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The fire patchiness paradigm: a case study in northwest Queensland.

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The Fire Patchiness Paradigm:

A Case Study in Northwest Queensland

Thesis submitted by

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Leasie Felderhof

STATEMENT OF CONTRIBUTION OF OTHERS

Ergon Energy

- Operating Expenses ($80,000).

Tropical Savannas Management CRC:

- Post-Graduate Research Scholarship.

James Cook University:

- Library access,
- General student support and supervision,
- Conference attendance.

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- Library access and use of drying ovens.

QPWS

- Office space in early stages of the project,
- Accommodation at Lawn Hill National Park,
- Access to LANDSAT imagery used in Chapter 2,
- Library resources,
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DEDICATION

This thesis is dedicated to the memory of Jill Landsberg. Jill drew my attention to the project and casually asked, “You wouldn’t be interested, would you?”. This single remark had an unprecedented effect – and resulted in the production of this thesis.

ABSTRACT

The Fire Patchiness Paradigm

Research into fire ecology has culminated in 'the patchiness paradigm'. This is the view that numerous small fires, with variety in fire timing, frequency and intensity, will lead to habitat diversity across the landscape, thereby benefiting species conservation. The paradigm recognises that fire is instrumental in shaping the Australian environment, and that no single fire regime will suit all species. As a result, land holders wanting to adopt ecologically sustainable fire management practices are advised to develop and maintain fine-grained landscape patchiness using fire. However, there is no guidance on optimal fire size, level of internal fire patchiness or desirable fire frequency. Having ill-defined objectives is incompatible with 'adaptive management', the approach espoused for managing in the face of inadequate information and uncertainty. Adaptive management, or learning by doing, requires clear management objectives and careful monitoring. When, how often, and how much should manager's burn, and how should they evaluate success? Although adaptive management accommodates uncertainty, the scale and internal patchiness of proposed fire operations need to be articulated in order to commence the cycle with a 'best guess' management target. Addressing this issue and bridging the gap between ecological understanding and applied land management is the critical next step in fire ecology. This thesis focuses on this concern.

The case study area was the Mount Isa Inlier, a semi-arid bioregion in northwest Queensland, Australia. The study concentrated on the fire ecology of spinifex/snappy gum woodlands, the dominant vegetation type in the bioregion. Remote sensing technology was used to examine landscape fire patterns and to identify key drivers of these patterns. Field surveys were undertaken to determine

regenerative responses of the vegetation and to investigate spatial variability between and within fires. To investigate the potential effects on fauna, a fauna fire-response database was compiled using expert opinion. Species were then classified according to their fire sensitivity based on species' refugium requirements during a fire and vegetation maturation stage requirements after a fire. The predicted response of fauna was tested in the field using birds as a sub-group. The results were interpreted in terms of setting objectives for adaptive management, with recommendations on a target fire size and associated monitoring.

The Mount Isa Inlier was found to have greater affinity with arid Australian landscapes than mesic savannas. Fire scars mapped over a six-year period (1998-2003) showed that the total area burnt per year was related to the strength of the preceding wet season. Post-fire changes in the vegetation were highly predictable. There was a flush of annual and ephemeral species after the first rain. The abundance of these species decreased over time, while the cover of perennial species increased. There was insufficient fuel for fire to spread for at least three years from the previous fire. By then, most ephemeral species have set seed, and perennial species have started to produce seeds. Resilience to fire was enhanced by the inherent variability within burnt areas. Vegetation at early recovery stages co-existed with patches of vegetation at later recovery stages. Mature plants in unburnt patches provide reproductive material that ensures individual species remain in the system. Collectively, these data provided an understanding of fire-mediated vegetation dynamics in spinifex/snappy gum communities.

When the fire-sensitivity of fauna species was tested, birds relying on long-unburnt spinifex during and after fire were more vulnerable than generalist species. Additional field studies were undertaken to investigate the internal fire-patchiness requirements of fire-sensitive species. The ideal characteristics for unburnt patches within fire scars could not be defined. Nonetheless the approach provided sufficient insight for a target fire size to be proposed. Restricting fire size to around 100 ha was considered acceptable to conserve birds in the bioregion. It is recommended that a suite of fire-sensitive species be used for ecological monitoring, based on the objective process used in this study.

Fine-scale satellite imagery (IKONOS, 1-m^2 – 4-m^2 pixel resolution) was investigated as a tool for quantifying fire patchiness. If fuel load or fire severity could be mapped, this would provide the initial step. Mapping fuel loads at this scale would also give accurate and spatially explicit fire histories for different areas. This would benefit researchers interested in characterising fire regimes as it would allow for successive monitoring. Field data on fuel load and fire severity were compared to reflectance values recorded by the IKONOS satellite. A fuel load map was produced, but the inherent uncertainty in remote sensing processes meant that results were generalised to areas with high, medium or low fuel load. Although this can assist managers to identify areas of high fire hazard, its day-to-day use for monitoring fire patchiness is questionable. Mapping fire severity was not successful and remains the key fire regime variable not yet captured by remote sensing. The fine-scale mapping components of this study supported the notion that restricting fire size should be emphasised as a management goal in northwest Queensland. Internal fire-patchiness was inherent and difficult to specifically plan for. Fire size can be readily monitored using existing remote sensing techniques.

The major contribution of this work is that it provides a way to mesh the patchiness paradigm with practical land management. By tailoring fire size to the needs of the most fire sensitive species, the remainder are likely to be catered for, by default. Fire-sensitive species can be identified by classifying species according to their requirements during, and immediately after, fire. The method tested here proved to be useful and can be applied in different environments and at different scales.

This is one of the few studies that endeavours to quantify the level of patchiness to which managers might aspire. It demonstrates a strategic approach that integrates well with adaptive management. Thus, the findings provide a way to progress from setting management goals based on ecological principles, such as ‘a fine scale mosaic’, to setting more specific targets based on ecological understanding and a coherent process. Further, the thesis provides important information on the fire ecology of spinifex/snappy gum woodlands in the Mount Isa Inlier. Fire-related research is scant for this area, so this information provides a starting point for ecological fire management in the region.

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