Prescribed Burning, is it effective?

Emeritus Professor Don Bradshaw
School of Biological Sciences, UWA

A brief history of prescribed burning

- Charles Lane-Poole opposed burning the forest in 1918 but his successor, Stephen Kessell, initiated prescribed burning
- It thus predates the 1961 Dwellingup and Karridale fires, but the practice was consolidated by those events
- The original intent of prescribed burning was to limit the impact of wildfires on life and property, and to protect valuable timber in State forests.

Photo B Miller

- **There was no suggestion that this was a continuation of traditional Aboriginal practices, nor a replacement for wildfire, but a deliberate addition aimed at curbing wildfire by denying it access to fuel.**

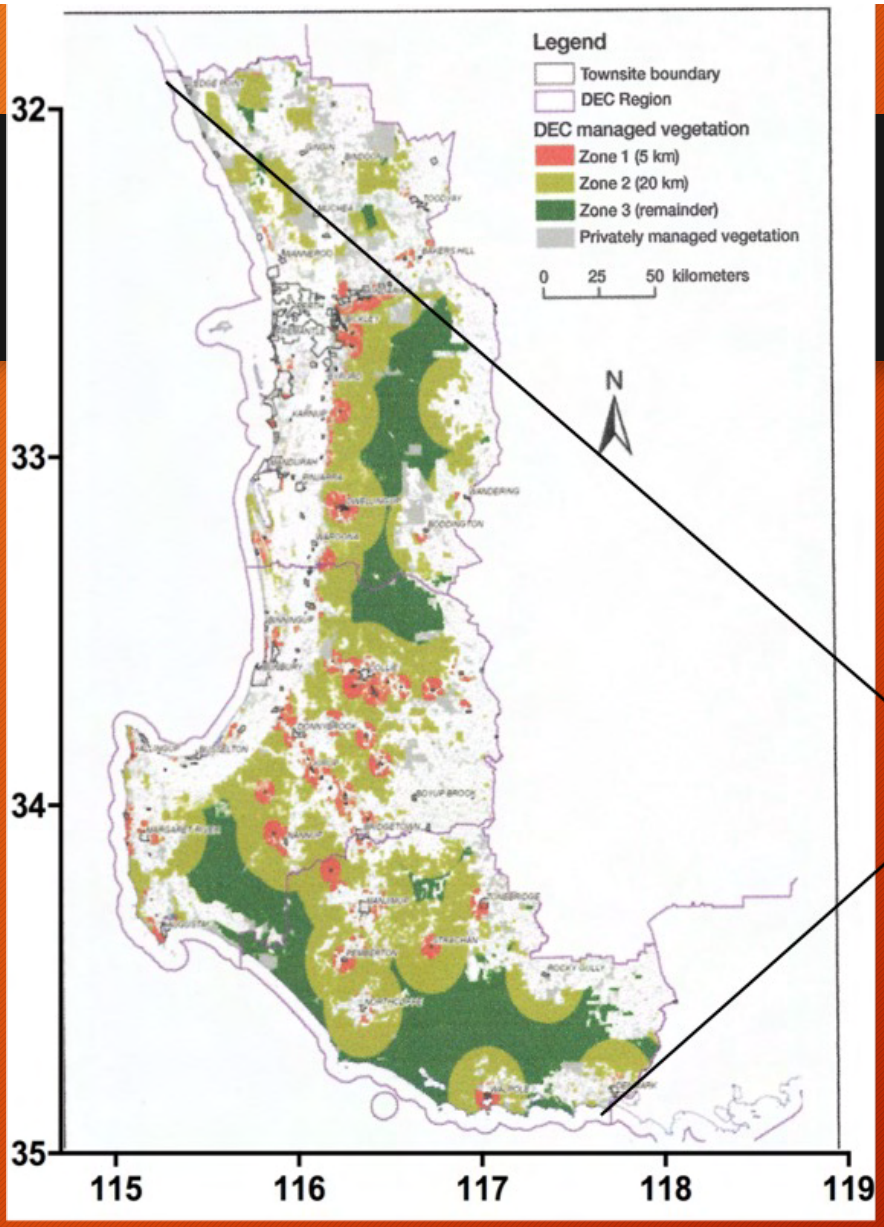
- **No consideration was given initially to protecting wildlife from fire, but by the 1980s, the pervasive imposition of fire in southwest Australia was being questioned for the first time in terms of impacts on the ecology and species of the biome and, in 1987 ….**
- ***"The Department will manage prescribed fire and wildfire on lands managed by the Department to protect and promote the conservation of biodiversity and natural values whilst also providing protection for human life and community assets."* (CALM, 1987)**

