Patterns in plant flammability at a fire-prone wildland-urban interface in eastern Australia

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Thesis submitted in fulfilment of the requirements for the degree of Master of Science (Research), under the supervision of Dr Brad Murray, Dr Megan Murray, Dr Leigh Martin, and Dr Tim Curran

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Certificate of Original Authorship

I, Thomas Hawthorne declare that this thesis, is submitted in fulfilment of the requirements for the award of Master of Science (Research), in the School of Environment at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Statement of thesis format

This thesis is submitted as a thesis by compilation. Chapter 1 provides a general introduction to wildfires and the wildland-urban interface, the gaps in the field and my research questions. The following three data chapters (Chapters 2, 3 and 4) have been prepared as standalone chapters with an additional introductory paragraph to link chapters. Chapter 5 provides a synthesis of my research and highlights the contribution this thesis makes to our understanding of plant flammability in wildland-urban interface systems and provides future directions for the field.

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Fig. 3.5 Boxplots for **(a)** mean time to flame (ignition) score, **(b)** mean burn time (BT), **(c)** mean combustion temperature (CT), **(d)** mean biomass consumed (BC) across all species. Box = interquartile range; line across box = mean; whiskers = range of values; Points on the figures = species values; exotic species = blue, native species = red; P = statistical significance.

Fig. 3.6 Boxplots for **(a)** mean time to flame (ignition) score, **(b)** mean burn time (BT), **(c)** mean combustion temperature (CT), **(d)** mean biomass consumed (BC) across all species. Box = interquartile range; line across box = mean; whiskers = range of values; Points on the figures = species values; Plant groups are as follows, UN = urban native species (blue); UE = urban exotic species (green); WN = wildland native species (purple); WE = wildland exotic species (orange); P = statistical significance. Note: WE category has one value, due to their only being one species (*L. camara*) in this category.

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Abstract

Wildfires can have detrimental impacts on biodiversity, human lives and infrastructure, particularly at the wildland-urban interface (WUI). The WUI consists of low-level urban development nested within a broader area of predominantly natural wildland vegetation, and as such, the WUI is the frontline of human-wildfire interactions. With many WUIs expanding and wildfires becoming more frequent it is critical that we understand wildfire risks and hazards at the WUI for effective future wildfire management. In this context, I investigate patterns in flammability of locally-abundant plant species from urban and wildland areas in a fire-prone WUI in the mid-lower Blue Mountains of eastern Australia.

I show that floristic composition of dominant plant species varies significantly among dry sclerophyll woodland and wet sclerophyll gully forest (wildland) and home gardens and parks and recreational (urban) areas of the WUI. Notably, urban areas have higher exotic species richness and canopy cover which is driven by the prevalence of exotics in household gardens. Given the significant floristic differences between urban and wildland areas, I then compare patterns in shoot flammability across 45 woody plant species between these WUI areas. I show that wildland plants are more flammable than urban plants via their longer burn times (higher sustainability) and larger amounts of consumed shoot biomass (higher consumability). In terms of native and exotic plants in wildland and urban areas, not only are wildland native plants more flammable than urban exotic plants, but urban native plants also have longer burn times, consume more biomass and in addition reach higher combustion temperatures (higher combustibility) than urban exotic plants. Across all species, I show that in general high-flammability plants contain lower shoot water content and have heavier shoot dry biomass than low-flammability plants. Shoot bulk density and degree of

ramification do not explain cross-species variation in flammability, and furthermore, none of the shoot traits measured were significant in explaining differences in shoot flammability among wildland-native, urban-native and urban-exotic species.

This thesis takes a novel approach to understanding fire risk at the WUI through the lens of shoot flammability. My findings enhance our knowledge of how plants burn and provide insights for selecting low flammability plants that may mitigate wildfire impacts on human lives and infrastructure. Furthermore, my work underscores the importance in understanding the influence of plant traits on flammability in fire-prone landscapes.