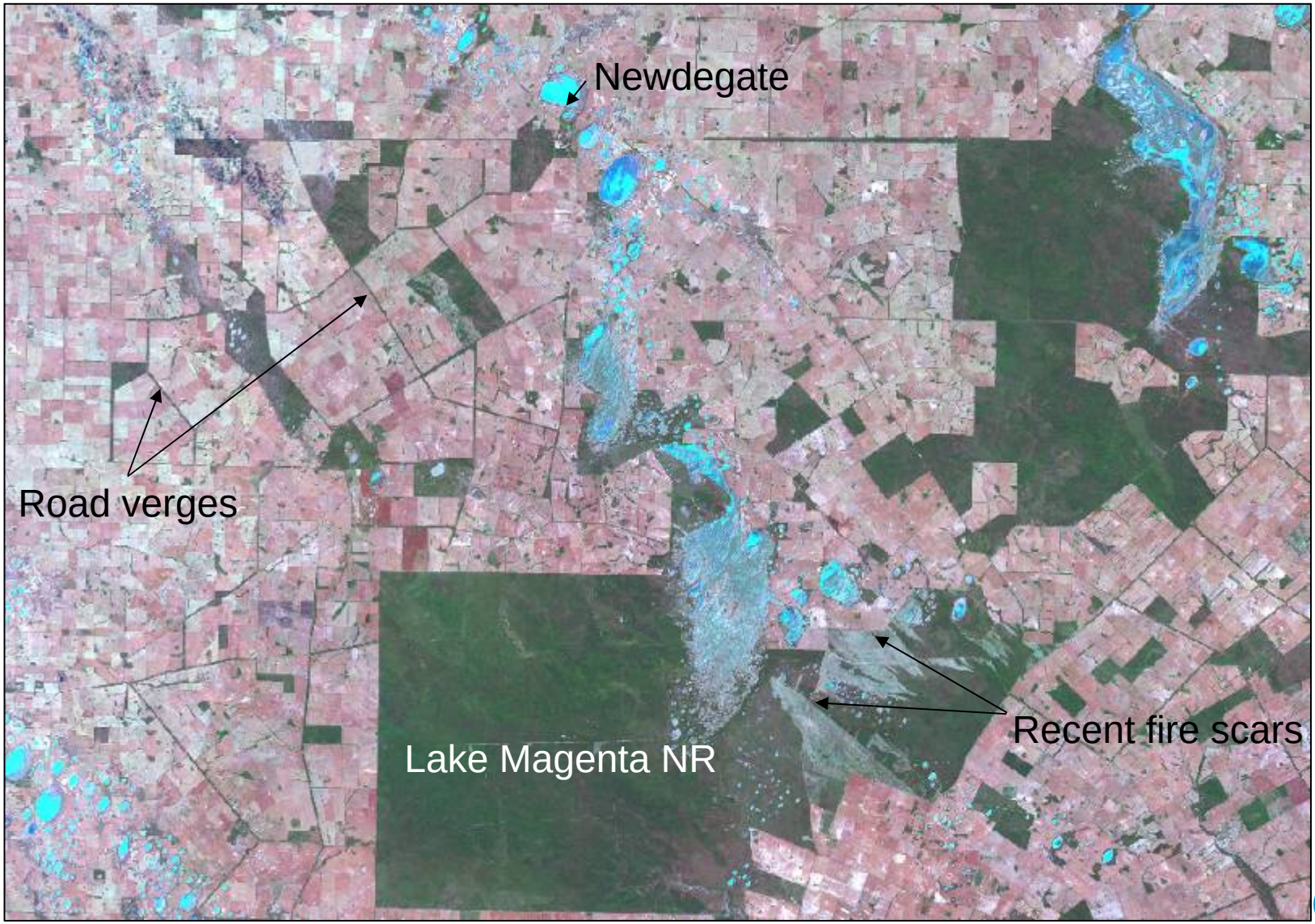
Responses to fire – obligate seeders

- Obligate seeders
  - Adult plants killed by fire
  - Recruit from seeds stored on the plant (serotinous), in the soil or colonise the site from unburnt refuges
  - Dependent on recruitment after fire for persistence at the site, so often immediately vulnerable to changes in fire regimes
- Examples
  - Many *Banksia* and *Hakea*, mallet *Eucalyptus* (serotinous)
  - Many *Acacia, Grevillea* and peas (soil seed bank)

The WA wheatbelt: a fragmented and threatened landscape

- The degree of fragmentation
  - ~10.8% extant native vegetation cover in SW Floristic Region biodiversity hotspot
  - Native vegetation cover in IBRA regions of the wheatbelt: Avon-Wheatbelt 14.6%, Mallee 54%
  - As little as 2-3% cover in some districts
- Fragmentation effects on flora
  - Smaller plant population sizes
  - Reduced gene flow (through loss of connectivity and dispersal agents)
  - Altered disturbance regimes
  - Increased edge effects (*e.g.* nutrient enrichment)
  - Altered hydrological processes