Current Practice

- The target of 200,000 ha to be burnt annually in the southwest of Western Australia was not arrived at scientifically but equated roughly to …"*the average program achieved in the mid 1950s of about 250,000 hectares, and the current actual achievement (in 1992-3) of 150,000 hectares"* (CALM, 1994).

- After the large fire at Waroona in Western Australia's southwest in January 2016 which partially destroyed the southwest town of Yarloop, the Ferguson Review recommended that:

- *". … the strategic objective will be that a fuel age of less than six (6) years will be maintained across 45% of the landscape on State Forest, National Parks and other Parks and Wildlife managed lands in the South West and Perth Hills" (Ferguson, 2017)*



What this means: 90,000 ha is for Zones 1 & 2 with 110,000 ha burned annually in Zone 3 (dark green) on a 6-year cycle

Prescribed burning

- Zone 3 (110,000 ha) refers to a ‘Biodiversity Management Zone’ where one third of the area would be prescribe burned at a frequency of <4 years, a further third at 4-7 years, and one third at >7 years (adapted from DBCA Annual Report 2016-17 and Burrows and McCaw, 2013)
- Very little Zone 3 will contain areas that have remained long unburnt

What was the fire frequency in the jarrah forest prior to European settlement?

- A careful study of burn scars in mature jarrah trees found that the frequency of large fires prior to European colonization was 81 years.
- In the karri and tingle forests it was 100+ years
- After 1829, with the settlement of Perth and the surroundings , the fire frequency in the jarrah forest increased to 17 years

- Burrows, N., et al. (1995). "Jarrah forest fire history from stem analysis and anthropological evidence." Australian Forestry **58**: 7-16.

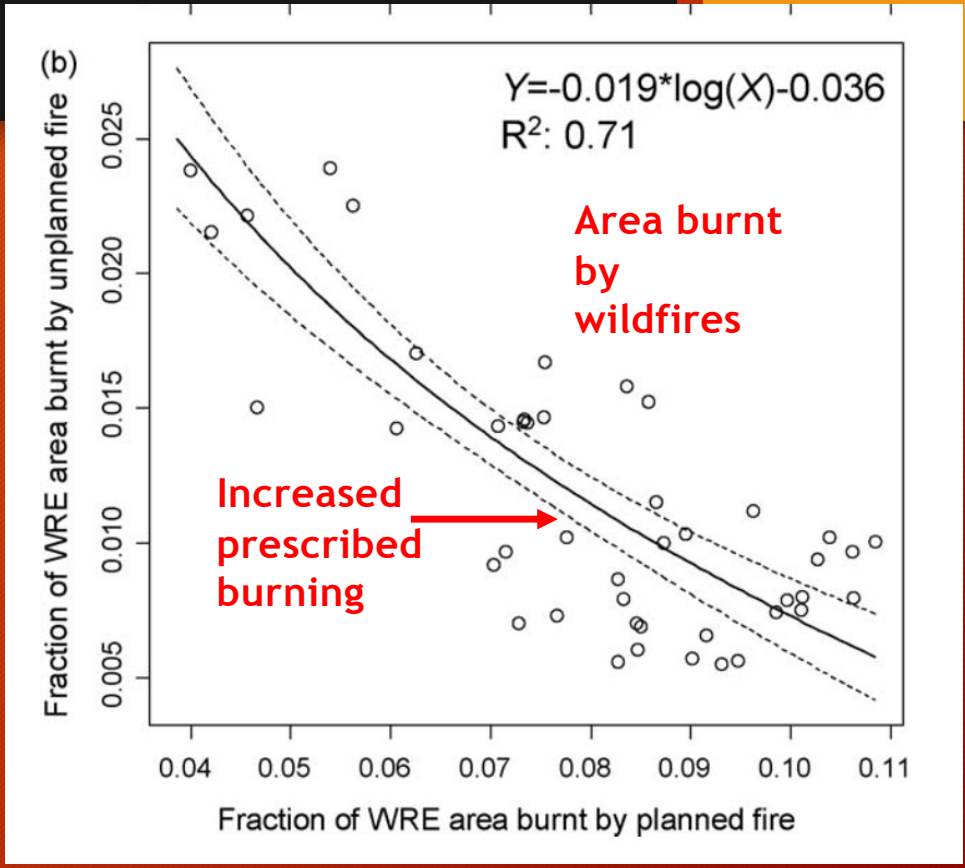
What is the evidence that prescribed burning prevents wildfires?

