



## Senate Finance and Public Administration References Committee

Inquiry into lessons to be learned in relation to the Australian Bushfire Season 2019-2020

Australian Academy of Science response to questions on notice

### Bushfire advice provided to government.

In response to Senator Watt's question about whether the Academy had provided advice to government on the bushfires, the Academy presented the scientific evidence base in relation to bushfires in the following forums:

- Roundtable discussions in November and December 2019 as part of the review of the *Environment Protection and Biodiversity Conservation Act 1999*. One roundtable was with the Minister for the Environment, the Hon Sussan Ley; the other was with the review's Commissioner, Professor Graeme Samuel.
- Bushfire roundtable discussions with the Prime Minister, Minister Andrews, Minister Ley and the National Bushfire Recovery Agency.
- Information to the Office of the Chief Scientist in collating information around bushfire research capability in Australia.

In response to Senator Watt's question about whether the Academy's January 2020 bushfire statement had been provided separately to the Federal Government, the statement was circulated to all parliamentarians simultaneously, including the Prime Minister's office.

### Papers on fire severity after logging

Professor Lindenmayer has provided additional evidence regarding (1) relationships between logging and fire severity, and (2) the ecological impacts of post-fire (salvage) logging. See *Attachment 1*.



Attachment 1.

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### Additional evidence regarding: (1) relationships between logging and fire severity, and (2) the ecological impacts of post-fire (salvage) logging

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The following information is provided as an addendum to evidence given in person by Professor David Lindenmayer at Parliament House in Canberra on behalf of the Australian Academy of Science. Further information is presented on: **(1)** empirical relationships between logging and fire severity, **(2)** the impacts on post-fire salvage logging on forest ecosystems, and **(3)** the critical need for a long-term monitoring capacity to quantify the effects of, and recovery from, wildfires. A list of references is given at the end of this short document and copies of those cited sources can be provided on request to the Senate Committee.

#### Empirical relationships between logging and fire severity

##### **Summary**

Climate and fire weather are the primary driver of the incidence of fire.<sup>1,2</sup> A useful model for understanding the incidence of landscape fire is the “four switch” model.<sup>3</sup> The four “switches” are: (1) sufficient fuel that is (2) dry enough to burn with (3) weather conducive to fire-spread, and (4) an ignition source. Logging has the potential to alter fire activity through its impacts on three of the four switches: sufficient fuel, fuel moisture, and the prevalence of ignition points.<sup>4</sup> Indeed, beyond the impacts of climate and fire weather, a series of empirical studies have demonstrated that native forest logging increases the severity at which forests burn.<sup>5-9</sup> Forests are more flammable following logging operations due to an increased fuel load, especially coarse woody debris. There is also an increased density of elevated and vertically oriented live fuels. By opening up the forest canopy, logging operations also may lead to fuels being drier.<sup>10</sup>

