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Forum May 7th 2008

DEPARTMENT OF
NATURAL RESOURCES, ENVIRONMENT AND THE ARTS

Biodiversity and fire – western Arnhem Land

John Woinarski



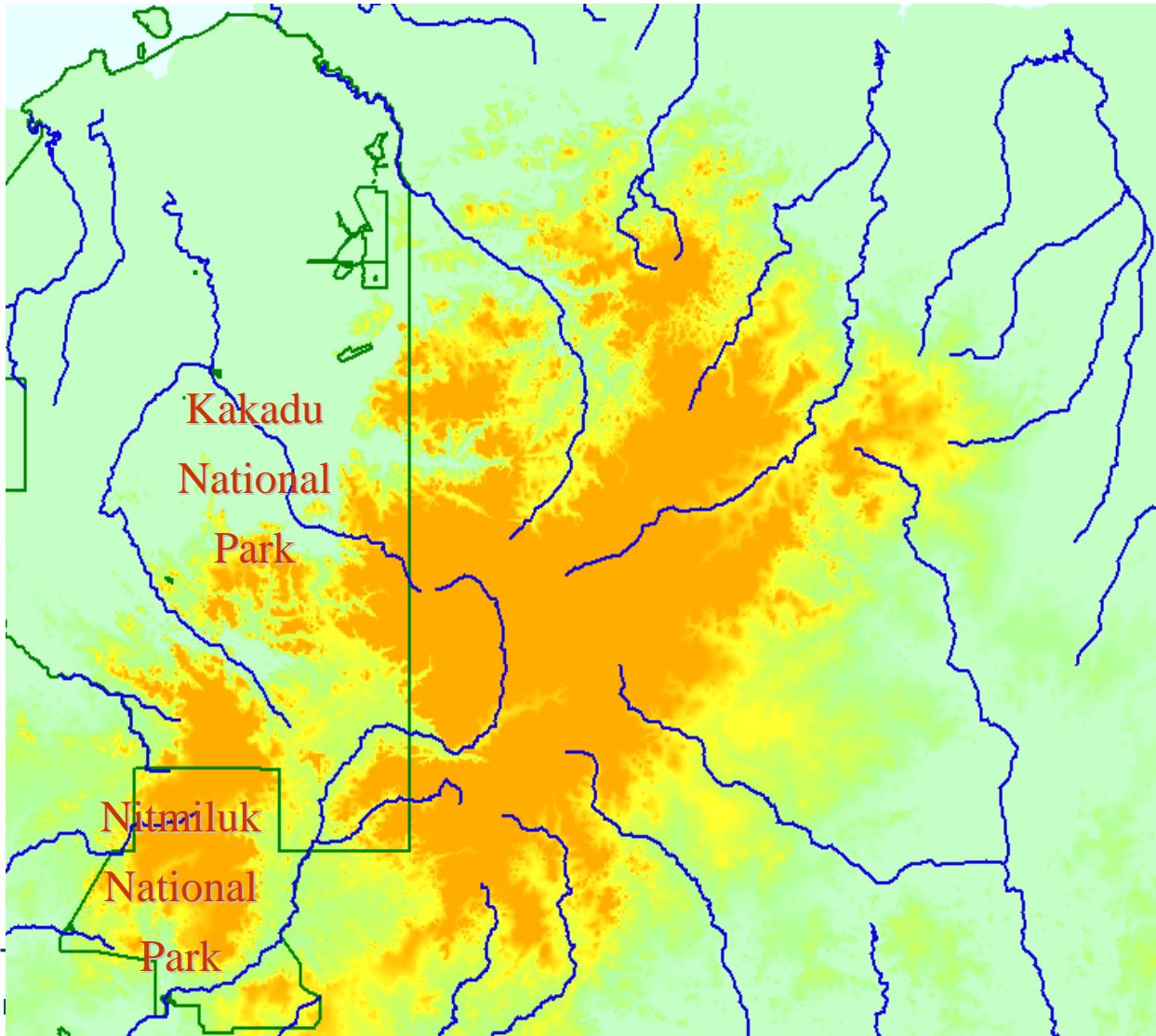


The story outline ..

- The biodiversity values of western Arnhem Land
- Condition and trends of those values;
- Responses of biodiversity to fire;
- Management implications



