THEME 3B.1- BIODIVERSITY AND ENVIRONMENTAL IMPACTS

Theme Leader: Grant Williamson

Subproject: Fire threshold analysis

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OVERVIEW

1. Theme

Biodiversity and Environmental Impacts

2. Project question or problem statement

What was the ecological fire interval status of vegetation across NSW prior to this season, and what is its state now?

3. Key findings

- Analysis of the pre-2019/2020 season shows that large areas of long unburnt vegetation did exist right across the state, but on the whole the state consisted of a diverse mosaic of vegetation condition (Figure 1). Areas that experienced significant fires, such as the Blue Mountains, had extensive areas that were within ecological fire thresholds, as well as areas that had been burnt recently or frequently.
- Prior to the 2019/2020 fire season large areas of infrequently burnt vegetation were present in many landscapes. Importantly, the recent fires are not constrained to these long-unburnt areas. Fires burnt over large areas of vegetation that were recently burnt, including by management fires, or were managed within recommended ecological thresholds.
- Analysis of the fuel age and vegetation state of the landscape post-2019/2020 moved vegetation out of the long unburnt condition and in some cases will make the vegetation vulnerable to ecological state

change if burnt by subsequent fires in the near term (Figure 2,3). Note that there is no mapped area within fire boundaries that is considered within threshold, as the thresholds represent the state of the vegetation should another fire occur. At present there is also a greater area of vegetation classified as too frequently burnt, where community recovery to past conditions has been impacted.

- Despite the large area coverage of the 2019/2020 fires, there remain areas of long unburnt vegetation throughout the state.

4. Significance of findings in context of previous studies

Previous studies have identified sensitivity of different vegetation communities in NSW to both high frequency fire (Kitchin et al. 2002), and long inter-fire intervals (Nieuwenhuis 1987, Morrison et al. 1995). Inappropriate fire regimes, of either too-long or too-short an interval, can lead to local species extinction and community change (Keith 1996). Researchers have worked to establish optimal fire intervals at both the species and community level (Gill & Bradstock 1992, Bradstock & Kenny 2003). Application of established thresholds in this analysis shows that large areas of the state are now in a vulnerable state, where additional fire in the short term may have adverse impact on species and ecosystems.

5. Limitations and remaining knowledge gaps

- Application of this 'fire threshold' algorithm relies on accurate fire history mapping extending many decades into the past. The fire history dataset available is incomplete and declines in accuracy and coverage further back in time. This means some fires, both unplanned and planned, may not be represented in this analysis; this impacts the threshold calculation, for example areas classified as long unburnt may in fact have experienced fire in the past that is not recorded in the record that would place them within threshold.
- The ecological thresholds that have been applied are subject to contention, and research to better underpin these thresholds is continuing. In particular, the application of the thresholds does not take into account the severity of the fire impact; intense fire resulting in crown defoliation has a greater impact on vegetation communities than low-severity ground fires or prescribed burns, but this is not yet

taken into account in the operational use of the thresholds or in this analysis.

- The analysis was only performed on vegetation types available in the Parks NSW vegetation mapping data for which fire intervals were available.

6. Implications for fire management

- While long-unburnt vegetation did exist prior to the 2019-2020 fire season, the state consisted of a diverse matrix of different vegetation conditions, all of which were burnt-over to some extent by the 2019-2020 fires.
- Claims that there were universally high fuel loads in vegetation that had not been burnt in a long time are questionable, as are claims that prescribed fires are universally able to prevent wildfire spread, as large areas that appear well-managed or even burnt too frequently according to ecological fire return thresholds were burnt in this season's fires.
- Going forward, fire managers should be aware of the sensitive ecological status of much of the vegetation, which will remain vulnerable to additional fire for some years to come. However, areas of long-unburnt vegetation that may be appropriate for treatment continue to be present and post a fire risk, and targeted application of hazard reduction burning where these areas are close to human settlement, or in order to restore ecological thresholds, may be appropriate.

7. Figures

Figure 1. Vegetation biodiversity threshold status for available vegetation types prior to the 2019/2020 fire season.

