Habitat features of open forests and woodlands in relation to disturbance by fire

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Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not being submitted for any other degree or qualification.

I certify that any help in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Abstract

Extensive bushfires have been a recurring feature in the forests and woodlands of south-eastern Australia and the threat from fire to both the community and the environment is forecast to grow as the incidence of fire and drought is predicted to increase due to climate change. Notwithstanding the loss of life and property caused by these fires and demands from the community for protection from fire by increasing the area of hazard reduction burning, the effects of such burning on fauna, flora and wildlife habitat have not been fully considered. This omission assumes greater importance as attrition of fauna habitat attributes from the landscape has been exacerbated by clearing, urbanisation and other forms of habitat destruction and modification.

Thresholds for burning vegetation communities in New South Wales (NSW) are based on plant species' responses to fire and do not consider multi-factorial issues such as drought, site attributes or fauna requirements. The aim of the research reported in this thesis was to investigate knowledge gaps concerning the impact of fire on habitat features of open forests and woodlands on the Northern Tablelands and North-West Slopes of NSW, to extend understanding of the nexus between fire and species diversity to encompass environmental variables at a landscape scale and to consider the adequacy of the theory of fire management based on traits of flora species' fire responses. The consequences of managing fire at broader scales are complex and this study tests ideas concerning the incorporation of severe drought and landscape attributes into fire planning and biodiversity conservation beyond the use of fire as a single issue management tool.

The impact of burning and other environmental variables on floristic change in eucalypt-dominated communities was assessed by recording community composition, species richness and diversity in sites in reserved land with a range of known fire histories in northern NSW. Most studies of post-fire plant species richness have concentrated on short periods after fire, and there is a dearth of empirical evidence regarding the compositional changes in vegetation that occur in the absence of fire over long periods. This study provides evidence that fire is one of many factors that influence plant composition and species richness, with unique assemblage of plant

taxa occurring in long-unburnt vegetation, and should not be the sole consideration in fire planning without reference to its interactive effects with landscape heterogeneity, extreme climatic events and effects on habitat resources.

Fire management impacts on fauna habitat were investigated at the same sites used to study plant species dynamics in northern NSW. The aims of this component of the study were to determine the habitat attributes of long-unburnt vegetation, measure fuel loads in these communities in relation to time since fire and consider the significance of these observations for fire management. Time since fire was the most significant variable explaining the occurrence and abundance of important faunal habitat attributes. The amount of bark, shrub cover and ground cover was strongly associated with time since fire. Tree hollows (100/ha), log hollows (400/ha) and fallen timber volume ($55m^3$/ha) were markedly more abundant in long-unburnt vegetation compared to 55 tree hollows/ha, 100 log hollows/ha and $20m^3$/ha of fallen timber in more frequently burnt vegetation. Fuel loads in open forests and woodlands unburnt for 100 or more years were low to moderate (6t/ha) and similar to the hazard in recently burnt sites (6.5t/ha). Not only were habitat attributes of open forests and woodlands reduced by frequent burning but the quality of these features as fauna habitat was diminished by burning. This was demonstrated through experimental burning of log and bark habitat and monitoring vertebrate and invertebrate fauna occupation of these attributes.

My findings show that basing fire-interval thresholds only on plant responses to fire, and neglecting drought effects and landscape attributes, compromises achieving optimal fauna habitat in the landscape. In the vegetation communities studied, recommended upper thresholds are too low to cater for the habitat requirements of fauna. Consequently, rather than introducing fire because the communities are beyond upper thresholds based on plant fire response, long-unburnt vegetation should be identified as a threatened asset in fire planning and management and be protected. Based on the evidence presented in this thesis recommended upper fire thresholds for open forests and woodlands in northern NSW should be doubled if the habitat requirements of fauna are to be adequately addressed in fire planning. It is likely that a similar situation pertains in open forests and woodlands throughout southern and eastern Australia.

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Publications arising from this thesis

Croft P, Hunter JT, Reid N (2007) Depletion of regenerative bud resources during cyclic drought: What are the implications for fire management? *Ecological Management and Restoration* **8**, 187-192. (Chapter 2.1)

Croft P, Hunter JT, Reid N (2010a) Threat of frequent fire and drought for the rare wattle *Acacia william siana* J.T. Hunter: an experimental burn highlights implications for fire management. *Ecological Management and Restoration* **11**, 217–220. (Chapter 2.2)

Croft P, Reid N, Hunter JT (2010b) Experimental burning changes the quality of fallen timber for vertebrate and invertebrate fauna habitat: implications for fire management. *Wildlife Research* **37:** 574−581. (Chapter 3)

Croft P, Reid N, Hunter JT (2012) The bark of eucalypt trees: habitat quality for arthropods and impact of fire. *Pacific Conservation Biology* **18**, 186−193. (Chapter 4)

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