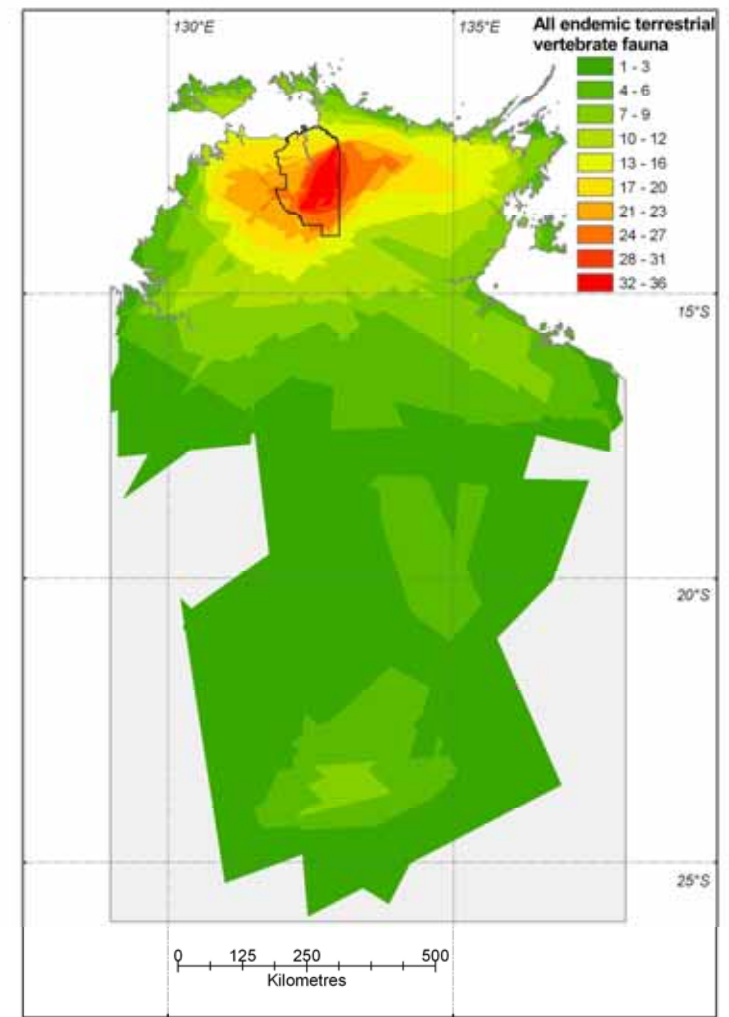
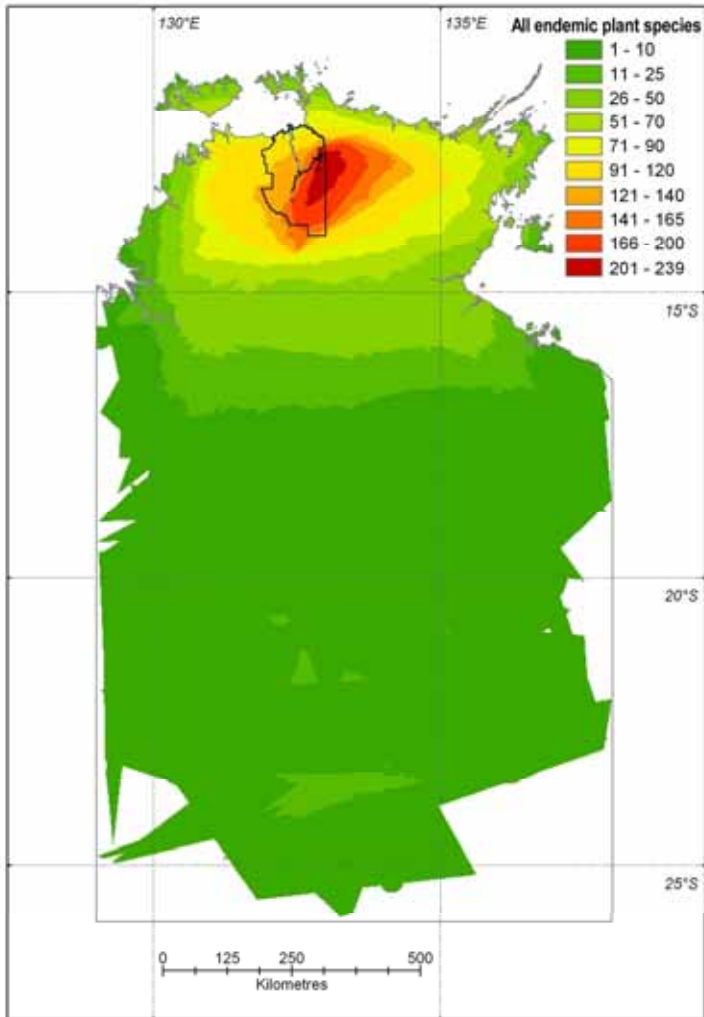
Western Arnhem Land



Plateau area
34,000 km²
[15% in
Kakadu]

Endemic species

numbers of co-occurring NT endemic species:
plants (left); terrestrial vertebrates (right)



ENVIRONMENT AND THE



Relictual species

- The WAL plateau has had an unbroken presence in the landscape for >100 million years, while the surrounding lowlands have been intermittently inundated.
- Many evolutionary oddities, clinging to survival from an earlier age



