The efficacy of past and current land management in influencing wildfire regimes and consequent risks to people, the environment and the economy.

Palaeological Evidence

The earliest known evidence of human occupation in Australia dates to about 65,000 years ago (Clarkson *et al.* 2017). Sediment cores typically show peaks in charcoal and changes in vegetation, which cannot be explained by climate change, around 40,000 years ago, when substantial evidence of human occupation starts to appear in archaeological records (e.g. Sing *et al*. 1981; Kershaw *et al.* 2002, 2006; Prideaux *et al.* 2010). Recently, the authors of a synthesis of charcoal studies reported that there was no such peak coincident with human arrival at 50 +/- 10 ka, but that charcoal increased and decreased with cyclic global warming and cooling as evident in ice cores from Greenland (Mooney *et al*. 2011; p. 28, Fig. 3).

However, during the last 70,000 years, two peaks in charcoal deposition, suggestive of massive burning, did occur across Australia around 41,000 years ago on a geological time scale and around 38,000 years ago on a millennial time scale (Mooney *et al.* 2011, Fig. 2). Also, there was a trend of increasing charcoal deposition between about 50,000 years ago and 40,000 years ago that does not correspond with any trend in temperature indices from Greenland and runs counter to the trend of decreasing temperature indices from Antarctica (Mooney *et al*. 2011, Fig. 2, 3; Johnson 2016). Pertinent to discussion of cause and effect, there was an exceptional spike in biomass burning evident in charcoal deposition after European occupation of Australia, followed by a sharp decline from the mid Twentieth Century coincident with widespread use of prescribed burning (Mooney *et al.* 2011, Fig. 5).

Palaeoclimatic and palynological data from Tasmania and New Zealand show that vegetation changed differently during the last glaciation in Tasmania than it had during three prior glaciations, and during all four glacial cycles in New Zealand. Twice as much open vegetation developed under the influence of Aboriginal burning as would be expected based on climate alone (Jackson 1999). A comparison of soil development under the influence of Aboriginal burning against soil development in New Zealand where people had not yet arrived, showed that the firestick created infertile, poorly drained soils which supported a distinctive, hard-leaved pyrophilic woody flora (McIntosh *et al.* 2005).

On the Atherton Tableland in North Queensland, greatly increased fire activity relative to climate converted araucarian dry rainforest to grassy sclerophyll woodland between about 40,000 and 28,000 years ago. By the end of this period, charcoal deposition had declined to relatively low levels despite the dry climate. About 10,000 years ago, rainforest began to recolonize the Tableland as climate became warmer and wetter. Charcoal increased as rainforest reinvaded the sclerophyll woodland. When it became too wet to burn (> 2300mm annual rainfall), charcoal again declined to low levels (Singh *et al*. 1981, Kershaw *et al.* 2006, Jurskis 2015).

In this same area, from about 43,000 years ago, fungal spores, presumed to be from megafaunal dung, decreased in proportion as charcoal increased over about 3,000 years (Rule *et al.* 2012; Figs. 1, 2). Studies of the carbon isotopic composition of fossil eggshells and teeth indicate that emus and wombats adapted to a poorer diet after Aboriginal burning eliminated mesic vegetation, whereas another large bird, *Genyornis*, was unable to adapt (Miller *et al*. 2005). Megafaunal extinctions in southwestern Australia coincided with human arrival and with increased fire activity relative to climate (Prideaux *et al*. 2010).

There is virtually no evidence of Aborigines hunting megafauna, even though there is evidence of megacarnivores preying on megaherbivores where they coexisted with Aborigines (Prideaux *et al*. 2010). Eggshells apparently scorched in campfires suggest that Aborigines ate eggs of the extinct *Progura*/*Genyornis* as well as the extant emu (Miller *et al*. 2016). By contrast, in New Zealand, where Maori hunted another giant bird to extinction, there are hundreds of known cooking sites containing the remains of up to tens of thousands of moa (Flannery 1994).

