

# **Wild, tame and feral fire: the fundamental linkage between indigenous fire usage and the conservation of Australian biodiversity**

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## **Abstract**

There have been three great ages of bushfires in Australia: (i) the pre-human, when lightning started massive wild fires that, over millions of years, stimulated the evolution of fire-adapted species which eventually subordinated the Gondwanan rainforests in all environments except the most fire protected. These wildfires create a 'coarse-scale' mosaic of large areas of vegetation in different stages of recovery to which a diversity of herbivores became adapted, including numerous extinct 'megafauna' species; (ii) the Aboriginal, when fire was used as a tool to hunt game, possibly driving some megafauna species to extinction. The taming of bushfire created a very fine-grained habitat mosaic which supported high densities of game species, such as kangaroos, adapted to burnt landscapes, and eventually resulted in the conservation of fire-sensitive vegetation, particularly during the height of glacial aridity; (iii) the current period, when fire has become feral, causing the landscape-wide loss of unburnt habitats and homogenisation of the fine-grained habitat mosaic, contributing to the extinction of smaller mammals and some bird species in the continental interior and monsoon tropics. The disruption of the refined and consistently implemented system of fire management established by Aboriginal people is, I believe, the root of the current fire management problem. While it is unrealistic to attempt to 'return' to Aboriginal fire management, the fact that Aborigines were able to 'tame' wildfire should be a great source of inspiration in the quest for ecologically sustainable fire regimes.

## **Introduction**

I believe there have been three great ages of bushfires in Australia: (i) the pre-human period when lightning started massive wild fires and enabled fire-adapted species to eventually subordinate the Gondwanan rainforests that originally clothed the entire continent; (ii) the Aboriginal period when the wildfires were tamed and generations of people created a cultural landscape through their skilful use of fire; and (iii) post-1788 to the present, when fire has become feral. Each of these three ages has variously favoured and disadvantaged, sometimes to the point of extinction, different plant and animal species. The challenge for modern day land managers is to once again tame fire to both reduce the loss of life and property but also to conserve biodiversity. I suggest this goal can only be achieved with a profound understanding of the long history of fire in Australia.

## **The fire stick replaced the lightning strike**

Before humans colonised Australia some 40-60,000 years ago fires were caused by lightning strikes. The onset of the summer monsoon in northern Australia provided reliable dry lightning storms at the end of a rain free dry season. Occasional monsoon

storms would penetrate deep into the continental interior and start fires at the beginning of the drought-prone summer months. Such reliable natural ignitions provided an extraordinary evolutionary theatre allowing for vegetation to adapt to fire rendering Australia the most fire prone continent on Earth.

The lightning storms would have created a 'coarse-scale' mosaic of large tracts of vegetation in different stages of recovery. (Fig. 1a) This pattern of landscape would have provided habitat for a wide diversity of herbivores including browsers and grazers, including the extinct 'megafauna'. Of particular importance would have been the extensive fire edges that would have supported animals requiring a mix of resources. Australia was truly a land of fire.

Sometime towards the end of the ice-age humans arrived in Australia, possibly attracted to the continent because of the plumes of smoke blown by the trade winds north-westward towards the Indonesian archipelago that, because of globally lower sea levels, would have formed a long peninsula. There was a short sea passage of less than 100 km separating greater Australia (a land made up of New Guinea, Australia and Tasmania, united due to lower sea levels) from Asia. The crossing of this passage made the ice-age colonists of greater Australia the first seafarers, and thus the most technologically advanced humans at that time. There is little doubt that they carried in the stone-age tool kit the technological means to make fire. They probably already knew how to use fire to modify landscapes with fire for hunting and to make otherwise intractable areas accessible. The marine resources and many plant species would have been familiar to the first colonists. Although the marsupial fauna, particularly the large sized herbivores such as *Diprotodon*, would have been new, these people would have had experience of big, dangerous game encountered during their expansion from Africa through India and Southeast Asia. They may also have experienced infrequent landscape fires, caused by lightning striking flammable vegetation, but nothing on the scale that occurred in Australia.