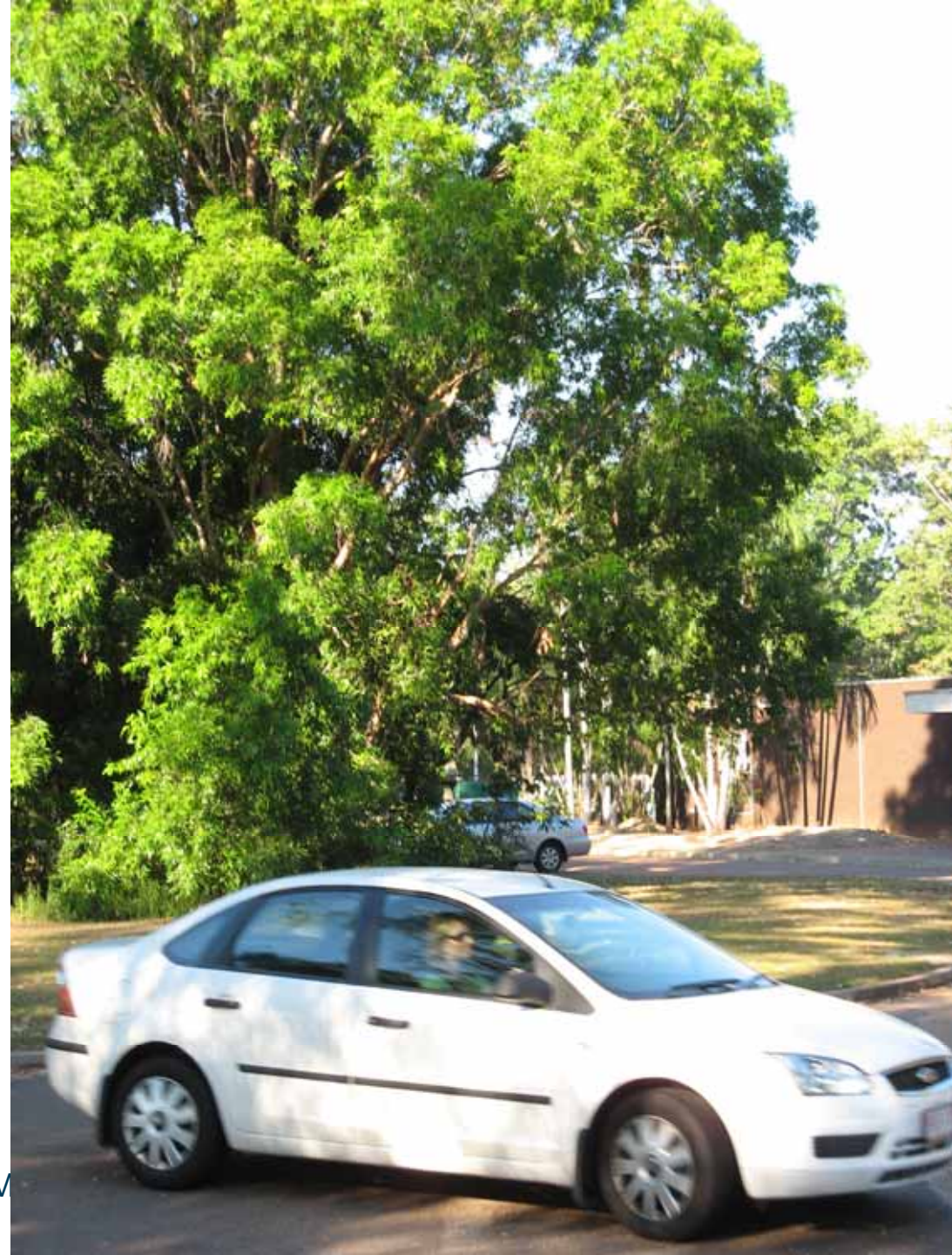
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Boronia viridiflora [Photo Dave Liddle]



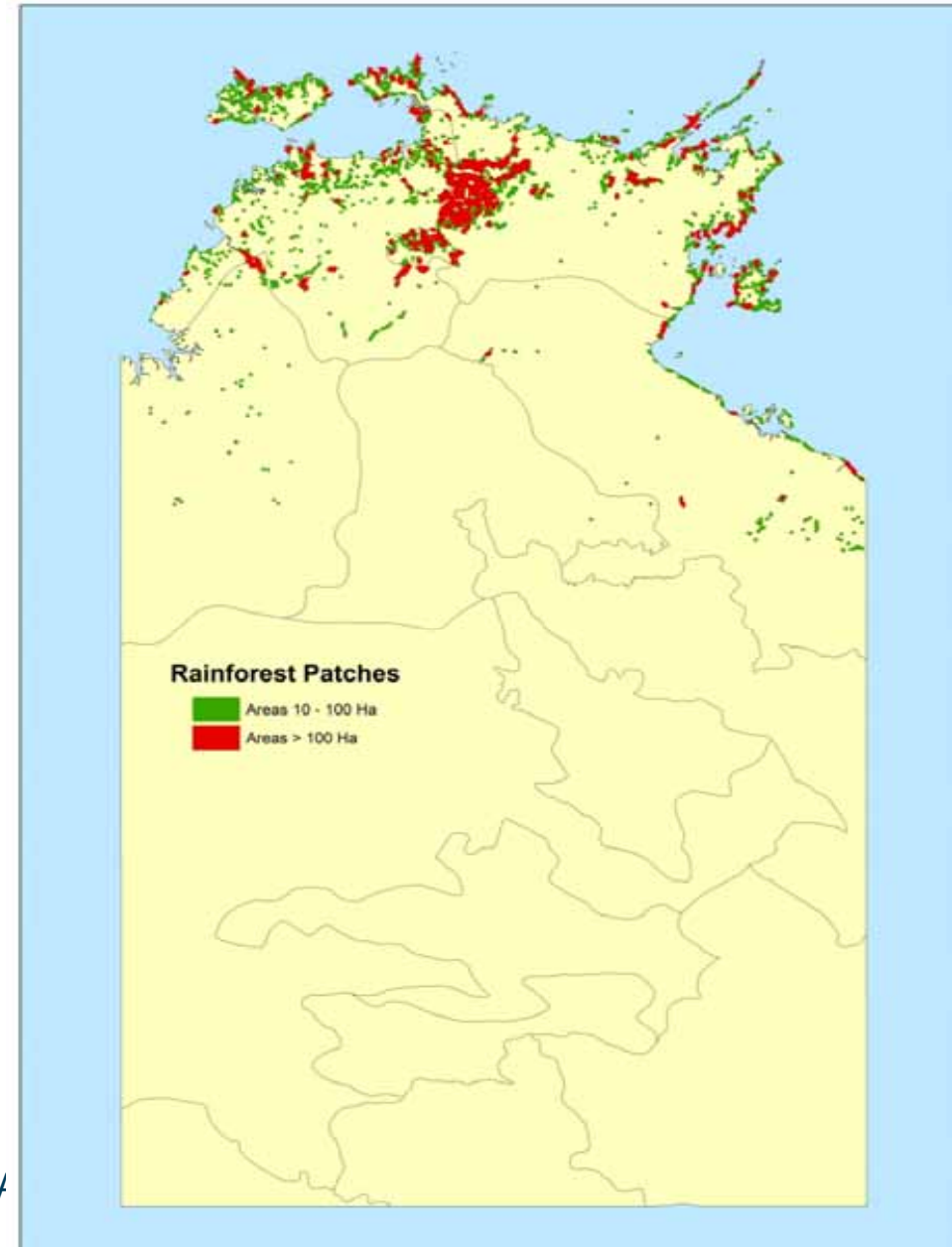


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Significant conservation values