After Kangaroo Island was separated from the mainland by rising seas, the last known date of Aboriginal occupation was about 4000 years ago. There was a spike in charcoal and an abrupt change in vegetation around this time, that was attributed to marginally drying climate. A large, sustained increase in charcoal from 2500 years ago indicated infrequent high intensity fires with considerable accumulation of fuel between them. This was attributed to cessation of Aboriginal burning (Singh *et al*. 1981). A more plausible scenario, in my opinion, is that high intensity fires initiated vegetation change after the demise of Aborigines about 4000 years ago, and dense eucalypt forest developed during the succeeding millennium (Jurskis 2015). In any case, Flinders (1814) saw dense forest and clear evidence of infrequent high-intensity lightning fires on this uninhabited island in 1802.

European explorers and naturalists found evidence of recent vegetation change where Aboriginal populations had been reduced or eliminated by diseases (Jurskis 2015). For example, G.A. Robinson wrote that many districts of northeastern Tasmania had been taken over by dense underwood after the demise of local Aborigines (Flood 2006). Strzelecki (1845) battled through 80 kilometres of almost impenetrable scrub in South Gippsland, where Aborigines had been eliminated by smallpox and tribal warfare before European settlement (Wesson 2000, Flood 2006). When settlers cleared the scrub, they found stone axes, grindstones, and clay cooking ovens indicating that it had grown up after the demise of the local tribes (Howitt 1891). The size of the largest young eucalypts in the scrub indicated that it dated from a megafire about 30 years after the smallpox epidemic of 1789 (Coverdale 1920).

E.M. Curr (1883) described some small scrubs that had grown up on Murray River floodplains after local tribes were scourged by smallpox, and he independently deduced the time of the epidemic from the size of trees growing in abandoned cooking ovens. Extensive dense scrubs observed by Mitchell (1848) in central Queensland apparently grew up after Aborigines were reduced by smallpox, because their distribution and extent cannot be explained by environmental factors (e.g. Pyne 1991 cf. Jurskis 2015). Traditional Aboriginal Knowledge indicates that current widespread eucalypt decline, shrub invasion and high intensity wildfire are consequences of lack of burning. Victor Steffensen (pers. comm. 2016) summarises the problem as "upside-down country – thin on top and thick underneath".

Mild burning of open vegetation produces little charcoal and few fire scars because most seedlings are killed and relatively little woody material accumulates. Fire intensity and residence time are relatively low in light fuels composed of litter and grasses, so that heavy fuels, such as large fallen timber and standing green trees are not readily ignited (e.g. Burrows *et al*. 1995). Charcoal deposition indicates the quantity of biomass burnt (e.g. Mooney *et al*. 2011), not the extent or frequency of fire in the landscape.

Charcoal concentration in sediment cores provides a coarse surrogate for the prevalence of high intensity fires burning dense woody vegetation. The spikes in charcoal concentration within numerous sediment cores around 40 thousand years ago suggest a widespread increase in burning of woody biomass. (Singh *et al*. 1981; Kershaw *et al*. 2002, 2006; Prideaux *et al*. 2010; Mooney et al. 2011, Fig. 2). It is likely that the original Australians occupied grassy areas and extended them by pushing fire into thick woody vegetation (Jurskis 2015).

Johnson (2016) attributed lack of spikes in charcoal concentration around the same time, at four dry and/or cold sites, to absence of burning by people. However, these sites were not dominated by woody vegetation, and were therefore relatively unproductive of charcoal, whatever the fire regime. One of these sites, showing no change in charcoal or vegetation (Turney *et al*. 2008), was in Tasmania, where widespread changes in fire regimes, vegetation and soils after human arrival have been well documented (Jackson 1999, McIntosh *et al*. 2005). Declines in charcoal concentration after spikes at other sites were associated with changes in vegetation such as increases of grasses or chenopods at the expense of woody vegetaion (e.g. Singh *et al*. 1981, Rule *et al*. 2012, Johnson 2016).

