Resilient or suicidal giants: what types of fires do the world's tallest flowering forests support?

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Australian tall wet eucalypt-dominated forests are widely considered to experience a fire regime of infrequent, high-severity, stand-replacing crown fires. Yet, this paradigm ignores the possibility of low- and mixed-severity fires in these ecosystems. We analyse fuels from a network of long-term monitoring plots that span the continent to investigate the fire regime of tall wet eucalypt forests.

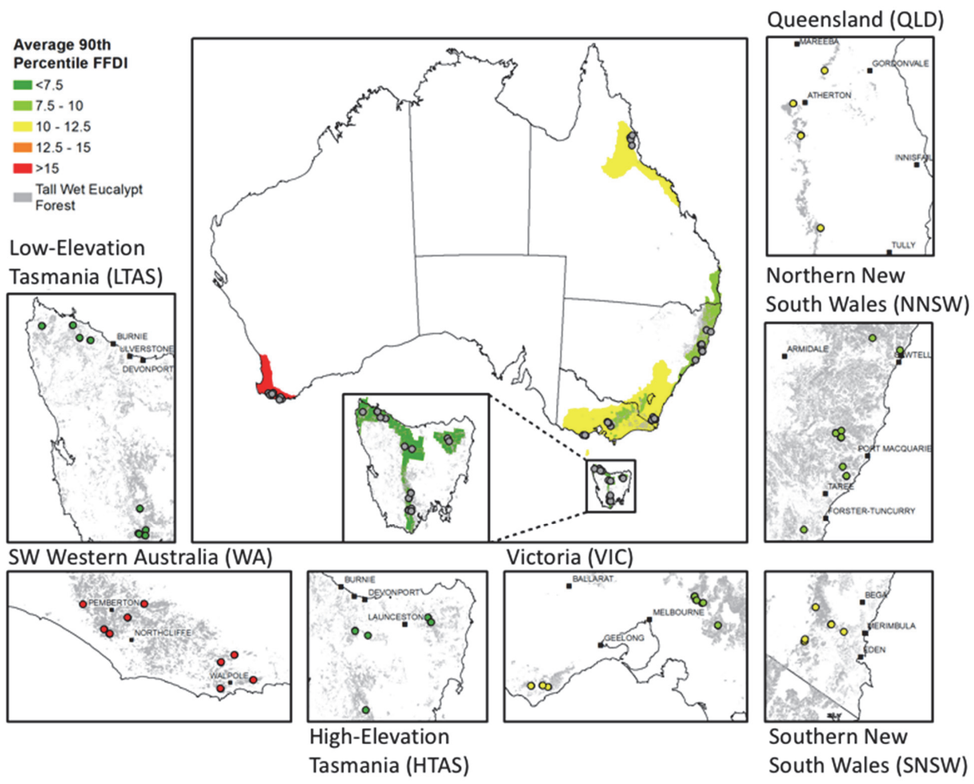


FIGURE 1: Map of the locations of the 48 permanent plots and their associated macroecological regions in the TERN Ausplots forest monitoring network

METHODS

We collected and analysed fuels data from the TERN Ausplots Forests Network

- The network consists of 48 1-ha plots in mature tall wet eucalypt forests across seven macroecological regions that span the vegetation's range in Australia (Figure 1).
- We estimated fuel loads with destructive sampling and allometric analyses, understorey microclimate using temperature and humidity loggers, and fire weather using observations from nearby weather stations.
- We used these data to predict potential flame heights on bad fire weather days (>90th percentile FFDI) using McArthur's Mk5 fire behaviour equations. We compared these flame heights to canopy heights to obtain an estimate of the relative frequency of crown fires.
- We validated this approach using data from four low-severity fires in plots we had already measured.

Tall wet eucalypt forest in North Queensland, Western Australia, and Victoria. *Photo: Sam Wood*