- pivotal environments
- rainforests



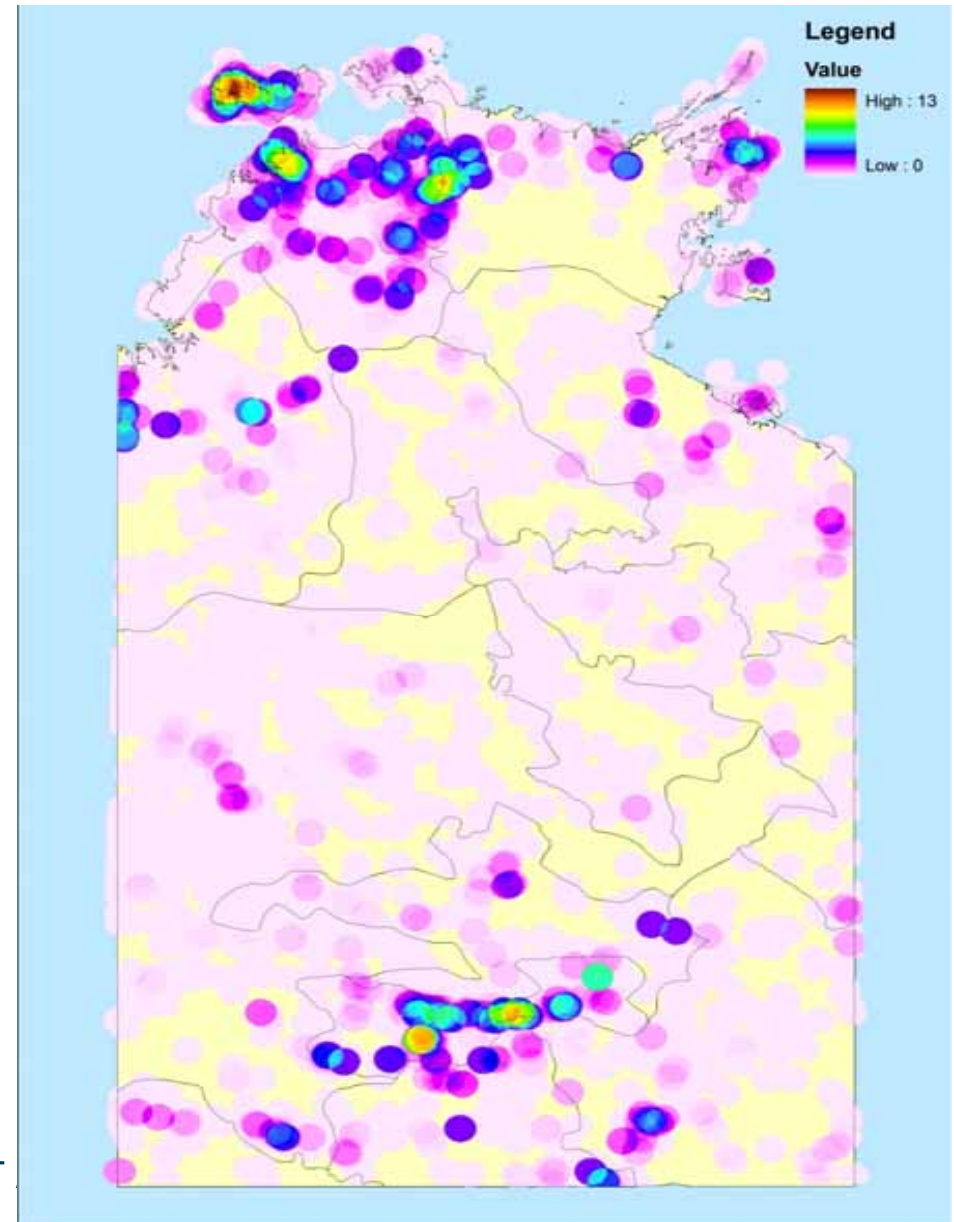
Significant conservation values

- pivotal environments – sandstone heathlands



Significant conservation values

- co-occurrences of threatened species



Condition & trends – trends in status of threatened species

	decreasing	stable	increasing	unknown
plants (n=11 spp.)	0	2	0	9
animals (n=20 spp.)	12	2	0	6