Aborigines ate big birds' eggs, but there is no evidence that they killed or ate megafauna. Also, there is no evidence that vegetation changed as a consequence of megafaunal extinctions before biomass burning increased. Sediment cores indicate a continental increase in burning of woody vegetation around the time of Aboriginal influx/proliferation, followed by a widespread change from dense mesic vegetation to grassy ecosystems with sclerophyll trees and shrubs. Aboriginal occupation of the continent was neither instantaneous nor uniform. Nevertheless, widespread Aboriginal burning exterminated most of the megaherbivores by eliminating their browse or, possibly in some cases, their shelter. Megacarnivores disappeared with their prey. Open grassy ecosystems dependent on human input of mild fire became widely established. After this, less woody vegetation was burnt until Aboriginal burning was disrupted by European settlers.

European explorers and pioneering pastoralists described frequent mild burning of mostly open grassy ecosystems by Aboriginal people (e.g. Tench 1795, Flinders 1814, Darwin 1845, Mitchell 1848, Curr 1883, Howitt 1891, Pyne 1991, Gammage 2011, Jurskis 2015). On the other hand, Mooney *et al*. (2011) compared a rough index of human occupation from archaeological sites in the arid zone against charcoal in sediment cores mostly from the humid zone. They claimed a lack of correlation as proof that Aborigines did not influence fire regimes. Apart from the geographical separation of the independent and dependent variables, and the scarcity of dated Aboriginal sites 'prior to ca. 20 ka'(Mooney *et al*. 2011; p. 38, Fig. 7), the analysis was invalid because charcoal deposition cannot be used as a measure of Aboriginal burning in open grassy ecosystems.

Historical Evidence

An outstanding spike in biomass burning during 70,000 years of records occurred after European settlement. It is clear that woody thickening and intense fires consequent to disruption of Aboriginal burning fueled megafires that produced unprecedented amounts of charcoal (Mitchell 1848; Mooney et al. 2011, Fig. 5; Jurskis and Underwood 2013). For example, high intensity fires burnt 5 million hectares of Victoria in 1851 only two decades after Europeans began to disrupt Aboriginal management (Adams and Attiwill 2011, Jurskis 2015). After Europeans arrived, woody thickening, megafires and pestilence occurred firstly when Aboriginal burning was disrupted, and secondly when foresters attempted to suppress fire.

State forest services were established in the early 20th Century by European-trained foresters imbued with the principles of Colonial Forestry, especially fire suppression (Underwood 2013). Consequently, woody thickening and accumulation of three-dimensionally continuous fuels led to disastrous megafires, as well as to chronic decline of eucalypt forests and outbreaks of arbivores (Jurskis 2015). In 1939, the Black Friday megafires killed 77 people, burnt two million hectares of Victoria and southeast New South Wales, and destroyed 69 sawmills.

Despite the extreme weather conditions, many fires in far East Gippsland at the same time caused little damage. Forests east of the Snowy River were mostly controlled by the Lands Department and routinely burnt by graziers, keeping them open, healthy and safe (Attiwill *et al.* 2009). John Mulligan was there. His family wasn't worried, even when his uncle's car repeatedly stopped because of vapour locks in the fuel lines with the extreme heat (John Mulligan, East Gippsland Wildland Fire Taskforce pers. comm. 2018). A map of the fires in Victoria shows a striking contrast. A million hectares of unbroken fire extended from the Murray River north of Corryong and southwesterly along the Great Dividing Range to Melbourne. However the 14 'large' fires mapped in far East Gippsland were miniscule in proportion (Luke and McArthur 1978; p. 308, fig. 23.2).

In the absence of mild burning, highland forests of southeastern Australia were devastated by plagues of phasmids from the 1940s to the early 1960s (Campbell 1966). Thousands of hectares of hydroelectric catchments were aerially sprayed with dangerous insecticides in diesel fuel to control the stick insects (Campbell and Hadlington 1967, Jurskis and Turner 2002). At the same time, psyllids plagued forests in coastal New South Wales and bellbirds responded to the increased food resource by irrupting and extending their range (Moore 1961, Jurskis and Turner 2002). Foresters belatedly realised the futility and destructiveness of attempted fire suppression.