- Foresters maintain that, when approximately 8% of the bushland was burned annually, wildfires were less frequent (CALM, 1994)
- A long-term study by Matthius Boer and colleagues in the Warren District found that the area prescribe-burned correlated negatively with the number and the area burned by wildfires (Boer et al. 2009)

- Boer, M. M., et al. (2009). "Long-term impacts of prescribed burning on regional extent and incidence of wildfires - evidence from 50 years of active fire management in SW Australian forests." Forest Ecology & Management. **259**: 132-142.

Does prescribed burning reduce the impact of wildfires?

- From the slope of the line, which is -0.21, one can calculate the 'leverage' of the burning which is poor, with 4 hectares needing to be burned to 'protect' 1 hectare of bushland
- The effect of the prescribed burn also only lasts for a maximum of 6 years



However …

- A recent study* has re-analysed the data in the Boer et al (2009) paper and identified a number of flaws:
- The most serious was the way in which the correlation between PB and wildfires was calculated
- Averages over a 6-year window were calculated instead of year-by-year comparisons.
- This meant that the temporal link between PB and wildfires was lost so that, statistically, half the wildfires will have occurred **before** the PB!

- Campbell T, Bradshaw S D, Dixon K, W. & Zylstra P (2022). Wildfire risk management across diverse bioregions in a changing climate. *Geomatics, Natural Hazards and Risk* **13**, 2405-2424.

Calculating the Regression

- Showing the correct yearly stepwise way to assess the impact of a prescribed burn (PB) on subsequent wildfires (WF)
- Boer *et al* (2009) incorrectly graphed the average of PB and WF numbers over a 6-year window