The WA wheatbelt: a fragmented landscape



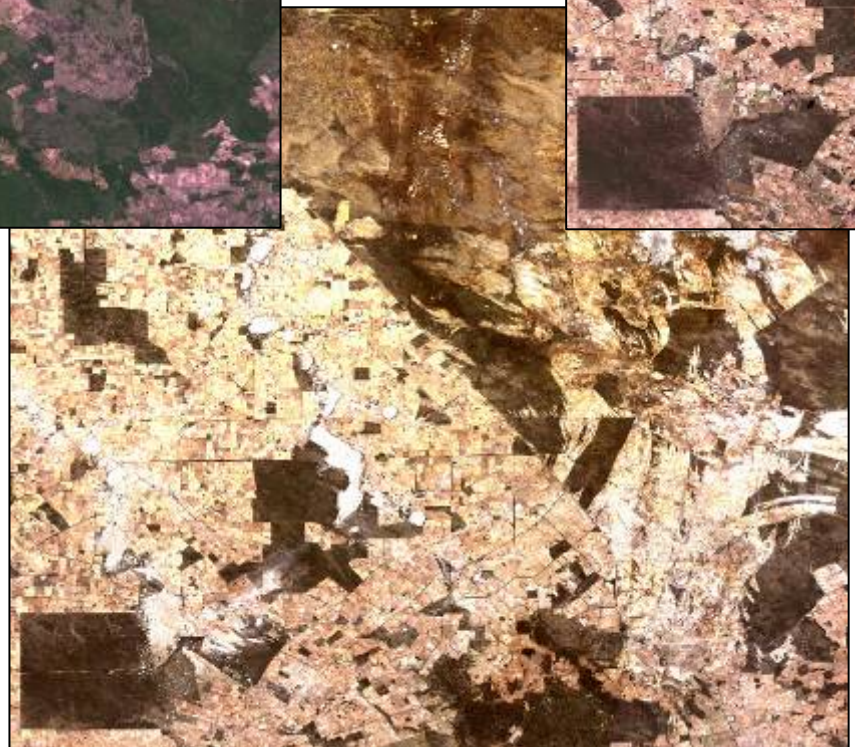
Life on the edge of wheatbelt nature reserves

Fire-related processes affecting plant conservation in remnant vegetation:

- Inappropriate fire regimes
  - Altered frequency, season, extent or intensity of fires
  - Different sources of fire ignition
  - Loss of connectivity (for passage of fire)
- Fire mitigation methods
  - Fire exclusion and suppression
  - Scrub rolling
- Weed invasion

Fragments get fewer and smaller fires

1980



2004

2000

Inappropriate fire regimes - 1

Conservation risks of lower fire frequency

- Lack of recruitment opportunities
  - Period between fires may exceed plant and seed longevity
  - Adult plants senesce
  - Seeds released or seed viability declines with time
  - Obligate seeders (especially serotinous species) and some resprouters affected
- Ecologically dysfunctional abundance of fire-sensitive plant species
  - Competitively exclude other species

Inappropriate fire regimes - 2

Conservation risks of higher fire frequency

- Lack of opportunities for reproduction and recruitment
  - Period between fires may be less than that required for a plant to mature and produce seed
  - Depletion of seed bank or resources for resprouting over time
  - Obligate seeders (especially serotinous species) and some resprouters affected
- Significant issue for fire refugia
  - *E.g.* granite outcrops

Fire mitigation methods - Scrub rolling

- How?
  - Strip of vegetation ~40m in width chained
  - Chained vegetation burnt at a later date
  - Fires conducted under moderate weather conditions and planned to extinguish a short distance into adjoining vegetation

- Why?
  - Used as a planned fuel reduction buffer strip
  - Minimise the risk of unplanned wildfires
  - Vegetation burns more completely
  - Lower flame heights render fire easier to control

- Where?
  - Usually along remnant boundaries or internal access tracks
  - Blocks of vegetation > 5000 ha in size in eastern Wheatbelt
  - ~ 550 ha of vegetation affected in study area since 2001 (greater area than 40% of NRs in district)

Scrub rolling

- What are the possible impacts?
  - Combines two disturbance events know to cause plant mortality and stimulate recruitment
  - Potentially different impacts of plants with different fire responses
  - Serotinous, obligate seeders at risk if seed release or germination after chaining occurs prior to burning