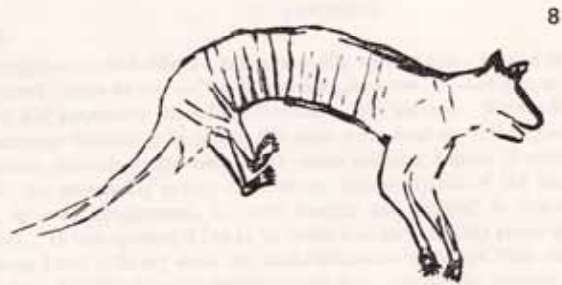
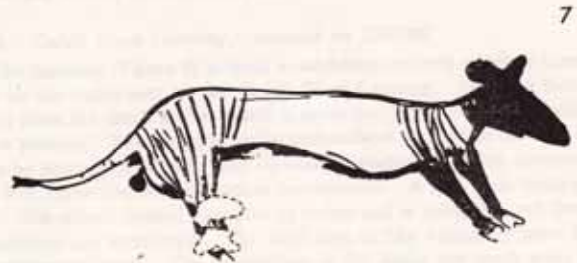
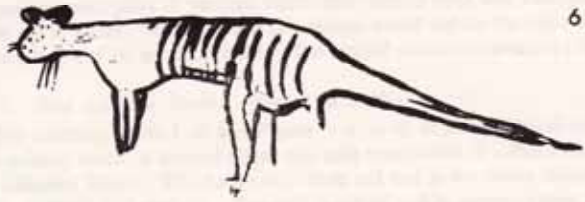


Figure 6.—Drawing of painting at Site 3 (see Plate I (c)).
Figure 7.—Drawing of painting at Site 4 (see Plate I (d)).
Figure 8.—1 : 1 scale tracing of painting at Site 5, Cadell River Crossing.

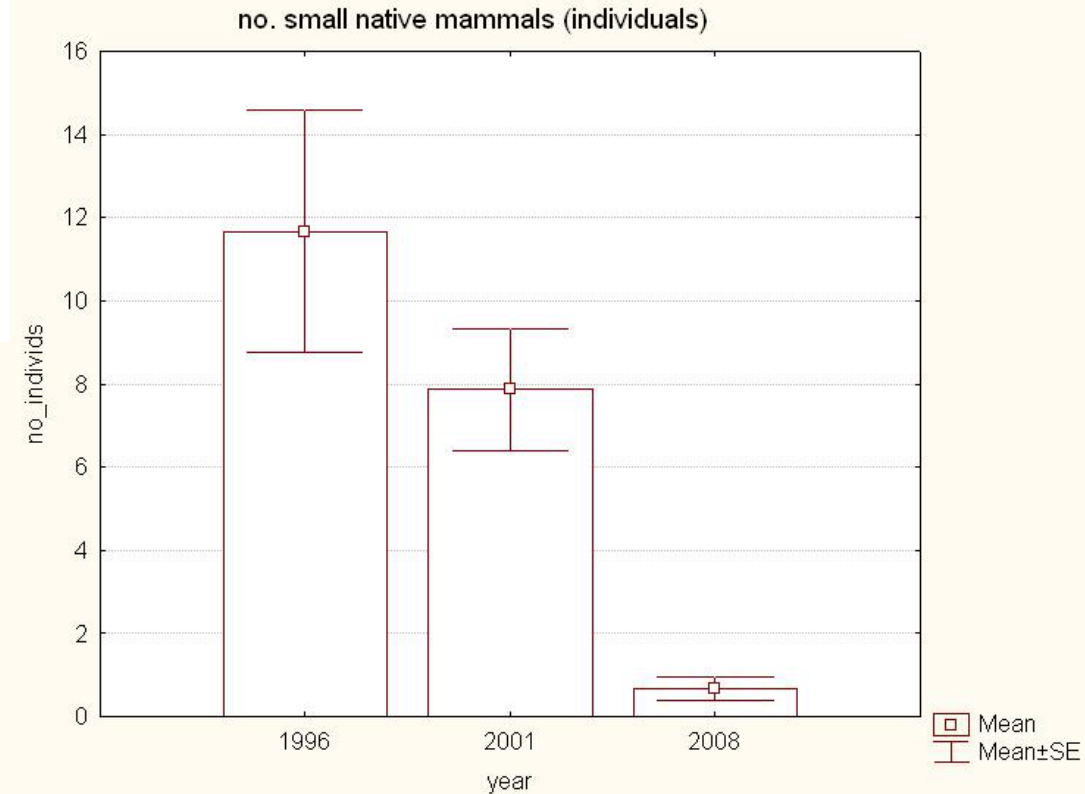
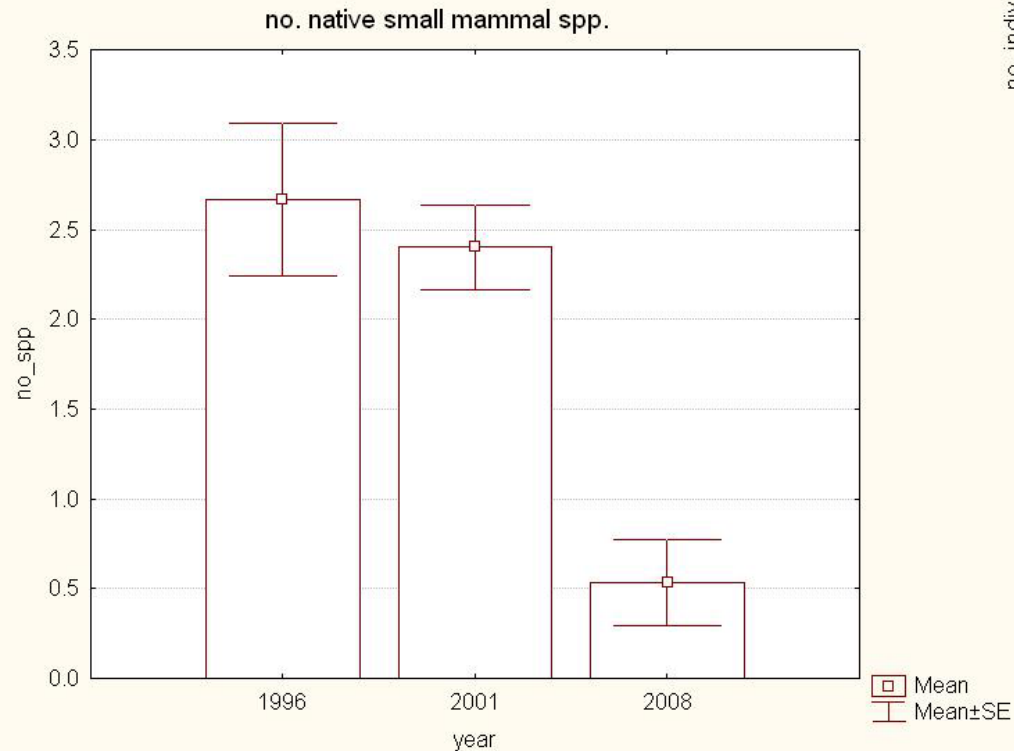
Condition & trends – trends in native mammal fauna