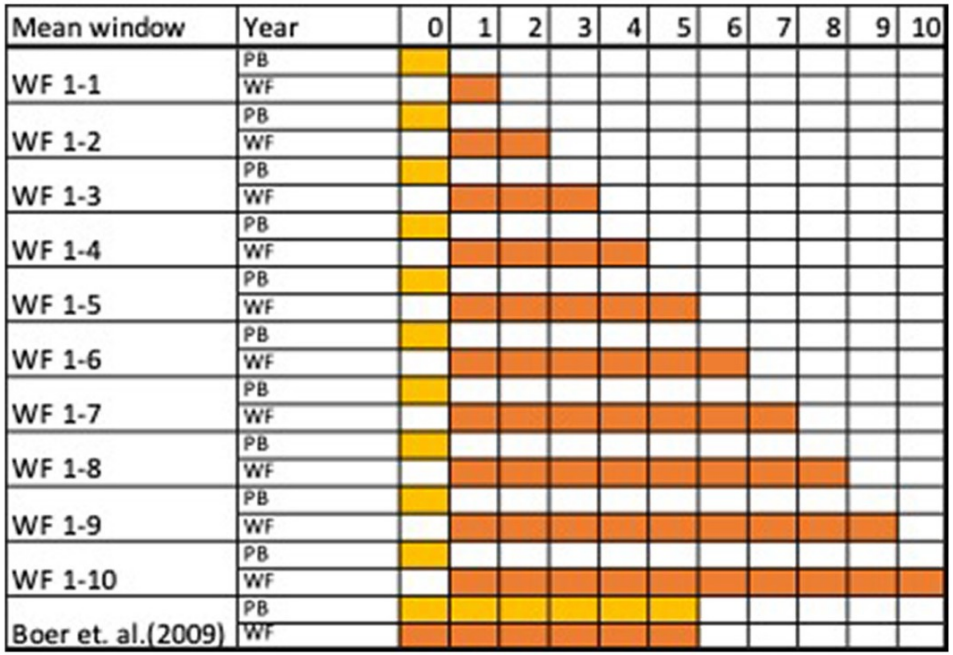
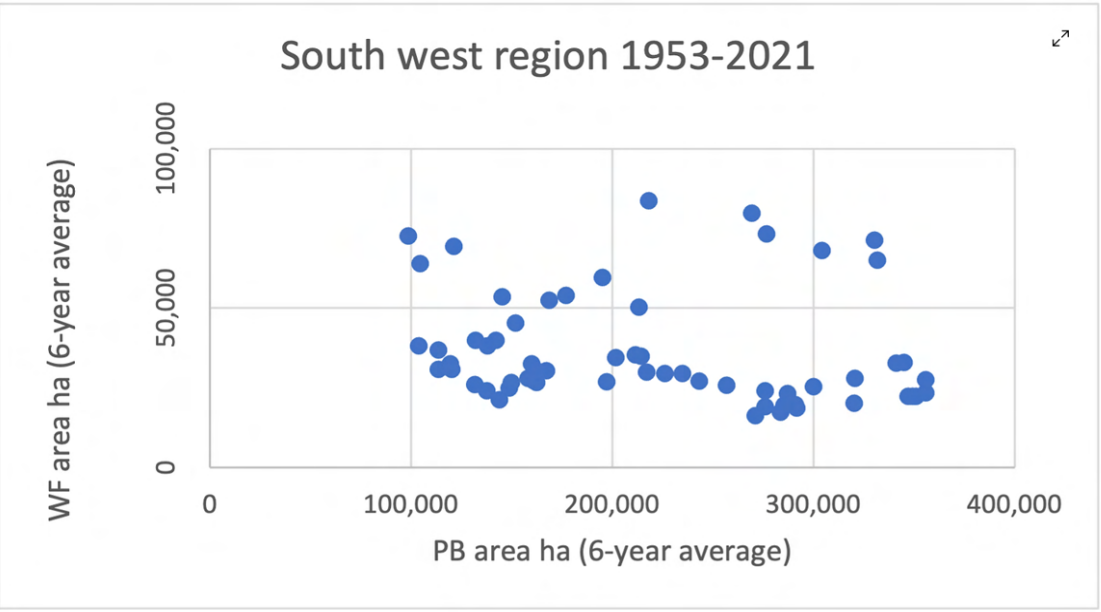


Figure 4. Graphical representation of time averaging windows used to calculate regressions between mean extents of prescribed burns and wildfires.

When corrected, there is no correlation between prescribed burning and wildfires



Note too, that the area being subjected to PB ranges from 100,000 to 350,000 ha, whereas wildfires impact on only 25,000 to 75,000 ha i.e. PB is having a much greater impact on the environment than wildfires!