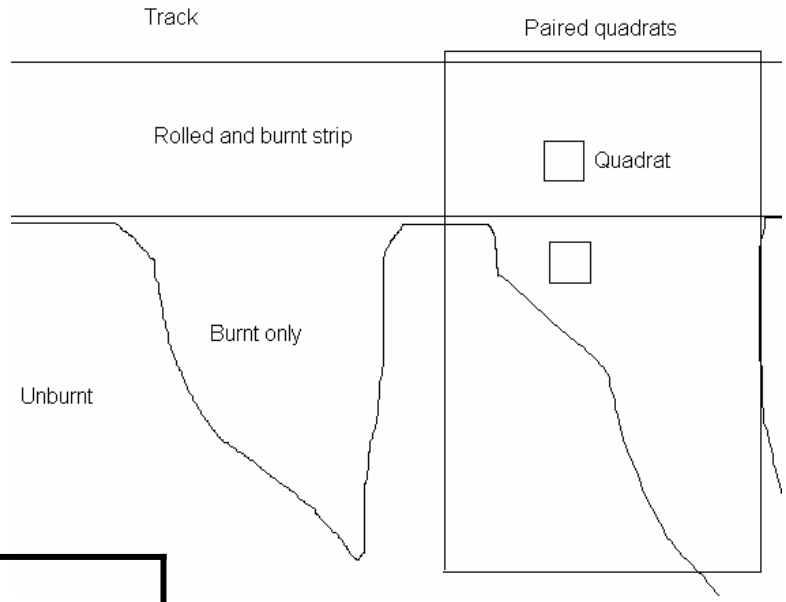
Scrub rolling

Rolled and burnt

Burnt only

Scrub rolling – study methods

- Methods
  - Paired 10 by 10 m quadrats in scrub rolled strip and adjacent burnt area
  - Number of recruiting or resprouting individuals counted
  - Two fire response types, for two genera
- Study species

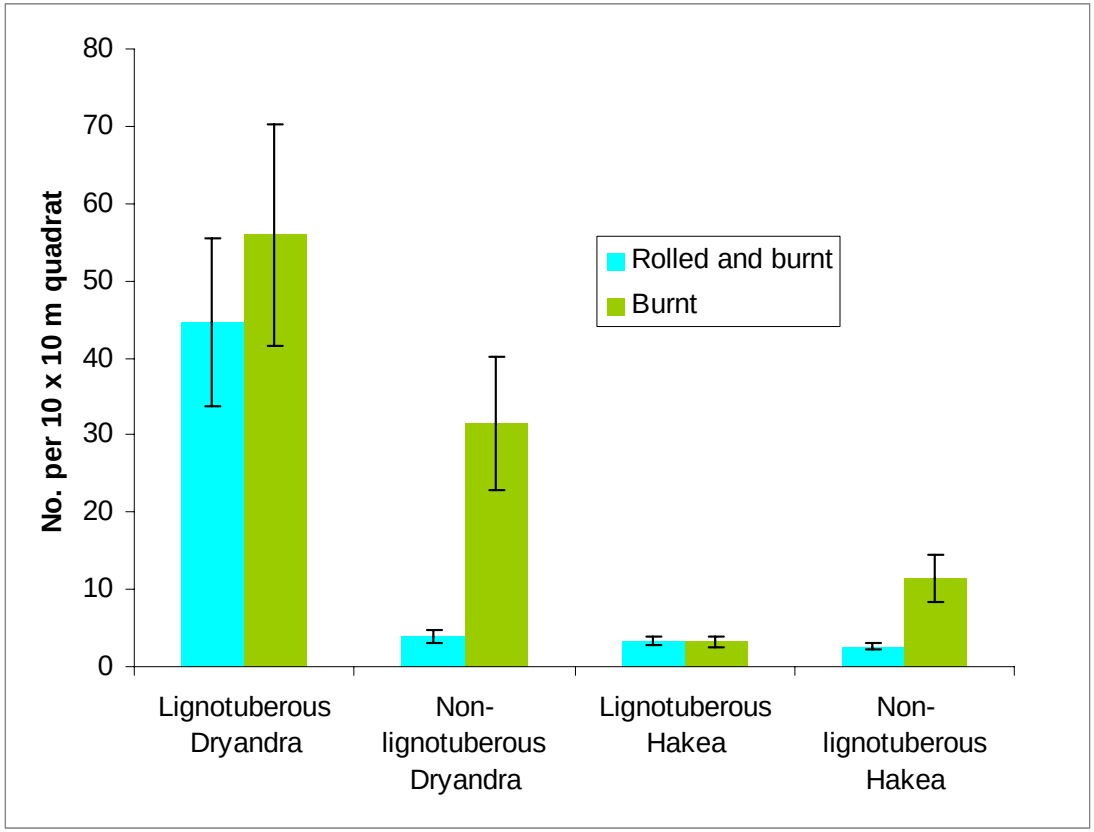


Genus	*Dryandra*	*Hakea*
Serotinous, obligate seeder	*D. pallida* *D. cuneata*	*H. pandanicarpa* *H. cygna*
Resprouter	*D. pteridifolia* *D. erythrocephala* *D. ferruginea*	*H. incrassata* *H. prostrata*