In 1951, The Hume-Snowy Bushfire Prevention Scheme was established to protect hydroelectric catchments, timber resources and pastures in New South Wales' Alps using prescribed burning (Jurskis *et al.* 2006). In 1961, the Dwellingup megafire burnt hundreds of thousands of hectares of forest and destroyed four towns in Western Australia. Trials of aerial ignition were initiated in 1965 to improve the extent and efficiency of prescribed burning in Western Australia. These trials extended to the Australian Alps and east coast hinterland by 1967/8 (Underwood 2015). An aerial burn in autumn 1968 saved Bega from wildfire during the following fire season (Cheney 2015) when over a million hectares were burnt, 14 people were killed, and more than 150 homes and buildings were lost in other parts of NSW (Adams and Attiwill 2011).

After foresters reinstated mild fire, forest health, structure and fire safety temporarily improved (Jurskis *et al.* 2003, 2006; Jurskis 2005; Sneeuwjagt 2011). No significant occurrences of chronic eucalypt decline or pest outbreaks were reported in New South Wales' State Forests for the next quarter of a century (Jurskis *et al.* 2003). In Western Australia, an outbreak of gum leaf skeletoniser across 90,000 hectares of southern jarrah forest in the 1980s had little or no impact on areas that had been deliberately burnt up to three years earlier. Burning didn't directly control the insects (Farr *et al.* 2004), rather it maintained resilience of trees (Jurskis 2005).

There was a pronounced general decline in charcoal deposition (Mooney *et al*. 2011, Fig. 5). Half a century of data on the efficacy of broadscale prescribed burning in southwestern Australia showed a strong inverse correlation ($R^2 = 0.77$) between area subsequently burnt by wildfires compared to area of prescribed burning, provided that, on average, more than 10% of the forests had been burnt in a few preceding years. The relationship held, despite great variability in climate and in the area treated each year, through a period of warming and drying climate (Boer *et al.* 2009; Adams and Attiwill 2011, Fig. 7.1; Sneeuwjagt 2011; Burrows 2016).

Burning reduced the number and the extent of wildfires, especially megafires (Boer *et al.* 2009). From 1962-1990, the mean annual area burnt by prescribed fire and wildfire was 12.5% and 0.3% respectively. From 1991-2012, the mean treated area fell to 6.6% and, despite superior detection and suppression capability, the area burnt by wildfire increased almost four-fold to 1.1% (Burrows and McCaw 2013). From 2011- 2015, the annual area treated declined to ~3.5% whilst the area burnt by wildfire increased threefold to ~3.1% (Burrows 2016).

Three percent of State Forest in New South Wales was treated annually by prescribed burning in the decade to 2003 and a slightly smaller area was burnt by wildfires. Burning occurred mainly in coastal areas where a substantially higher proportional area was burnt. During the same period, 0.4% of National Park was treated each year whilst twelve times the area (2.5 million hectares) was burnt by wildfires (Jurskis *et al.* 2003). Between 1997 and 2006 an average of 0.4% of the Sydney Basin was treated by prescribed burning each year whilst 4.2% was burnt by wildfires (Penman *et al.* 2011).

From about 1980, ecologists with no experience of mild burning had raised concerns that it would eliminate plants and animals which had thrived during millennia of Aboriginal burning. The silly idea that life histories of supposedly fire-sensitive plants should be used to determine intervals between prescribed fires was readily accepted. NSW NPWS eventually produced *Guidelines for Ecologically Sustainable Fire Management* that specify "*acceptable fire intervals*" for all types of vegetation..

Prescribed burning was progressively reduced (Jurskis *et al.* 2003, Boer *et al.* 2009, Sneeuwjagt 2011, Burrows and McCaw 2013) and ecosystem health and safety declined as a consequence. For example, after strategic burning and fire suppression were introduced to National Parks around Sydney. biomass accumulated, biodiversity declined, disease flourished and a vicious circle of high intensity fire was initiated (Jurskis and Underwood 2013). Megafires now occur in southern Australia nearly every year and almost two hundred human lives have been lost in the new millennium (Adams and Attiwill 2011, Jurskis 2015). Chronic eucalypt decline is now widespread along with irruptions of arbivores including psyllids, beetles, weevils, caterpillars, fungi, koalas, possums, mistletoes and parasitic shrubs and vines (Jurskis and Turner 2002; Jurskis 2005, 2015).