Paradoxically, increasing fire frequency produces a more flammable landscape

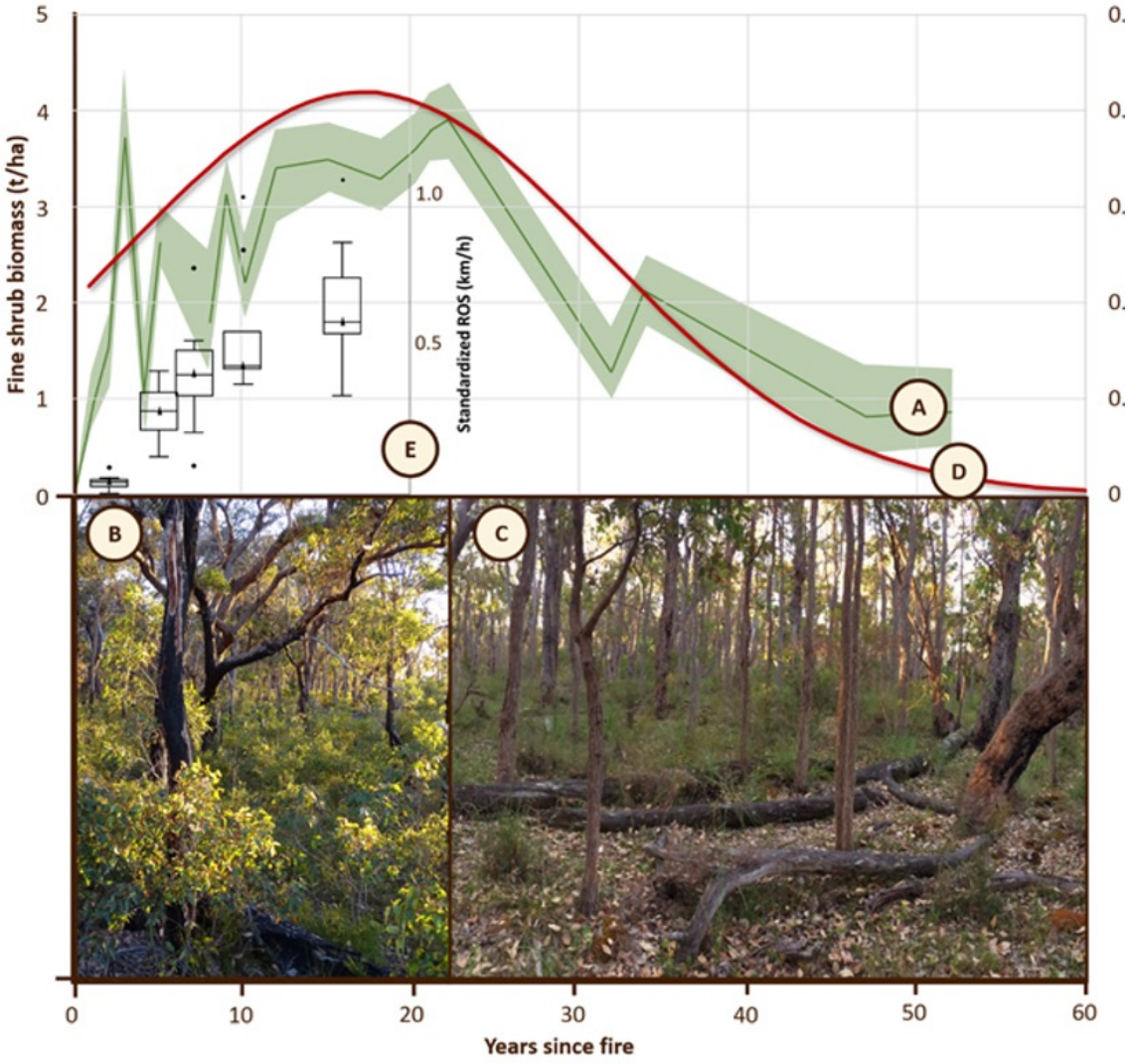
(A) Changes in jarrah forest understory with time after fire

(D) The annual likelihood of fire per hectare (Probability of Ignition at a Point , PIP) with time after fire

(B) Dense regrowth from a low intensity wildfire in jarrah forest

(C) Long unburnt jarrah forest with little understory vegetation

Zylstra, P., et al. (2022). "Self-thinning forest understoreys reduce wildfire risk, even in a warming climate." Environmental Research Letters **17** 044022.