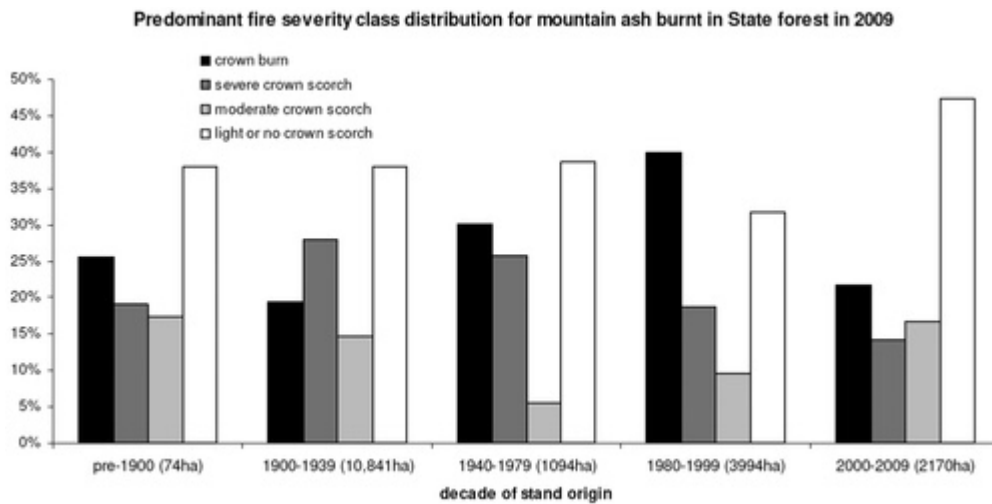
##### **Further detailed evidence**

A global review of the effects of logging on fire regimes in moist forests, concluded that logging increases the risk of fire in a range of forest types.<sup>11</sup> It found that the changes in conditions associated with logging (to microclimates, stand structure, fuel characteristics) increased the fire severity.<sup>11</sup>

Three individual studies of fire severity following the February 2009 fire in Victoria have found similar relationships between logging and the severity of subsequent fire. Price and Bradstock<sup>5</sup> found that the probability of crown fire was significantly higher in recently logged areas than in areas logged many decades previously, therefore highlighting the likely ineffectiveness of logging as a fuel treatment.

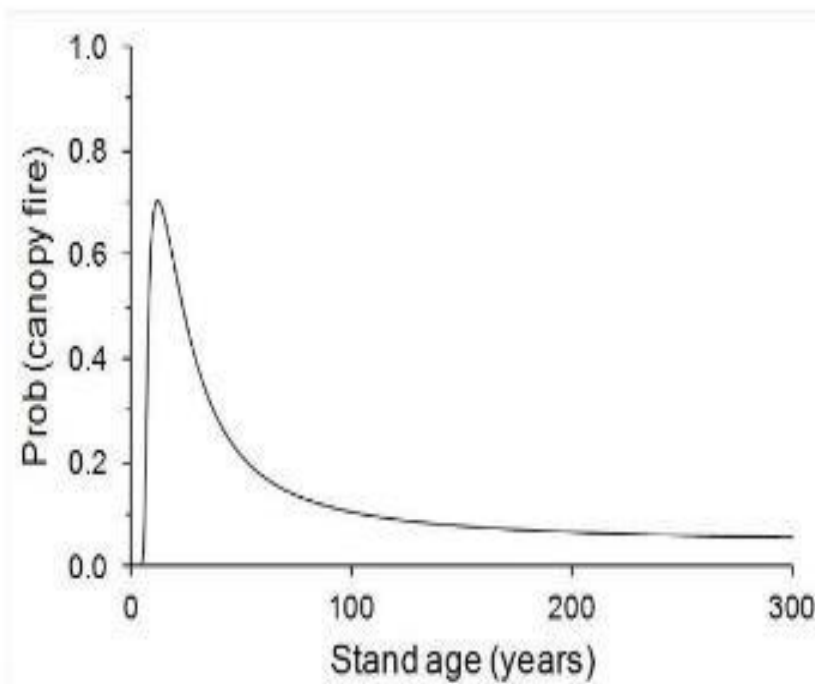
Attiwill et al.<sup>7</sup> showed that the likelihood of crown fire was 30-40% lower in long unlogged areas than in regrowth forest. They found that intermediate age classes (older than 10 years and younger than 80 years) experienced the greatest fire severity. In fact, regrowth forests were twice as likely as old growth forests to burn at high severity (Figure 1).

**Figure 1. Data showing relationships between fire severity and forest age (from Attiwill et al., 2014<sup>7</sup>).**



Taylor et al.<sup>8</sup> analysed fire severity following the 2009 fire in Victoria. After controlling for fire conditions, they found a strong non-linear relationship between the age of a Mountain Ash forest and fire severity. High severity fire occurred more often in stands between the ages of 7 to 36 years (see Figure 2). High severity fire almost never occurred in young stands (less than 7 years old) and was also reduced in older stands (more than 40 years old). In stands older than 15 years, the probability of crown consumption decreased with age such that it rarely occurred in stands aged 300 years. Young stands were seven times more likely to experience canopy-scorching bushfire than old growth stands (Figure 2).