About 20% of forests and woodlands on New South Wales' coast were declining in health by 2010 (Jurskis and Walmsley 2011) and the proportion is increasing rapidly as frequent mild burning has disappeared in accordance with the *Guidelines* and the *Bush Fire Environmental Assessment Code*. Despite the Millennium Drought in the first decade, spotted gum and blackbutt forests on well drained sites were not declining. Now all types of forest are chronically declining. More than 50% of eucalypt ecosystems in Queensland's Wet Tropics World Heritage Area were affected by 2014 (Stanton *et al.* 2014). Things are just as bad in NSW and VIC.

Over the past few years, yellowing of foliage of burrawangs and banksias became apparent in southern coastal NSW and East Gippsland. Recently, with another severe drought, these normally extremely drought tolerant species are dying en masse whilst on the same sites invasive rainforest species such as figs, pittosporoum, pencil cedars and blueberry ash remain healthy. It seems to me that Phytophthora is responding to deterioration of roots of the drought tolerant species consequent to soil changes in the absence of mild fire. Meanwhile NSW continues to spend millions of dollars on various investigations of various so-called diebacks which are simply variants of chronic decline consequent to lack of mild burning. Each individual symptomatic pest, parasite or disease attracts its own specialist researchers with their own extravagant and wasteful funding by taxpayers (Jurskis in press).

Planning, Approval and Operational Problems

The situation is much worse now than it was 50 years ago, when foresters applied real adaptive management. Well managed forests with healthy trees are very rare. In NSW, it is illegal, in practice, to manage forests sustainably using frequent mild fire. In the vast majority of eucalypt forests, health, safety and biodiversity can only be maintained by mild burning about every three to six years (Jurskis 2011). However, the *Bush Fire Environmental Assessment Code* (*BFEAC*) specifies minimum intervals of ten years between fires in dry shrubby forests and thirty years in moist shrubby forests (incorrectly described in the *Guidelines*, *Code* and related literature as wet sclerophyll forests (Jurskis 2015)) . Virtually all eucalypt forests on public lands are shrub-invaded because of lack of mild burning and/or grazing. Recent LIDAR surveys on the north coast of NSW showed that a third of the State Forest area had inpenetrable understoreys (J. Black, Forestry Corporation pers. comm. 2019).

The rules and procedures for burning in NSW now practically ensure moderate or high intensity burns in most cases. Fuel accumulates more rapidly after intense fires. Following the prescribed interval between burns, fuel and scrub development is such that mild burning according to regulations and routine practices is almost impossible. Nevertheless, large blocks are planned from the office for burning in later years. Long lines of fire are lit around perimeters, reaching maximum rates of spread almost instantaneously (Jurskis 2015, p. 190). Lines are often lit from the bottom of slopes and across the wind. Canopies are scorched, trees burn down and understories get thicker as a result of dense germination and resprouting.

Academics who have no experience and no idea how to use mild fire say that we can no longer apply it because climate change is closing the window of opportunity. When I started working in the bush on NSW north coast in the late 1970s, burning was easy and enjoyable. We used commonsense, matches and suitable weather conditions in a healthy and safe landscape. The development of 3D continuous fuels with lack of burning is closing the window. Dense scrubby forests won't easily burn under mild conditions, but they explode in severe conditions causing firestorms and ember showers that destroy lives and homes of people and animals, producing huge carbon emissions. The more mild fire we use, the easier and safer and more environmentally friendly it becomes.

Traditional knowledge and science both indicate that mild fire should be applied progressively as fuels develop and cure. In thick forests it should be applied firstly on high and dry sunny ridgetops, using spots that gradually coalesce whilst humidity increases as the sun goes down. Spots should be lit progressively into the wind (Jurskis 2015, Underwood 2015). Hilly country needs lighting from the top down, and fire should be extended to sheltered aspects and gullies as they warm and dry. However fire management is now over-regulated by emergency services, so we have hugely expensive and ineffective water bombing operations in response to disasters, rather than cheap, efficient and safe burning, including aerial delivery of fire, to sustain healthy and safe landscapes.