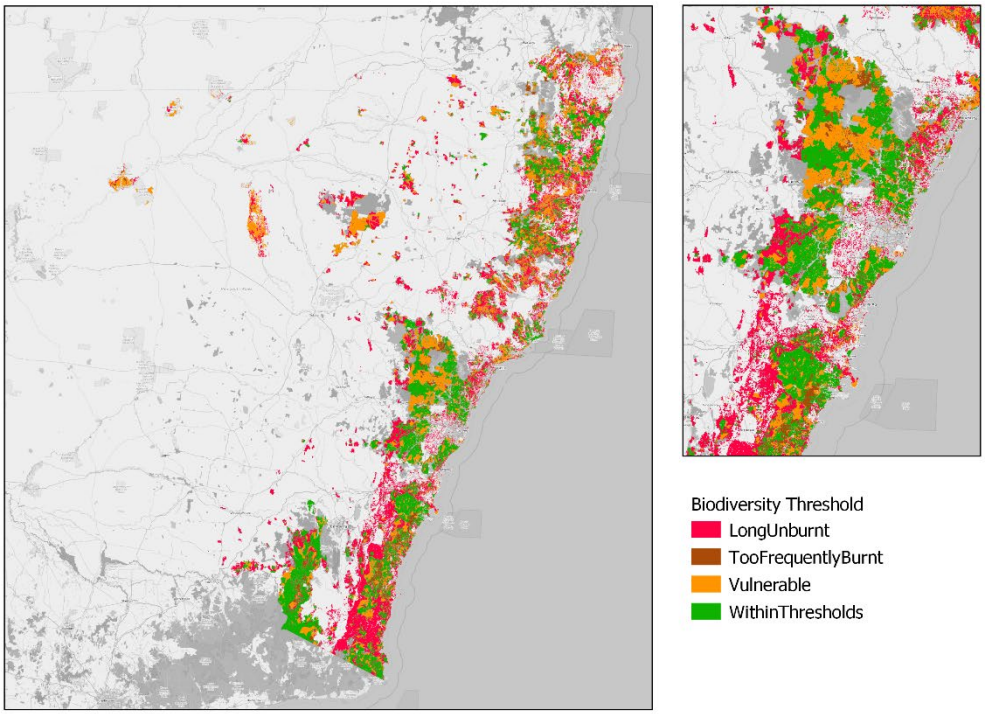


Figure 2. Vegetation biodiversity threshold status for available vegetation types after the 2019/2020 fire season.