DBCA were concerned at the implications of this paper by Zylstra *et al* (2022)

- A letter from the Director General of DBCA to a member of The Leeuwin Group stated:

…”***The arguments of Zylstra et al (2022) that flammability declines with forest age hinge on sparse and unreliable data derived from repeated sampling of a handful of unique and unrepresentative places, and do not correspond with practical experience and observation.”***

This was followed by the publication of a critical paper by Miller *et al* (2024)

- The paper argued that bias had been introduced in Zylstra *et al* (2022) by the 'rounding down' to zero of small areas less than 0.5ha in area and …
- By the reliance on a very small number of long-unburnt sites which functioned statistically as 'outliers'

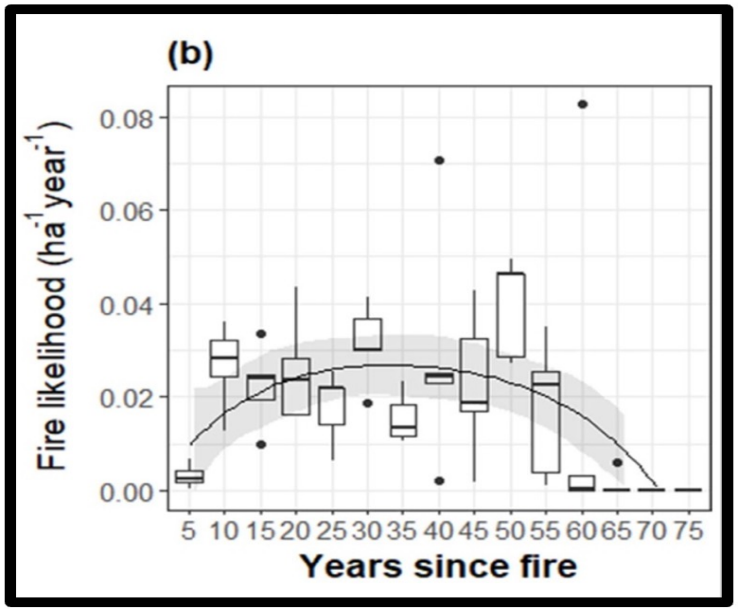
Miller B P, Fontaine J B, Tangney R, McCaw L, Cruz M G & Hollis J J (2024). Comment on 'Self-thinning forest understoreys reduce wildfire risk, even in a warming climate'. *Environmental Research Letters,* **19,** 068001.

Critically, Miller *et al* (2024) did not test their criticisms by re-running the data

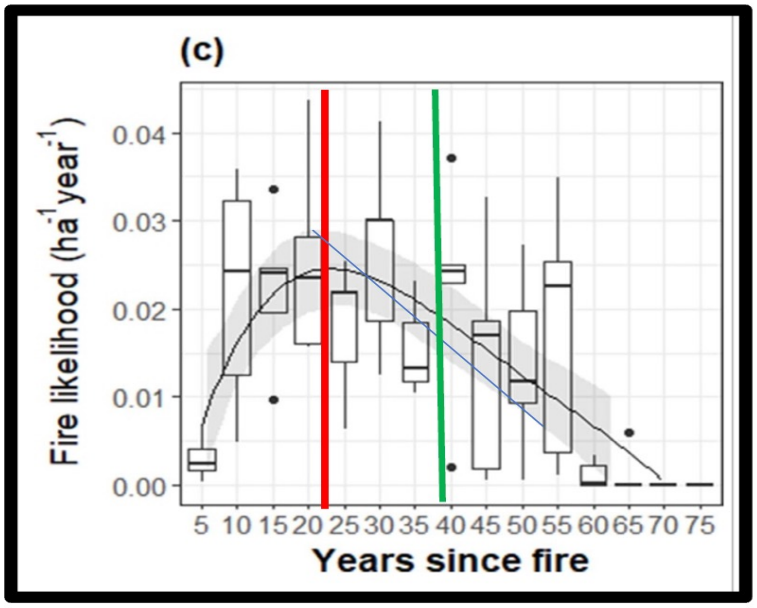
- In a response to Miller *et al's* paper Zylstra *et al* (2024) argued that just as many small values are 'rounded up' as 'rounded down' in the analysis and the process does not introduce bias, but only increases 'noise' in the data set
- We responded to the second criticism by deleting all the long-unburnt sites being accused as 'outliers' in the data set and published our response in 2024