The Science

Physics

In 1968, Athol Hodgson who later became Chief Fire Officer in Victoria published an article in the American *Journal of Forestry* which explained the basis of *Control Burning in Eucalypt Forests*:

> "*Doubling the available fuel usually doubles the rate of spread of the fire and increases its intensity fourfold. Control is made extremely difficult by mass short-distance spotting from stringybark fuel and spectacular long-distance spotting from candlebark fuels. Control burning over large areas … cheaply and effectively reduces the incidence of high intensity wildfires and minimizes damage*".

Firebreaks, so-called asset protection zones and waterbombers don't work because of long-distance delivery of ember showers by fire storms exploding in 3D fuels during extreme weather. Boer *et al*. (2009) reported that burning at a landscape scale effectively reduced risks for six years.

Ecology

Academics have promoted a concept that there is conflict between hazard reduction burning and nature conservation. In fact, ecosystem health and safety are two sides of a coin when there is mild burning throughout the landscape. In fire studies at Eden, groundcover species richness started to decline within 3 or 4 years of mild fire (Penman *et al*. 2008, Fig. 4c; Penman *et al*. 2009, Fig. 1a) and declined by 6 species over 20 years after wildfire (Penman *et al*. 2009 Fig. 1a). Shrub species richness increased by only 2 species over 15 years after wildfire (Penman *et al*. 2009, Fig. 1a), whilst shrub density increased by 1500 stems per hectare over 20 years (Penman *et al*. 2009, Fig. 2). In the same forests, substantial accumulation of soil nitrogen occurs after 10 years without mild fire and the carbon/nitrogen ratio is reduced causing increasing acidity and nutrient imbalances that are harmful to eucalypts and consequently promote shrub development (Turner *et al*. 2008).

These changes are exacerbated by microclimatic changes associated with shrub development such as increased shading and topsoil moisture (Jurskis *et al*. 2011) and by proliferation of N-fixing shrubs such as acacias and casuarinas (Turner *et al*. 2008). Fire ecologists typically report that burning depletes soil N because they compare levels in frequently burnt areas against long unburnt 'controls' where N has accumulated over several decades (Turner *et al*. 2008, Jurskis *et al*. 2011). Based on rates of N accumulation in the absence of fire, and N removal by prescribed burning, Turner *et al*. (2008) suggested that an interval of about 5 years between fires would maintain dynamically stable nutrient cycling processes and healthy forests. This is similar to the interval that would maintain competitive interactions supporting maximum plant diversity and minimum shrub cover according to the data of Penman *et al*. (2008, 2009).

Ecosystem Health and Safety

Since the three aspects of fuel/vegetation mass/structure, competition between plants, and nutrient cycling are inextricably linked, it is not surprising that they point to similar fire intervals (3-6 years) to maintain biodiversity, health and fire safety of eucalypt forests (Jurskis 2011).

Traditional Knowledge

The science is consistent with estimates of pre-European fire regimes derived from a combination of dendrochronology, sedimentary charcoal, grasstree records and historical accounts (e.g. Mitchell 1848, Curr 1883, Howitt 1891, Burrows *et al*. 1995, Ward *et al*. 2001, Abbott 2003, Hassell and Dodson 2003).

Politics, Policy and Legislation

Under New South Wales' *Bushfires Act* of 1949, as amended after each major fire event up to and including 1994, fire management on private, leasehold and vacant crown lands was the responsibility of volunteers under a very lean bureaucracy supported by local government. It was coordinated across the State by the Bush Fire Council in Sydney including ex-officio members from public land management and other agencies. Naturally, equipment, training, performance and coordination between agencies varied widely across the State. Assistant Forestry Commissioner Roy Free and Fire Management Officer Bob Richmond were exofficio Councilors and had been working on thorough reform of the legislation to improve overall standards of fire management and hazard reduction. The Coalition Government was receptive and the 1994 disaster gave impetus to the process (Jurskis 2015).