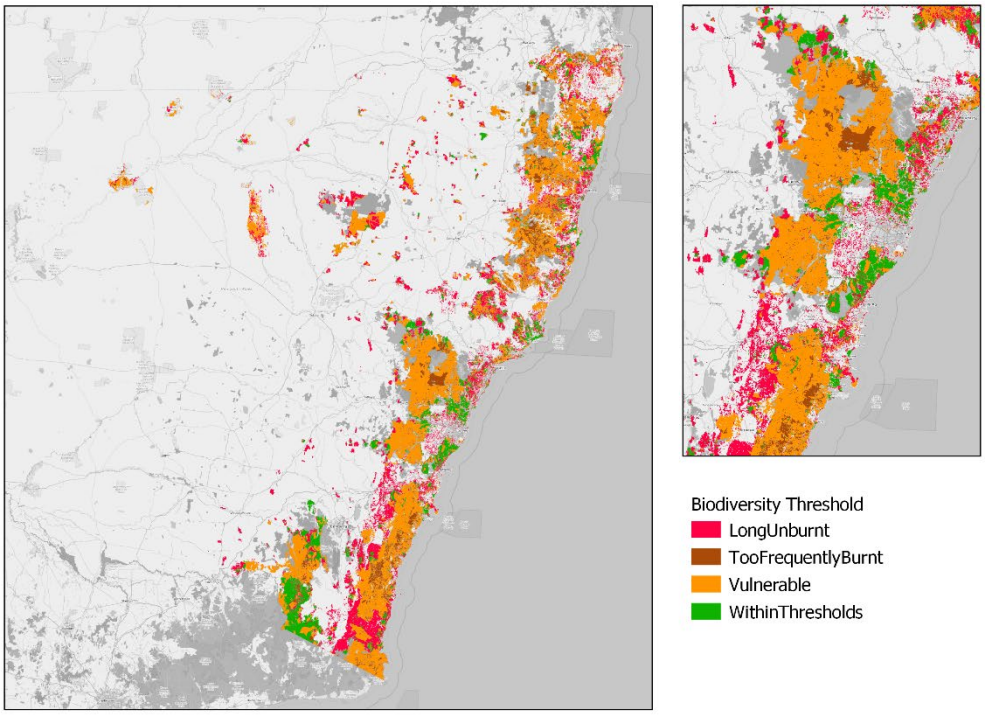
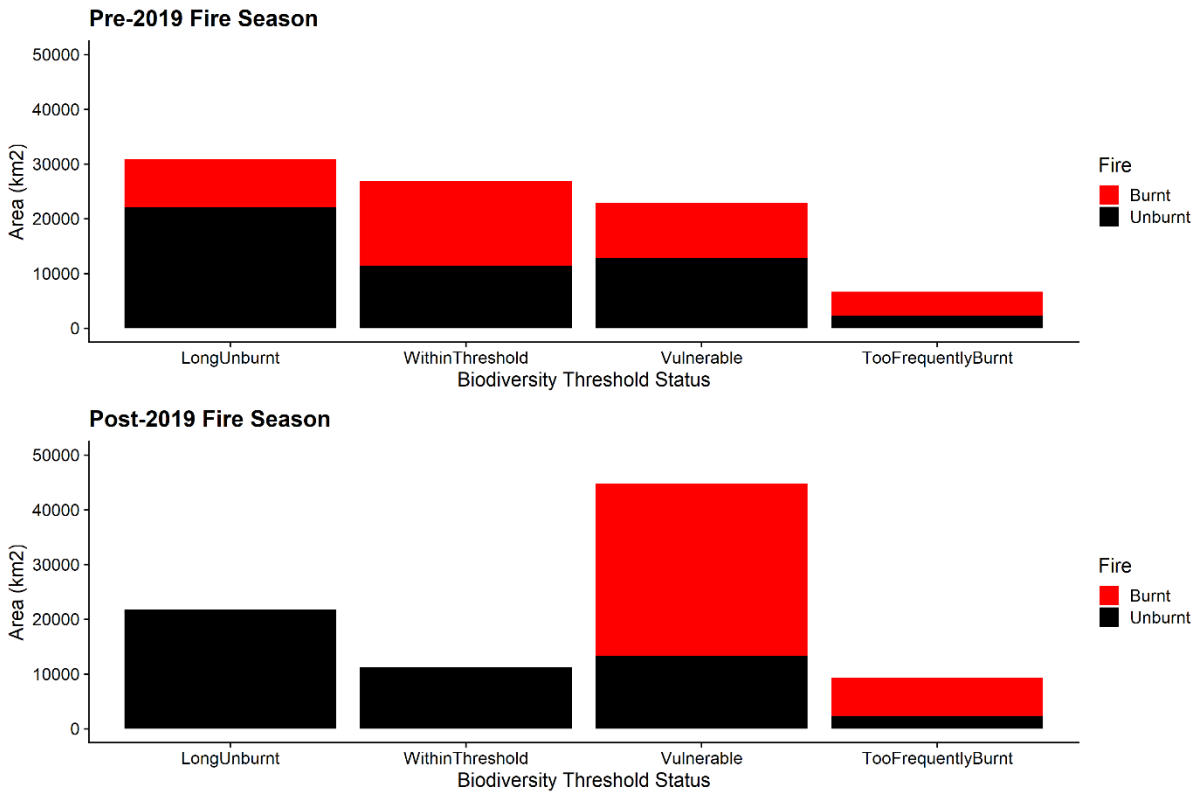


Figure 3. Areas inside and outside 2019/2020 fire boundaries of different vegetation biodiversity fire interval threshold status before the season (top) and after the season (bottom).