Photo: Peter Cooke



Condition & trends – trends in native mammal fauna (fireplot monitoring data)





Condition and trends: relictual species

- many have ebbed and flowed across the landscape over millions of years;
- many are now at as low an ebb as you can get;
- but the pressures are persisting; ebb any more and they twinkle out.
- what was once was the inviolable stronghold may no longer be so



Condition & trends – condition of sandstone rainforest patches

[% “severely disturbed” (Russell-Smith and Bowman 1992)]

fire	buffalo	feral pigs
67%	47%	27%

Condition & trends – sandstone heathlands

nominated as threatened ecological community under
EPBC Act.





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Condition & trends – sandstone heathlands

would be the first listed threatened community in the NT;

of the other 38 listed communities in Australia, almost all are due to intensification of land use.



Condition & trends – Callitris (fire-sensitive species; obligate re-seeders)

plateau Callitris generally
faring better than lowland
stands;

but general trend for decline
in the plateau;

models indicate ongoing local
loss.



For WAL plateau area, what threats are most significant for biodiversity?

<i>threat</i>	<i>plants</i> (<i>n=18 spp.</i>)	<i>animals</i> (<i>n=20 spp.</i>)	<i>total</i> (<i>n=38 spp.</i>)
fire	10	15	25
weeds	3	8	11
feral herbivores	5	4	9
feral predators	0	8	8

number of threatened species (excluding marine)

[noting that threatened species probably provide good indicators of more general trends]

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But note that there are other threats!

number of threatened species (excluding marine)

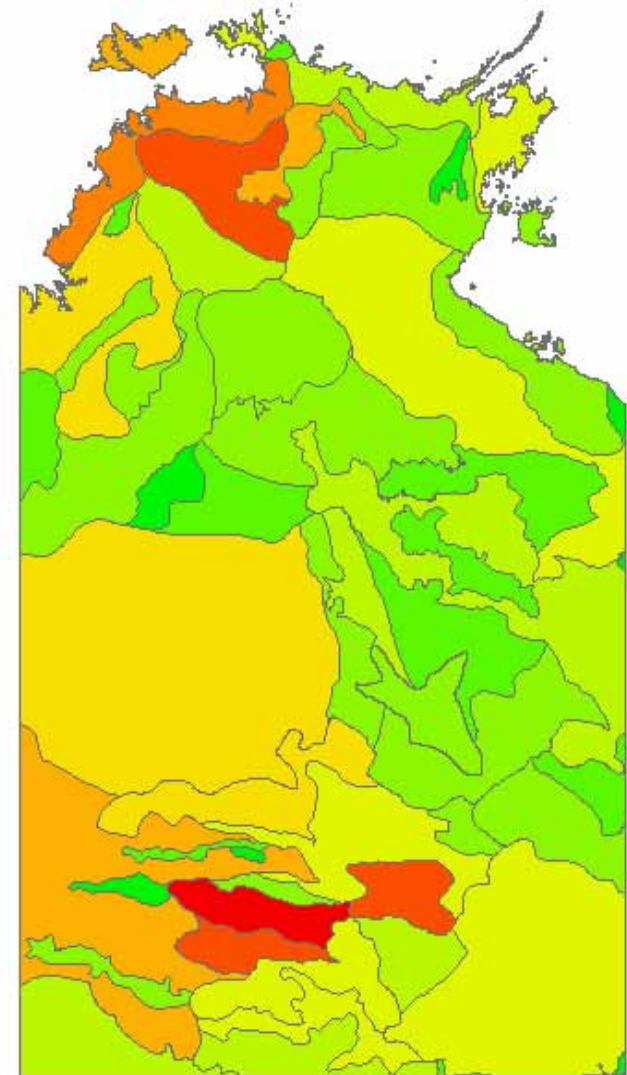
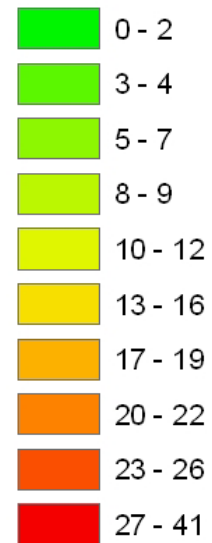


- compound/synergistic impacts of fire with other threats
 - e.g. fire and exotic grasses;
 - fire and predation by cats;
 - fire & feral herbivores;
 - fire and toads.

Q. But is this significance of fire consistent across all of the NT?

A. No, not really.

Tallies of threatened species affected by fire, for Territory subregions.



So, what do we know about fire and biodiversity in WAL?

- Detailed studies of individual focal (strategically selected) species;
- Fire experiments;
- Natural experiments;
- Monitoring plots;
- Knowledge from long-term residents.