**Figure 2. Empirical relationship between stand age (and time since logging) and the probability of canopy fire (modified from Taylor et al., 2014<sup>8</sup>).**



Winoto-Lewin et al.<sup>9</sup> analysed fire severity in regrowth, mature and old growth wet eucalypt forest and eucalypt plantation in Tasmania. They controlled for both topographic position and fire weather and found that old growth forests and plantations were less flammable than regrowth forest. Old growth and mature forest were subject to much less canopy scorch than regrowth forests.

In conclusion, while climate-weather-fire interactions will, of course, increase fire intensity and rate of spread, past forest disturbance also clearly impacts fire severity. Studies by Price and Bradstock,<sup>5</sup> Bradstock and Price,<sup>1</sup> Attiwill et al.,<sup>7</sup> Taylor et al.,<sup>8</sup> Winoto-Lewin et al.<sup>9</sup> have all demonstrated that crown fire is significantly less likely to occur in older and unlogged forests. This includes under extreme conditions, such as the most extreme bushfire conditions recorded in Australia to date (i.e. those experienced during the 2009 Victorian 'Black Saturday' fires).<sup>8</sup> In that case, when the rapidly spreading crown fire encountered mature and old Mountain Ash forest with no history of logging, it dropped dramatically in severity to a slow-spreading surface fire.<sup>12</sup>

### The ecological impacts on post-fire (salvage) logging

#### **Summary**

An extensive body of work globally has documented the wide range of ecological impacts of post-fire (salvage) logging (e.g. Lindenmayer et al.,<sup>13</sup> Leverkus et al.,<sup>14</sup> Thorn et al.<sup>15</sup>). The vast majority of studies indicate that the impacts of salvage logging on the environment are negative. The reasons for such detrimental impacts are largely related to the fact that salvage logging takes place after intense and severe natural disturbance. Therefore, ecosystems are subject to two (and sometimes more) intense disturbances in rapid succession, yet many ecosystems are not adapted such kinds of disturbances regimes.<sup>16</sup>

#### **Further detailed evidence**

A series of studies has examined the ecological impacts of post-fire salvage logging in the wet forests

of the Central Highlands of Victoria. Briefly, the various empirical observational and experimental studies have shown that salvage logging:

- Has long-term impacts on key soil nutrients and soil structure.<sup>17</sup>
- Significantly reduces the abundance of large old trees,<sup>18</sup> which are key attributes of forests critical to the survival of numerous species.<sup>19,20</sup>
- Impairs forest recovery following bushfires.<sup>21,22</sup>
- Alters plant communities including through a significant reduction in populations of important resprouting taxa such as tree ferns.<sup>21,22</sup>
- Significantly reduces bird species richness.<sup>23</sup>

Studies elsewhere in the world indicate that salvage logging can have pronounced effects on the condition of aquatic ecosystems (reviewed by Lindenmayer et al.<sup>13</sup>) and promote short-term fire risks.<sup>24</sup> In summary, the overwhelming body of evidence drawn from a wide range of studies conducted in many forest types in many countries globally, clearly indicate that post-fire logging has marked detrimental impacts on forest ecosystems and forest biodiversity (e.g. Lindenmayer et al.,<sup>13</sup> Leverkus et al.,<sup>14</sup> Thorn et al.<sup>15</sup>).

### The importance of long-term monitoring

Understanding the effects of, and recovery from, wildfires demands long-term monitoring information.<sup>25</sup> This is essential to determine impacts across multiple fires in a given region and/or ecosystem. This is also essential for understanding how to best mitigate fire effects.<sup>26,27</sup> Australia has limited its capacity to adequately quantify bushfire risks because it has axed its long-term ecological monitoring capacity (as of 2017).<sup>28</sup> **Without long-term data, Australia will have no predictive capability to forecast the impacts of fire on any aspect of the environment.**<sup>29</sup> The costs of maintaining an effective long-term ecological research network is around \$1.5m per annum. This is a small fraction of the estimated \$100 billion that the 2019-2020 wildfires cost the Australian economy.

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