8. Key reference list

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Gill, A. M., & Bradstock, R. A. (1992). A national register for the fire responses of plant species. *Cunninghamia* 2:653-660

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Kitchin, M. B., Reid, N., Bradstock, R., & Gross, C. (2002). Fire ecology and fire management for the conservation of plant species and vegetation communities in a National Park in northern NSW, Australia.

Morrison, D. A., Cary G. J., Pengelly, S. M., Ross, D. G., Mullins, B. J., Thomas, C. R., & Anderson, T. S. (1995). Effects of fire frequency on plant species composition of sandstone communities in the Sydney region: Inter-fire interval and time-since-fire. *Australian Journal of Ecology*, *20*(2), 239-247.

Nieuwenhuis, A. (1987). The effect of fire frequency on the sclerophyll vegetation of the West Head, New South Wales. *Australian Journal of Ecology*, *12*(4), 373-385.

9. Appendix

Methods

- Fire-tolerant vegetation communities in New South Wales have established ecological thresholds for the optimal return-time of fire, comprising a minimum and maximum number of years between fires in order to maintain the ecological state of the community.
- The FireTools algorithm for biodiversity thresholds, developed by Parks NSW, uses these thresholds to classify vegetation into four states representing its status relative to fire occurrence. **Long Unburnt** vegetation has not been burnt in a long time, past the recommended maximum burn interval, and may have elevated fuel loads or be transitioning to a fire-intolerant vegetation type. **Too Frequently Burnt** vegetation may be transitioning to a new vegetation community due to an excess of frequent fire. **Vulnerable** vegetation has been frequently burnt, and is in danger of transitioning to a **Too Frequently Burnt** state if burnt again soon, while **Within Threshold** vegetation has not been burnt too frequently, its fire interval is currently between the recommended minimum and maximum time since fire and an additional fire will not leave it too frequently burnt. Formal definitions of these thresholds are provided in Table 1 below.
- An application of the FireTools algorithm across fire-impacted areas of the state for vegetation communities where fire intervals are available was performed using pre-2019/2020 fire season data, to gauge the state of the vegetation before the fire season, and using post-2019/2020 fire season data to gauge the impact of the fires on vegetation status.

Table 1 – Formal definition of vegetation thresholds taken from the FireTools 1.4 Manual

Too Frequently Burnt	These areas have experienced sustained (two or more) consecutive intervals between fires shorter than the recommended minimum interval for this vegetation type. Any Rainforest / Mangrove/ fire exclusion vegetation that has been burnt will be in this category. *Areas of vegetation that are repeatedly burnt at intervals shorter than recommended for the vegetation type may experience a decline in the abundance of plant species sensitive to frequent fire. If inter- fire intervals shorter than the recommended minimum continue, these sensitive species are at risk of local extinction. Attempts should be made to minimise fire occurrence in these areas.*
Vulnerable to Frequent Fire	These areas have already experienced one inter-fire interval less than the minimum interval recommended for this vegetation type and/or the current time-since-fire is less than the minimum recommended interval. All unburnt Rainforest/ Mangrove/ fire exclusion vegetation is in this category.
Within Thresholds	The time-since-fire age of the vegetation is greater than the minimum recommended inter-fire interval and less than the maximum recommended inter-fire interval. If a fire occurs before the number of years specified as the minimum interval has been reached it will move into the 'Vulnerable to Frequent Fire' category. If three or more fires occur in close succession the area will move into the 'Too Frequently Burnt' category.
Long Unburnt	The post-fire age of the vegetation is greater that the recommended maximum inter-fire interval for this vegetation type. *If fire continues to be absent from the vegetation for a prolonged time, it is anticipated that plant species that require fire to stimulate flowering or seed production (and their seed banks) may begin to senescence. Long unburnt areas in some vegetation types are very rare and therefore significant. Long unburnt vegetation may also have other ecological values that make it important habitat for certain species in a given area. Careful consideration should be given before burning these areas, and wherever possible the decision should be based on a scientific assessment and/or recommendation prior to burning.*