Detailed studies of individual focal species

- Callitris
- Allosyncarpia
- heathland plants

- Leichhardt's grasshopper
- partridge pigeon
- northern quoll
- brush-tailed rabbit-rat
- frilled lizard
- Arnhem rock-rat
- yellow-snouted gecko
- kangaroos
- black-footed tree-rat
- gouldian finch

» But, John, note the cupboard is a bit bare – information is available from detailed ecological studies for maybe 1% of WAL's vertebrate fauna, and far less for invertebrates.



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Callitris

[Russell-Smith, Bowman,
Price, Prior]



- woodland species;
- obligate seeder;
- high mortality in hotter fires (with seedlings susceptible to mild fires);
- can survive mild fires every 2-8 years, but not more frequent or more intense;
- **declining**;
- “long-term outlook in this area .. is bleak” (Prior *et al.* 2007)



partridge pigeon [Fraser]

- lowland woodland species;
- breeds on the ground in the early-mid dry season;
- needs some dense vegetation (grass clumps) for nest protection;
- prefers some open (burnt) areas for foraging;
- **declining**;
- preferred fire regime – fine-scale mosaic (& not too much fire in the early-mid dry season)



northern quoll

[Oakwood; Begg]

- lowland and (mostly) stone country species;
- shelters in rock crevices and hollow logs;
- main cause of mortality is predation;
- predation rates much higher in extensively and intensively burnt areas;
- broad-scale studies show highly significant correlation with low fire frequency;
- **declining;**
- preferred fire regime – infrequent and small-scale fire;

» But, of course, toads are now of more concern (sort of)



brush-tailed rabbit-rat

[Firth]

- woodland species
- shelters mostly in hollow logs;
- diet mostly comprises seeds of perennial grasses;
- broad-scale studies demonstrate significant correlation with low fire frequency;
- hanging on in WAL (just); **declining** generally;
- preferred fire regime – infrequent fire



Arnhem rock-rat [Begg]

- stone country species;
- dependent on seeds & fruits of mostly woody species;
- single hot fire caused major drop in population, reduced subsequent breeding, and response evident >1 yr post-fire;
- **declining**;
- preferred fire regime – no fire.



Kangaroos

[Murphy & Bowman]

- prefer to feed in recently burnt areas (except in dry rocky habitats);
- **generally stable (except for nabarlek);**
- preferred fire regime – mosaic, with relatively frequent early dry season burns.



gouldian finch

[Dostine, Woinarski,
Franklin *et al.*]

- hill woodlands; diet of grass seeds; nest in tree hollows;
- forage better in burnt areas;
- require a mix of grass species that provide a succession of seeds across the wet season (esp. perennial species);
- **declining**;
- preferred fire regime – cool, patchy;
- preferred fire regime - infrequent (because frequent -> longer-term decline in hollows and change in grass spp composition)



yellow-snouted gecko

[Johanssen]

- terrestrial species in lowland woodlands;
- eggs laid under leaf litter in the mid dry season;
- eggs (and probably sheltering adults) cooked by fire [mixed gecko omelette];
- extensive fires probably depopulate large areas; and would then be recolonised only slowly from unburnt neighbouring areas;
- **declining**;
- preferred fire regime – very infrequent (1 / 10 yr)



black-footed tree-rat

[Rankmore]

- lowland woodlands;
- shelters in pandanus, tree hollows, hollow logs;
- eats fruits & seeds;
- clear habitat preference for woodlands with dense tall shrubby understorey (more fruit trees, more fruit);
- **declining**;
- preferred fire regime – very infrequent (e.g. 1 fire / 10 yrs).



Probably many others

- Male emus need to sit on eggs for 56 days straight, in the dry season;
- Preferred diet is fruits.



Fire experiments

- Kapalga - large scale, but relatively short-term (5 yrs)
- (Munmarlary) – long-term but small-scale (for fauna)
- (Solar Village) – long term, unreplicated



Kapalga

- (vertebrate) fauna results are a little messy;
- most detailed analysis is for northern brown bandicoot [Pardon *et al.*] :
 - declines in all fire treatments;
 - least decline in unburnt; most in late dry season;
 - requires patchy but infrequent fire (else it will disappear)



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Solar Village; (Munmarlary)

- Long-term change with fire exclusion in lowland woodlands





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Solar Village; (Munmarlary)

- Long-term change with fire exclusion in lowland woodlands





Solar Village; (Munmarlary)