Scrub rolling - plant recruitment

Results

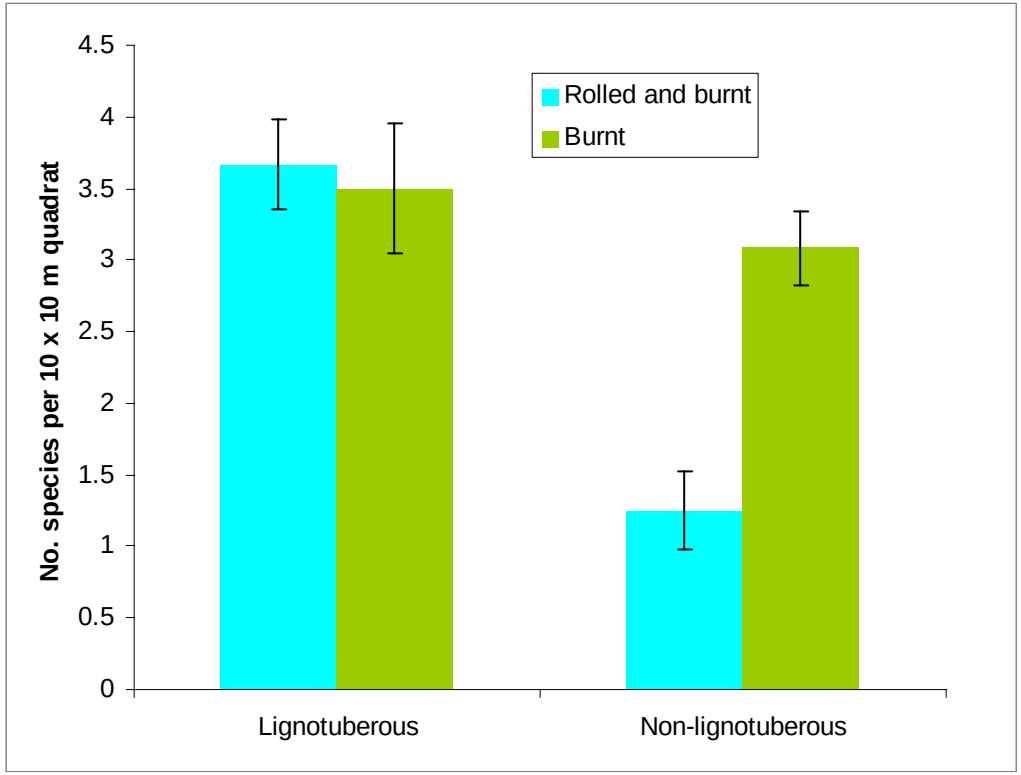
- Fewer recruits of serotinous, obligate seeders (non-lignotuberous) in rolled strips
- Little difference in abundance of resprouting taxa (lignotuberous)



Scrub rolling – species richness

Results

- Fewer species of serotinous, obligate seeding *Dryandra* and *Hakea* in rolled strips
- Little difference in species richness of resprouting *Dryandra* and *Hakea*



Weed invasion

- Increased risk of weed invasion after fire
- Greater opportunities for weed recruitment (germination stimuli of heat, smoke)
- Increased light, water and nutrient availability post-fire
- Edges most vulnerable to invasion

Weed invasion

- Key research questions:

Why do some vegetation edges have greater weed invasion after fire than others?

- Increased soil nutrients (fertiliser enrichment)?
- Greater source of weed propagules (paddock management, methods of seed dispersal)?
- Greater vegetation disturbance before and/or after burning (native and stock herbivores, vehicles)?
- Vegetation type burnt?

Are increases in weeds post-fire a temporary or permanent change?

Are the areas affected stable in extent over time?

Conclusion

- Appropriate fire management is essential for conservation
  - Remnants in the wheatbelt appear to be experiencing different fire regimes from uncleared portions of the landscape
  - Unknown consequences for flora susceptible to fire-related decline
- Edges of remnants are especially prone to fire-related degradation
  - Inappropriate planned fire management
  - Evidence that fire management methods consisting of two temporally separated disturbance events adversely affects some species
  - Weed invasion after fire
  - Minimise disturbance to existing edge vegetation (*e.g.* spray drift of herbicides or fertiliser, wind-blown soil and seeds)
  - Breakdown of effective edge vegetation may lead to increased penetration of disturbance effects into remnants

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Thank you

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