Fahey's Coalition Government was defeated by Carr in 1995 and the proposed reforms were modified. The Rural Fires Act of 1997 came with a proviso that the objects relating to fire management were to be pursued "*having regard to the principles of ecologically sustainable development*". Nature Conservation Council (NCC), was given a privileged position on the Bush Fire Coordinating Committee, ensuring that these principles would be misconstrued to interfere with sustainable management. This was after the High Court's Mabo decision which, by rejecting *Terra Nullius*, should have set the scene for responsible land management. However our National Forest Policy promotes wilderness, and NSW Wilderness Act was not repealed as it should have been. In announcing the reforms, Rural Fire Service (RFS) Commissioner Philip Koperberg pledged that they would make it easier to carry out burns (Jurskis 2015).

In fact, burning became much more difficult because the untenable life cycles theory was insinuated into the planning and approvals process, and shrub-invaded vegetation was wrongly classified as (ill-defined) wet sclerophyll forest and 'protected' from mild fire by regulation (Jurskis 2015). Now "*acceptable*" intervals between prescribed burns are those that will ensure environmental degradation, explosive fuels and uncontrollable megafires (Jurskis and Underwood 2013). This suits cost-squeezed public land managers, because everyday costs of management are reduced and firefighting is externally funded as disaster response.

Former head of CSIRO bushfire research, Phil Cheney, said:

> *The irony is that in the process of cost saving on government land, they have shifted the costs to the suppression industry and created a monster that I fear, like in the USA, is unstoppable. Unless government land managers are made responsible for all suppression*

*costs on their land then there is absolutely no incentive to undertake management that will reduce the hazards and make suppression cheaper and easier. The volunteers are caught up in this mess and are quite cynically used to avoid criticism of government actions. As Phil Koperberg would often say to me "*You may know about fires but I know about politics*"* (N.P. Cheney pers. comm. 2015).

Cheney was spot-on and the unstoppable monster is now in charge.

Our National Capital was partly incinerated in 2003 and our "*Nation Charred*" after fire spotted over many miles of bare paddocks. The House of Reps Inquiry received evidence from experienced land managers right across Australia, and rediscovered the simple answer that we need to restore mild fire across the landscape. However, the land management and emergency services bureaucracies in some eastern states boycotted the Inquiry, and the Green member put in a dissenting report. This set the scene for the COAG Inquiry whereby the paramilitary emergency services leaders and junk scientists swept traditional knowledge, history, commonsense and pragmatic science under the table. They put 'education', disaster warnings and evacuations in place of sensible management (Jurskis 2015). This paved the way for ongoing disasters and ever-increasing funding of their bailiwicks.

In the eastern states, governments on both sides of politics have continued to support the disaster industry and junk science at the expense of pragmatic, scientific and conservative land management. For example, in February 2018, NSW allocated four million dollars for new research to be conducted by Professor Ross Bradstock (NSW Government 2018). Three of the four priorities are:

impacts and management of hazard reduction burns
drivers of bushfire frequency and severity
impacts on the environment and endangered plants and animals

Bradstock previously co-authored a totally flawed model supposedly showing that prescribed burning mostly doesn't work in southeastern Australia (Price *et al*. 2015, Figure 3). In fact, the perceived lack of efficacy of burning in the southeast compared to the southwest was almost entirely due to the miniscule amount that was done. Furthermore, the authors wrongly assumed that high intensity wildfires were equivalent to mild burning in controlling fuel accumulation. Their model of so-called leverage of burning included wildfires that promote rapid fuel accumulation. This grossly inflated the 'treated' areas. The model is worse than useless.

In March 2018, 60 homes were destroyed by wildfire at Tathra. Bradstock claimed that lack of burning wasn't a factor in the disaster. RFS supported the claim, reporting that there were 93 hazard reduction "*activities*" in the previous 11 years across 517 hectares (Hannam 2018). That's an average of 6 hectares per activity and 8 activities per year totalling 49 hectares. Bradstock says broadscale burning doesn't work, but claims that narrow breaks around houses can create "*defensible space*". However he admitted that houses at Tathra were ignited by ember storms driven by high winds (Hannam 2018). The fire came from many kilometres away and jumped the Bega River because it was fed by embers from heavy, elevated fuels in long unburnt bush.

