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Recent Australian wildfires made worse by logging and associated forest management

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The recent fires in southern Australia were unprecedented in scale and severity and much commentary has rightly focused on the role climate change played in exacerbating the risk of fire. Here, we argue policy makers also must recognize that historical and contemporary logging of Australian forests also had a profound effect on these fire's severity, fire frequency, and other key aspects of fire regimes.

More than 5.8 million hectares of Australia burned between September 2019 and January 2020[1], with several million hectares more burned in subsequent months. Discussions among land managers, politicians, policy makers, and scientists have now focused on the origins and behavior of the wildfires to try to ensure they do not happen again. Not unreasonably, much of this discussion has centered around the role of human-forced climate change[2], and the associated prolonged drought and extreme weather conditions as major drivers of these recent conflagrations. It is clear that discussions about links between climate change and fire are warranted and should galvanize action to halt climate change[3].

However, the contribution of land management, and especially forestry practices, to wildfires has often been neglected in these discussions. This is an oversight given that land management is well within the control of Australians (unlike global action to abate climate change) and that there is an extensive body of science available to decision-makers. Some parts of the forest industry are now calling for increased logging within both the burnt and unburnt forest estates[4]. Here we provide a summary of recent scientific evidence of the impacts of forestry on these fires and discuss strategies to limit future catastrophic conflagrations.

Forest logging and fire

Since European settlement, Australian forests have had a long history of land use change. While the full extent of forest loss and degradation is unknown, some estimates show that at least 30% of eucalypt open forest and 30% of rainforest have been lost due to logging and agriculture[5]. Most of this loss occurred in the latter half of the 19th century. More recently, industry reports show that between 1996 and 2018, 161 million cubic meters of native forest was logged by the forestry industry across Australia[6]. Logging operations have had severe impacts on biodiversity; 181 forest-dependent species listed as threatened with extinction are directly affected by loss of habitat specifically due to logging[7]. However, this figure is an underestimate, due to the complexities of listing endangered species in Australia[8]. In addition to the direct impacts of tree felling on species at logging sites, activities associated with production like road construction further fragment already disturbed landscapes – with corresponding negative impacts on biodiversity[9]. For example, in the damp forest ecological vegetation class in the Central Highlands of Victoria, the average distance from logged wood production forests to undisturbed forest is just 71 m relative to 1700 m in protected areas of the same vegetation type[10]. This difference will be further magnified under plans for continued logging over the coming 5-10 years[10].

Beyond the direct and immediate impacts on biodiversity of disturbance and proximity to disturbed forest, there is compelling evidence that Australia's historical and contemporary logging regimes have made many Australian forests more fire prone and contributed to increased fire severity[11] and flammability[12]. At a site level, logging and other silvicultural treatments leave large amounts of debris (up to 450 tonnes per hectare) (Fig. 1)[13]. This addition of fuel close to ground level increases the severity of subsequent wildfire[11]. Other major logging-generated changes in forest composition and stand architecture, such as the

creation of extensive areas of young even-aged stands characterized by densely stocked trees of short stature and a paucity of mesic elements such as tree ferns and rainforest life forms, can influence fire dynamics[11] and patterns of spatial contagion in wildfires[14]. For example, fires spreading from logged areas have burnt into adjacent old growth eucalypts and rainforests dominated by ancient Gondwanan lineages[15]. The former have either never burned since establishment or are subject to extremely rare fires (e.g. every 300-500 years), and the latter have never burned, with fire only at the rainforest edges at intervals of ~ 1000 years[16].

Extensive areas of logged and regenerated forest have burned repeatedly in the past 25 years (Fig. 2). Of the ~1 million hectares burnt in the 2019-2020 bushfire season across East Gippsland (in north-east Victoria), ~ 36% had burnt previously at least once since 1995. Current understanding of the ecology of forests such as those dominated by the damp ecological vegetation classes suggests they should burn no more than once every 50-150 years[17]. Repeated fires in these and other ecosystems can lead to tree species failing to resprout[18], seed production and germination failure, and the death of young trees, triggering potential ecosystem collapse[14].

