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The Terra Nullius Fire Hypothesis

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"In West Australia the forest-fires are not so excessively destructive as in the eastern colonies, nor do they as there leave in ghastly deadness vast numbers of standing trees, after the burning element has swept through the woods; on the other hand the woods of West Australia are charming at all times, no lifeless trees disfiguring the landscape, all fresh and ever verdant with Zamias, Xanthorrhoeas, and Kingias remaining unimpaired by the scorching flames. Nevertheless, the bushy vegetation and underwood, and all kinds of herbaceous plants, are at least periodically apt to be annihilated in the woody country, when the bush ignites...".

Baron Ferdinand Von Mueller, 1879

The difference between east and west Australia in 1879 was that in the east, Aboriginal frequent patch burning had largely been abolished, but in the west, although the Noongar people had greatly declined, it was still widespread.

But suppose, when Europeans first settled in south-western Australia (1826 at Albany, 1829 at Swan River), there had been no other human inhabitants – truly a *terra nullius*. Knowing the undeniable inflammability of the vegetation (Moore 1884), the seasonal heat and dryness, summer easterly wind patterns, and the frequency of lightning strikes, what would have been the natural fire regime in the dry eucalypt (jarrah, wandoo, tuart) forest and woodlands? Would there have been only small, insignificant fires? Moderate sized, occasional fires? Or extremely large fires, trickling on for months in some cases, with occasional bursts of more extreme behaviour when heavier fuel was encountered, or the weather was extra hot and windy?

This paper outlines an hypothesis that, without human interference, either through ignition; or fire suppression; or by pre-emptive fuel reduction; or by creating barriers such as roads or farmland; the last of the above scenarios would have prevailed, and that the frequency with which fire visited any point would be determined, amongst other things, by the minimum period required for that vegetation type to accumulate enough dead matter to support a spreading fire.

Recent research into fire marks on long-lived grasstrees (Ward *et al.* 2001, Lamont *et al.* 2003) has given clear evidence that, before, and in the first few decades of European settlement, the dry eucalypt areas were burnt regularly every 2-4 years. This matches perfectly with remarks in the journals and letters of early explorers and settlers; the oral history of present Noongar Elders; the opinions of present day members of old settler families; and botanical evidence, such as the fact that all shrubs of the upland jarrah forest flower within 3-4 years of a fire, and that much of the eastern wandoo woodland had a grassy ground cover, which would burn every second year. There are some, however, who still try to refute both the grasstree evidence, and the historical evidence.

The original jarrah forest was about 4 million hectares, so a combination of Noongar and lightning fires would have had to burn at least a million hectares each year to maintain a 3-4 year cycle. It has been claimed, by a member of the Conservation Council of W.A. that this is impossible (Robertson 2003). This claim shows startling naivety about meteorology, fire behaviour, and actual fire history in Western Australia.

Given pre-European conditions, with no attempts at fire suppression, and no barriers such as wide roads, a single person, walking through the jarrah forest in the three summer months, could easily burn most, or even all, of it, wherever there was enough fuel to carry a running fire. Even recently, the potential for enormous fires has been shown. Fires burning for months in jarrah forest (in the 1920s), have been described by Wallace (1966)[1] and Quain (in the 1950s), in McCaw & Hanstrum (2003). A trickling fire from a single point of ignition can easily travel a kilometre a day, sometimes much more.

Although the fire season is a little longer, the native vegetation of the north-west of Western Australia is no more inflammable than that of the south-west, some might say less so. The difference between the two areas is that the north-west has far fewer humans, and fewer roads, farms, and urban areas to impede, or suppress fires. Satellite data (Committee on Earth Observation Satellites 2003) show that in 1993, 2 million hectares burnt, and in 1994, 9.2 million hectares burnt, through continuous fires during the eight month fire season. In 1995 2.5 million hectares burnt in August alone. Clearly, unimpeded fires can cover very large areas, which may be surprising to those with many theories about fire, but little real knowledge.

Given, in the south-west, a fire season of about a hundred days, there is potential for a few unimpeded fires, lit by lightning at the start of the season, each to travel over a hundred kilometres. Given the known pattern of wind changes as a high pressure cell moves into the Australian Bight, a million hectares could easily burn. Conservatively, a single ignition could burn, albeit patchily, about a quarter of a million hectares in three months, given the known pattern of hot spells and wind changes as high pressure cells advance into the Australian Bight. Phil Cheney's (1998) findings on flank-fires turning into very broad head-fires are very relevant to fire rate of spread and area burnt. If one fire could do that, what about half a dozen?

Recent mathematical exploration (Ward 2003) has suggested that, for a coterminous area of similar vegetation, divided into a mosaic of different fuel ages, given a modest number of ignitions (such as from lightning alone), and with no human suppression effort, there would be inevitable convergence on a cyclic R-phase mosaic, where R is the minimum return period for fire in that vegetation type.

As a concrete example, for a coterminous area of jarrah forest, where R=3 years (it may be otherwise in some parts), given no suppression, and, say, one ignition by

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1 *"... it is not unreasonable to assume that the forest was completely burnt through every 2-4 years. Even as late as 1925 the writer was able to observe three fires of this nature in unmanaged virgin forest east of Jarrahdale. These fires were alight in December and continued to burn until the following March."* (Wallace 1966).

lightning per year, there would be inevitable convergence, in a surprisingly few years, on a 3-phase mosaic, which would then continue to cycle, for example (1,2,3), (2,3,1), (3,1,2) and back to (1,2,3). This is exactly what many grasstrees stems show.