The Tathra fire burnt through part of a heavily scrubbed new reserve dedicated to protecting koalas. It probably killed or maimed any animals there. Megafires in spring/summer 2019 have undoubtedly incinerated thousands of koalas living at unsustainably high densities in chronically declining, densely scrubbed forests further north. Green groups have cynically taken advantage of this animal welfare catastrophe (not just for koalas) and stepped up their campaigns for more National Parks and moratoriums on sustainable industries such as carbon-sequestering, solar-powered timber production.

The large numbers of koalas and the uncontrollable fires are both symptoms of unhealthy forests. When I worked in the forests around Rappville, south of Casino in the late nineteen seventies, they were open and healthy and grassy and safe. Koalas were rare. When Wyan Creek sawmiller Greg Richards saw a koala, he caught it and took it to the local primary school to show the kids. Now the forests are explosively dangerous and full of species that irrupt in unhealthy forests, including koalas, psyllids, bellbirds, mistletoes, native cherries and other invasive native and exotic shrubs.

Though an undeniable catastrophe for the current population of koalas, the fires do not pose a threat to conservation of the species, because it is very resilient. For example, during the Millennium Drought, low-density populations continued to irrupt in dense regrowth arising from high intensity fires in the Sydney Water catchments in 1977 and in Mumbulla State Forest near Bega in 1980. However, unsustainably dense populations on the Koala Coast and in the Pilliga Scrub crashed for a second time (Jurskis 2017). (The first time was respectively in the Federation and the Great War Droughts.)

The South Gippsland koala population, incorrectly reported to be the only natural population in Victoria, first irrupted after a megafire around 1820, before European occupation. It survived some of the most intense and extensive clearing ever done in Australia, from the 1870s to the early 1900s. The koalas bounced back from 20 severe fire events in 200 years, including Black Thursday 1851, Red Tuesday 1898, Black Friday 1939 and Black Saturday 2009. Less than eight years after Black Saturday, they had once again irrupted into high densities (Jurskis in press).

Our fire management policies promote all the irruptive species whether plant or animal, native or exotic. The truly endangered species in Australia are those such as Hastings River mouse, that depend on open, grassy, healthy and safe forests and woodlands. For example, 24 small mammals became extinct in western NSW during the 19th Century after pastoralists disrupted Aboriginal burning and scrub choked out their habitat (Jurskis 2015).

The Way Forward

Environmental and fire control policies, legislation and practices must change to encourage reintroduction of mild fire regimes and restoration of healthy and safe landscapes. The paradigm must shift from exclusion of human activity to sustainable management.

Foresters accomplished this fifty years ago when they weren't hampered by red and green tape. Their efforts, ironically, later resulted in healthy, productive, managed forests being locked up in reserves to decline and face inevitable incineration in megafires. Now all tenures are mismanaged by dint of regulations. Peri-urban forests are arguably more difficult to manage now, because of the intricate mixture of people, tenures, infrastructure and bush. But it's certainly not impossible as demonstrated by Brian Williams at Kurrajong Heights on the outskirts of Sydney where the major impediment has been regulations and *BFEAC*. It's absolutely critical to substitute land management for emergency response if we are to avoid further unnecessary loss of human lives and ongoing socioeconomic and environmental destruction.

The crux of the matter is the undue political influence of emergency services generalissimos and green academics on land management. Ironically, they are increasingly rewarded for failure with funding for incredibly expensive and ineffective fire suppression technology and unscientific research that constructs ridiculous models to support their delusions. This is all at the expense of relatively cheap, preventative and restorative management.

All it would take to restore a healthy, safe and sustainable landscape is for our elected representatives at all levels of government, to listen to and support fairdinkum scientists and land managers with real-world knowledge and experience. The huge scale of the problem across most of southeastern Australia dictates that governments reduce obstructive regulation and bureaucracy, and mandate a consistent approach of proactive management across all tenures.

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