Appropriate land management response post-fire is now needed

It is important that policy makers acknowledge that climate change effects fire weather and is making fires worse across Australia[3]. Policy makers also must recognize that land management such as logging operations also have profound effects on fire severity, fire frequency, and other key aspects of fire regimes. Efforts to prepare for wildfires therefore require a response not only to climate change but also to historic and current land management.

There are solutions to reduce the risks of further catastrophic fire seasons in the future. First is the removal of logging from areas where it adds significantly to fuel loads and creates forest structures that increase fire severity and risks to human safety. In particular, logging of moist forests must not occur near human settlements. Second, it is essential that landscape scale impacts of forest fragmentation are reduced; this demands proactive restoration of some previously logged forests to build resilience to future fire events. There is also a need to protect remaining undisturbed or lightly disturbed areas as these are important fire refugia for many species, including arboreal marsupials and birds[19]. In the event of wildfires, land managers must avoid practices such as post-fire ("salvage") logging that can impair recovery and make regenerating forests more prone to further fires[20]. Finally, there is a need to restructure forest industries so that wood production is focused on exotic tree plantations. This is important to maintain employment in the forestry sector and at the same time, limit impacts on the native forest estate, including through a reduction in logging-generated fire proneness in forest ecosystems.

Now is the time for policy makers to recognize and account for the critical values of intact native forests because they are where fire severity is lowest, species persistence during fires is greatest, and rates of recovery after fires are highest[20]. Forests not degraded by logging, together with the biota they support, are more resilient than degraded forests to pre-fire conditions such as higher temperatures and short-term climatic anomalies (for example, droughts)[21]. Intact forests are critical not just in terms of fire resilience, but also in their role in mitigating climate change, maintaining hydrological cycles and other key ecosystem processes, and providing habitat for a wide range of flora and fauna[9]. Australians must therefore work to de-fragment the forest estate through policies that facilitate the expansion of old growth forest, as these actions can help reduce the patterns of extensive spatial contagion of mega-fires.

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Author Contributions

All authors contributed equally.

Competing Interests

There are no competing interests to declare.

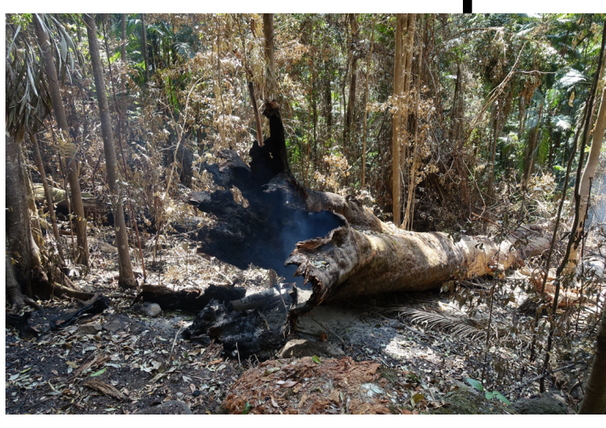
Figure legends

Figure 1. Fires within logged areas of native forests. South-east Australian fires (red) within native forests (green) and previously logged areas ('logging areas' (black). The first two images (left to right) are of the aftermath of logging in East Gippsland, the third image is of the debris remaining after logging in eucalypt forests in central Victoria, the fourth image is of burned Brush Box (*Lophostemon confertus*) within the world heritage Gondwana Rainforest (an ecosystem that has evolved in the complete absence of fire). Logging areas are derived from publicly available data from Forestry Corporation of NSW and VicForests, both of which underestimate the full extent of historic logging.

Figure 2. Fires within East Gippsland. Analyses of wildfires in East Gippsland, north-eastern Victoria between 1995 -2020 showing that of the ~1 million hectares burnt in the 2019-2020 bushfire season across East Gippsland (in north-east Victoria), ~ 36% had burnt previously at least once since 1995.

0 250 500

Kilometers



Bushfires 2019-2020

Logging areas

Native forests

Number of Wildfires between 1995 and 1 March 2020

Extent of East Gippsland Fires 2019-2020

Number of Fires

1

2

3

Kilometers

0 5 10 20 30 40