If fire were withheld, or suppressed, for R years or more, then a single ignition could burn the whole coterminous area, and so abolish the mosaic, leading to cyclic blanket burning of that coterminous area. It should be noted that a coterminous area can be perforated, and in the dry eucalypt areas such perforations would be rock outcrops, moist creek banks, steep south facing slopes etc. These are obvious refuges for those plants which have not adapted to frequent fire.

If this hypothesis is true (it needs much more testing through iterative modelling), then the implications are far reaching. For instance, with regard to fire frequency, Noongar ignitions may, over large areas, have been largely irrelevant. Most of the jarrah forest, except for the refuges mentioned above, would have burnt, from lightning alone, as a cyclic mosaic, with only 3 or 4 phases. This mosaic would, however, have been very coarse grained. Any single even-aged cell might have been tens, or even hundreds, of thousands of hectares.

The effect of Noongar ignitions, deliberate in time and place, would have been to create a finer grained mosaic, through pre-emptive burning in the earlier part of the season. Severe late summer or autumn fires would largely have been averted, and there would have been higher landscape diversity both of structure, and of dead matter ages (leaves,twigs,branches,logs - necrodiversity?), so promoting greater biodiversity, especially of invertebrates and fungi. The technique of sometimes lighting fast moving, wind driven strip fires (Harris 1882) would have created long buffers, so again, a finer grain mosaic.

There is historical evidence of Noongars doing early burning around berry patches, to protect them from later fires (Hammond 1933), and of Noongars beating out fires (obviously mild by today's standards) with green branches (Stokes 1846) to protect patches, possibly spear shaft thickets (Kelly 2000), which needed a decade or more to grow to a useful size.

A further implication of the hypothesis is that, while logging debris was (still is?), undoubtedly, the cause of some severe and damaging fires, the main cause of severe fires today is the prevention, through fire suppression, of convergence on the natural mosaic. While human life and property must, of course be protected, it might, if the hypothesis is true, be better, after lightning strikes, to "let burn" in remote areas, such as state forests or National Parks. This would give some terrible fires to start with (they are inevitable anyway), but would, eventually, settle down to a more moderate, cyclic regime. However, without any human intervention, by suppression or pre-emptive burning of buffers, the mosaic would be very coarse. Strategic suppression, or pre-emptive burning, would create a richer mosaic.

Grasstree data has shown, in some places, a marked decline in fire frequency at times of Noongar depopulation due to violence or disease, or such times as World Wars, when young men were absent. Although lightning would have been as common as ever, by that time there were many barriers to fire spread, such as farms and highways, greater human population, and fire suppression was more active and organised. By the 1920s motor transport and a richer road network would have allowed much faster access for fire crews, so fires would have been less likely to trickle on for months, although it seems some still did (Wallace 1966). It is worth noting that the main method of fire fighting up to the 1920s was by means of wet bags, or green branches (Brockway 1923). Forest workers were sent, sometimes alone, on a bicycle to tackle trickling fires[2]. Such an approach would be unthinkable today. Clearly something has changed, and it's not just the mode of transport.

To test the hypothesis, there is a need for intensive hypothetical modelling of coterminous fuel mosaics, running iterations with many different fuel arrangements, weather conditions etc. The coterminous part of a hypothetical fuel mosaic presented by Burrows (2000) has already been tested. Starting with 61 patches, ranging in age from 1 y.o. to "unburnt", and given the above assumptions, it converged, within five years, each with a single random ignition, to a cyclic mosaic of 1,2 and 3 year old patches. Empirical evidence is useful, but an analytical proof of the convergence may also be possible, or may already exist, through matrix theory, in particular that of ergodic matrices and Markov processes. This might be a suitable topic for an honours degree, or even Ph.D., in mathematics.

As a conservative approach, only ground spread has been considered, but obviously spotting must be built in, and will clearly increase the potential for fire spread. Once a satisfactory model is achieved, it should be tested on an actual example, such as the jarrah, wandoo, or tuart forest. This would involve GIS work, overlaying vegetation types, rainfall, topography, fire refuges etc. to determine coterminous areas. These may be many and small; few and large; or even one massive area. It would be interesting to see how the current road network, and farmland, might affect the size of coterminous areas of fuel. Following this, some ground truthing would be needed, allowing lightning fires to spread unrestrained, where and when it is safe to do so.

It is proposed to work this hypothesis into the form of a formal research proposal, which would need support in the form of mathematical and modelling expertise, GIS software, access to government records, and some transport later for field work. Various funding authorities will be approached.

It is noted that the West Australian government reportedly gave $5 million toward fire research after the recent eastern state fires. It is not clear where that money has gone, or to whom it is available, nor how priorities for fire research are determined. Those with real fire experience, and scientifically open minds, would probably regard the above as a top priority, but politicians or their advisers may not. In fact, they may have a motive to suppress it, if it threatened to upset suburban "green" voters, the media, or environmental ideologues.

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