Predicting with fire: using non-parametric Bayesian Networks to explore drivers of native mammal occurrence across a heterogeneous forest landscape

Bronwyn Hradsky[1]*, Trent Penman[1], Julian Di Stefano[1]

[1]School of Ecosystem and Forest Sciences, University of Melbourne, 4 Water St, Creswick VIC Australia 3363

*Corresponding author: hradskyb@unimelb.edu.au

Fire is a key ecological disturbance, shaping biome distribution and community composition globally and affecting faunal distributions via several different pathways. Fire may direct kill individuals, but also causes vegetation change and so indirectly influences the availability of food and shelter. Importantly, these fire-effects occur within a broader environmental context: conditions such as vegetation type and moisture can influence both fire and species distributions. Thus faunal responses to fire often vary between fire events or geographic regions, and time-since-fire is generally a poor predictor of species distributions at a landscape-scale. We investigated whether a Bayesian Network approach could provide an effective way of modelling these interdependent relationships, as regression models are constrained by the need to avoid correlated predictor variables and over-parametrisation. We used motion-sensing cameras to collect native mammal and invasive predator occurrence data at 113 sites across 56,000 ha of continuous eucalypt forest in the Otway Ranges, south-eastern Australia. There was a rainfall and elevation gradient across the study region, with the north-east being substantially flatter, lower and drier than the south-west; time-since-fire ranged from 6 months to 74 years. We developed a conceptual model of the system based on expert opinion and then used Uninet to populate this model as a non-parametric Bayesian Network from our field data. Species occurrences fell into two broad groups, with animals such as swamp wallabies *Wallabia bicolor* preferring drier vegetation types, less complex habitat and younger forest, but bush rats *Rattus fuscipes* and long-nosed bandicoots *Perameles nasuta* being more likely to occur at long-unburnt sites with wet vegetation and high habitat complexity. Fire influenced fauna directly and also through its effects on habitat complexity, woody debris availability and predator occurrence. Our study demonstrates that non-parametric Bayesian Networks are an effective technique for explicitly modelling the complex and context-dependent influence of fire history on faunal distributions.