Over time the colonists would have gradually 'tamed' wildfire as they used fires to hunt game, including the megafauna. The core feature of their taming of fire was the reduction in the spatial extent of landscape fires (Fig. 1b). This system of fire usage created mosaics that supported high densities of game species adapted to burnt landscapes. Inadvertently, they had developed a system of land management often described as 'fire-stick farming'. I suspect that the extinct fauna that required long-unburnt habitats, such as the leaf-eating kangaroos *Sthenurus*, *Simosthenurus* and *Procoptodon* would have been disadvantaged, and the addition of human hunting pressure may have eventually driven such species to extinction. Nonetheless, many smaller animal species, adapted to living at the edges of large areas burnt by lightning, became dependent upon the fine-grained mosaic created by Aboriginal fire-stick 'ranching'. In sum, I suggest that the one of the great triumphs of the Pleistocene Australians was the taming of wildfires through the development of 'igniculture'.

When the British settled Australia in 1788 it would have been unrealistic to expect the colonists to grasp the fundamental importance of fire in the continent's evolutionary history. The fires the navigators observed were noted and commented upon as evidence of humanity but the underlying reasons the fires were lit were often misunderstood, with many observers thinking that Aboriginal landscape burning as pyromania lacking any social or intellectual basis. While it is true that in some cases

the 19th Century squatters and 20th Century shepherds and cattlemen adopted Aboriginal burning practices, this technological transfer ceased with the more intensive husbandry of stock that requires investment in infrastructure such as fencing. Little thought was given to the consequences of disrupting the consistently implemented system of fire management that had moulded the Australian landscapes for thousands of years. Frequent small fires were replaced by spatially widespread and intense fires that were much more frequent than during the prehuman period of wild fires (Fig. 1c); human activities, including the actions of sociopathic individuals, provided ignitions on days of high fire danger. This transition from tame to feral fire is the root of the current fire management problem. Furthermore, the cessation of Aboriginal fire management and the associated periodic landscape-wide loss of unburnt habitats seems to be an important cause of the extinction of smaller mammals and some bird species in the continental interior and monsoon tropics.

### **Balancing bushfires and biodiversity**

Although the story, sketched out above, about how Australia became 'the land of fire' (see Bowman (2002) and (in press) for a more detailed discussion and references to the broader literature), requires more research and will inevitably change in the light of new evidence, there is sufficient information to inform fire management. The most basic point is that attempts to totally suppress fire are futile, because fire is as basic a feature of this continent as is Australia's mid-latitudinal geographic position. The typical media portrayal of bushfires as 'disasters' reinforces the desire to wage war against fire, and failure seems only to spur on heroic attempts to achieve a total victory.

Rather than fighting against the inevitable 'tide' of bushfires, Australians need to more effectively adapt to their fire-prone land, accepting that the conservation of biodiversity demands the skilful use of fire to maintain appropriate habitat mosaics. However, this now represents a tremendous challenge because of the construction of infrastructure and habitations established in bushland. Indeed, the bushfire 'problem' is ultimately about the mismatch between expectations of industrial civilization and the reality of an ancient and fiery land long managed by hunter-gatherers. In this context it is important to recognise that the Aborigines had limited infrastructure and great expertise and continuous opportunities to practice landscape burning. In contrast modern day fire managers activities are constrained by numerous risks to life and property, capricious social values about landscape fire and more limited opportunities to undertake burning. So while it is unrealistic to attempt to 'return' to Aboriginal fire management, the fact that Aborigines were able to 'tame' wildfire should be a great source of inspiration in the quest for ecologically sustainable fire regimes. To achieve this goal, a landscape perspective is required with analyses of why some styles of fire management work and others fail: current landscapes should be seen as great 'natural experiments' that await investigation. Why should high levels of biodiversity persist under some styles of landscape fire management and not others, why should some areas of be more prone to uncontrolled wildfires compared to other apparently similar landscape settings? Answering such questions is vital to the process of 'adaptive management' that fundamentally involves learning about and articulating the efficacy of various management interventions. In this regard, I suspect that the common mode of conducting short-term and narrowly focused ecological studies has generated a blizzard of detail that engenders a sense in land

managers that coherent solutions will remain forever elusive. It must be recognised that there is a fundamental mismatch between the temporal and spatial scales at which fire managers and ecologists operate. Ecologists typically work at the local scale and consider the longer-term fate of populations, while fire managers work at the landscape scale, often with the immediate goal of fire suppression. Fire managers often see only 'fuel' and forget about the conservation of biodiversity so valued by ecologists. It remains a great challenge to balance these sharply contrasting but legitimate perspectives.