RESULTS

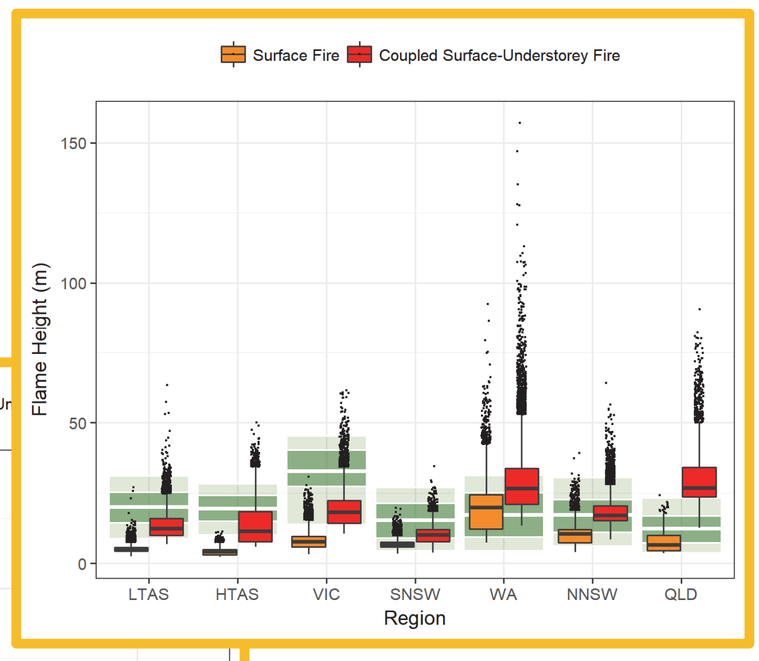
Contrary to theory, we found lower-than-expected probability of crown fires in tall wet eucalypt forests, albeit there was substantial geographic variation.

- The tall, moist forests of Victoria are least likely to experience crown fire, due to tall canopies, whereas the warm, seasonally-dry forests of southwest Western Australia are most at risk, as they have a continuous vertical fuel structure and frequent bad fire weather.
- Low-severity fires occurred in four of our plots under moderate to high fire-danger weather. Post-fire data from these plots indicate that current fire behaviour models substantially over-predict the likelihood of a crown fire, implying that crown fires are even less likely than our results suggest.

IMPLICATIONS

We demonstrate that fuel loads in tall wet eucalypt forests are unlikely to support crown fires except in the most extreme fire-weather conditions. We suggest this forest type is better described as supporting a mixed-severity fire regime. It opens the way to develop novel fire-management practices to mimic mixed-severity fires, such as variable-density thinning of the overstorey or removal of the understorey.

FIGURE 2: Boxplots of simulated flame heights resulting from the combustion of surface (orange) or surface and understorey fuels (red) in each region. Dark green boxes represent regional averages of the 25th-75th percentile heights to crown base (HCB). Flame heights are generally lower than the crown base, suggesting a low probability of crown fires



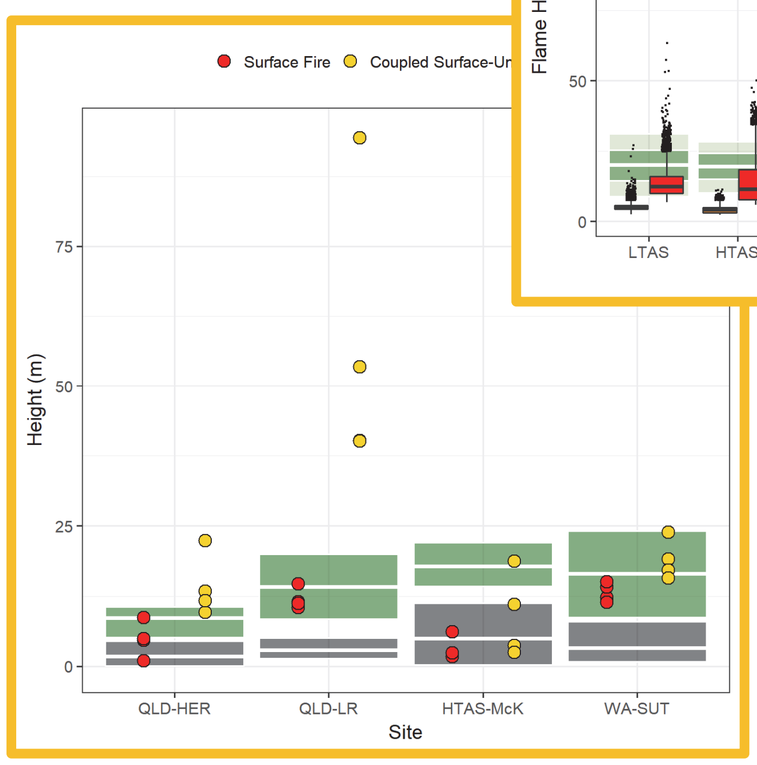


FIGURE 3: Predicted flame heights (dots) on days on which low-severity fires actually occurred. These are compared to 25th-75th percentile char heights (grey boxes). Predicted flame heights are substantially taller than char heights, suggesting the MacArthur equations substantially over-predict flame height. 25th to 75th percentile HCB (green boxes) is given for reference

This poster summarises the findings of a paper currently under review with the *Journal of Applied Ecology*. Please contact **james.furlaud@utas.edu.au** for more information. Please do not disseminate the findings of this research without permission from the authors.

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