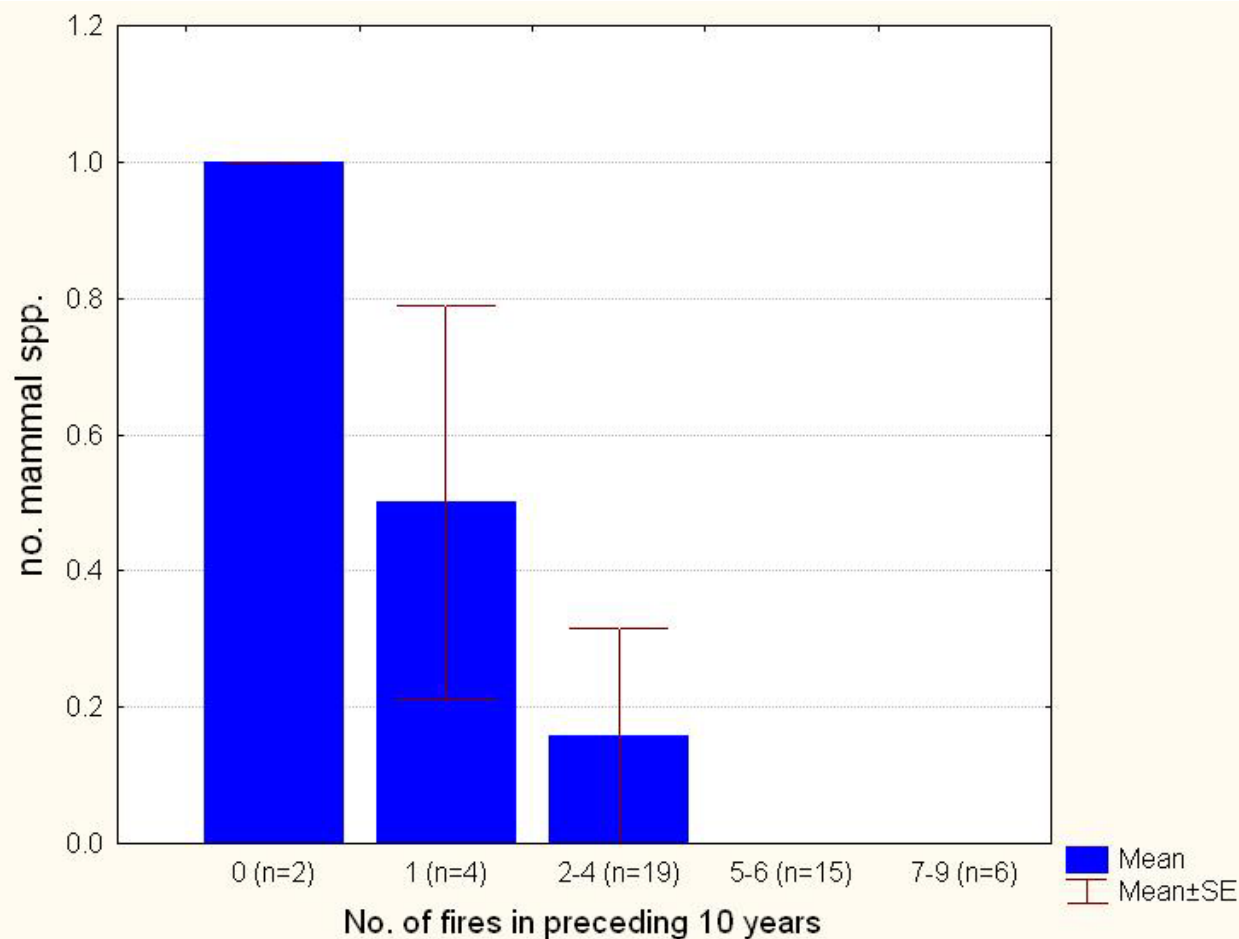
- Accompanied by very pronounced changes in fauna
 - some species preferred frequently burnt; some unburnt;
 - unburnt preference:
 - *Glaphyromorphus* skinks, bar-shouldered dove, green-backed gerygone, white-gaped honeyeater, white-throated honeyeater, dusky honeyeater, northern fantail, yellow oriole, brushtail possum, black-footed tree-rat
- Given landscape scale proportion of frequently burnt to infrequently burnt woodlands, many animal species are in abundances far less than their potential.

Natural experiments

- comparison of intensively (traditionally) managed vs “unmanaged” areas; (e.g. Yibarbuk et al.)
- but low statistical power (and hence insight), because of few replicates and uncertainty about comparable baselines.

Monitoring plots

- Very substantial ongoing monitoring of vegetation (and fauna) in Kakadu, Nitmiluk, Litchfield;
- For native fauna, significant (negative) relationships between species richness and antecedent fire frequency [Nitmiluk data]





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personal knowledge





conclusions

- extensive hot late dry season fires are generally the most detrimental



conclusions

- fires that are small-scale and patchy (burnt/unburnt patches of ca. 1-10 ha) are preferable to fires that are large-scale and uniform;

conclusions

- frequent fires (return times of 2 years or less) are generally detrimental



conclusions

- there is insufficient area of long (>5-10 years unburnt) vegetation.

conclusions

- too much area is burnt per year
 - suggest overall target of no more than 25-30%

conclusions

- many of the most fire-sensitive species live in the stone country
 - fires in this area should be few and fine-scale
 - target 10-30%, depending on vegetation type.



conclusions

- many of the most fire-sensitive species live in rainforests
 - these should be actively protected from fire

conclusions

- there are some particular threatened species persisting perilously in fire-prone areas. Such sites need particularly fire care.

real world

- Some of these ingredients may be particularly difficult to accommodate in management planning;
- some may sit uneasily with cultural priorities;
- some may be expensive;
- some may demand considerably more fire suppression or intensive management than that currently undertaken.

Why are we here?; and what do we do?

1. In this outstanding area, managers are responsible for maintaining (or enhancing) biodiversity (and cultural) values.

Managing fire is not an end in itself; it is a means for achieving the maintenance of conservation values.

Why are we here?; and what do we do?

2. There is adequate knowledge of the responses of biodiversity to fire; sufficient to make informed comment.

Why are we here?; and what do we do?

3. These biodiversity requirements and responses can be built into – as primary drivers – a fire management plan with spatially explicit targets, and performance measures.

Why are we here?; and what do we do?

4. Such fire management planning is adequately resourced and implemented.

Why are we here?; and what do we do?

5. There is adequate and ongoing monitoring to ensure that the management is effective. Or, if found ineffective, that the planning is modified appropriately.

Why are we here?; and what do we do?

6. Even the most optimal fire management will not maintain all biodiversity values (there are other threats).



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