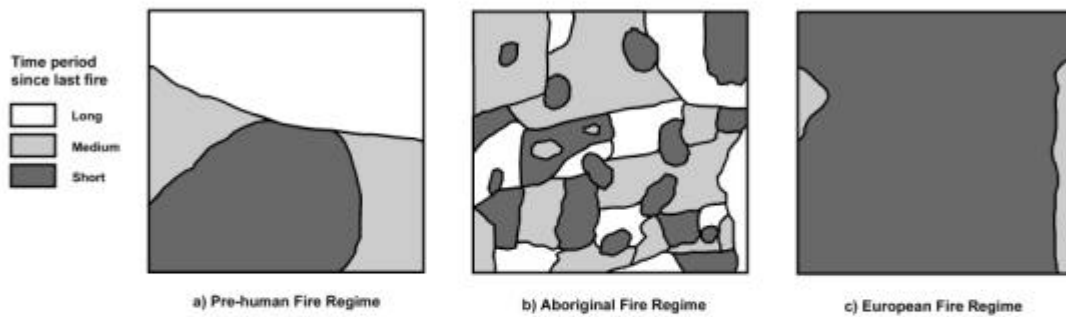
Rather than attempting to manage landscapes for all possible biological and social outcomes, I suggest we should accept that fire management can achieve only a limited number of objectives. Further, fire management is context specific, for example small fragments on the urban fringe present different opportunities and constraints compared to large tracts in remote areas: there are more resources but greater risk of destroying life and property, and a high likelihood of unplanned ignitions. Nonetheless, I see no reason why focused fire management should not be ecologically sustainable. In this regard, I see a parallel with the fire management system developed by Aborigines, which were focused on the management of a few core species but nonetheless conserved the biodiversity we value today. There can be no doubt that some styles of management are more sympathetic to biodiversity and ecosystem services than others. I believe the currently ascendant 'bushfire disaster' mode of management is ultimately more destructive of biodiversity than a program of recurrent fires to reduce fuel loads. Sustainable fire management requires complicated trade-offs to realise specific objectives. A concrete example concerns the management of bushfire smoke. We must accept that some management goals, such as reduced fire hazards, may have costs including the loss of some elements of biodiversity and the nuisance of low-levels of smoke pollution.

## **Conclusion**

I am confident that landscape fire can once again be tamed in Australia. To do this we must pay heed to the inevitability of fire on the Australian continent and the thousand of years of skilful Aboriginal fire management. However, given the great changes wrought by European settlement and the establishment of industrial civilization I do not advocate a re-imposition of traditional Aboriginal fire regimes. Indeed, I doubt that that fire regimes in the late 21<sup>st</sup> century will bear much resemblance to traditional Aboriginal landscape burning of the early 19<sup>th</sup> century. Nonetheless, and despite these differences, future fire management regimes will be, consciously or unconsciously, derived from traditional Aboriginal burning practices. 'Fire-stick farming' has not ended. Rather it has had a new beginning.

## **References**

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**Figure 1.** Schematic representation of the theory of Bowman (2002) concerning changes in the spatial scale and frequency of fires in a hypothetical tract of tropical *Eucalyptus* savanna. (a) In the pre-human period, lightning started fires infrequently and burnt large areas, creating a coarse habitat mosaic to which various species of birds and mammals had become adapted. (b) Aboriginal fire management was characterised by a high frequency of fires that burnt much smaller areas, producing a fine-scale habitat mosaic that supported most of the pre-human wildlife assemblage, with the notable exception of the Pleistocene megafauna. (c) Under European fire management, fires, that had a similar frequency as the Aboriginal period, burnt large areas thereby obliterating the pre-existing habitat mosaic created by Aboriginal landscape burning. This change in conjunction with the introduction of megaherbivores, has caused the decline and in some cases the extinction of many mammal and bird species.