- Zylstra P J, Lindenmayer D B & Bradshaw S D (2024). Reply to Comment on 'Self-thinning forest understoreys reduce wildfire risk, even in a warming climate'. *Environmental Research Letters,* **19,** 058001.

In fact, the change markedly enhanced the response



Data from our 2022 paper



Data from our 2024 reply, with outliers removed

The impact of prescribed burning

- Our (2024) analysis supports the conclusion of Zylstra *et al* (2022) that prescribed burning of forests increases their flammability through the rapid growth of an understory that peaks at 20-25 years after the fire (typically plants such as *Jacksonia* and *Acacia*)

- **These short-lived species 'die off' over time and flammability of the forests declines progressively to very low levels by 40-50 years**

What will happen to the age structure of the forests with future prescribed burning?

A huge increase in young, highly-flammable, forest with very few long-unburnt areas

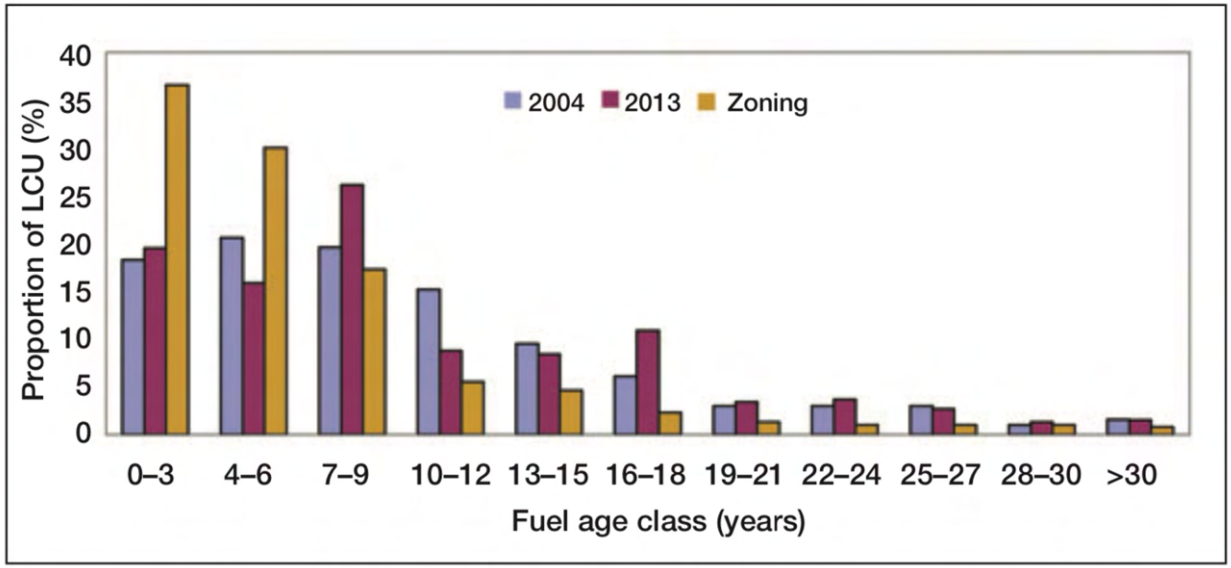


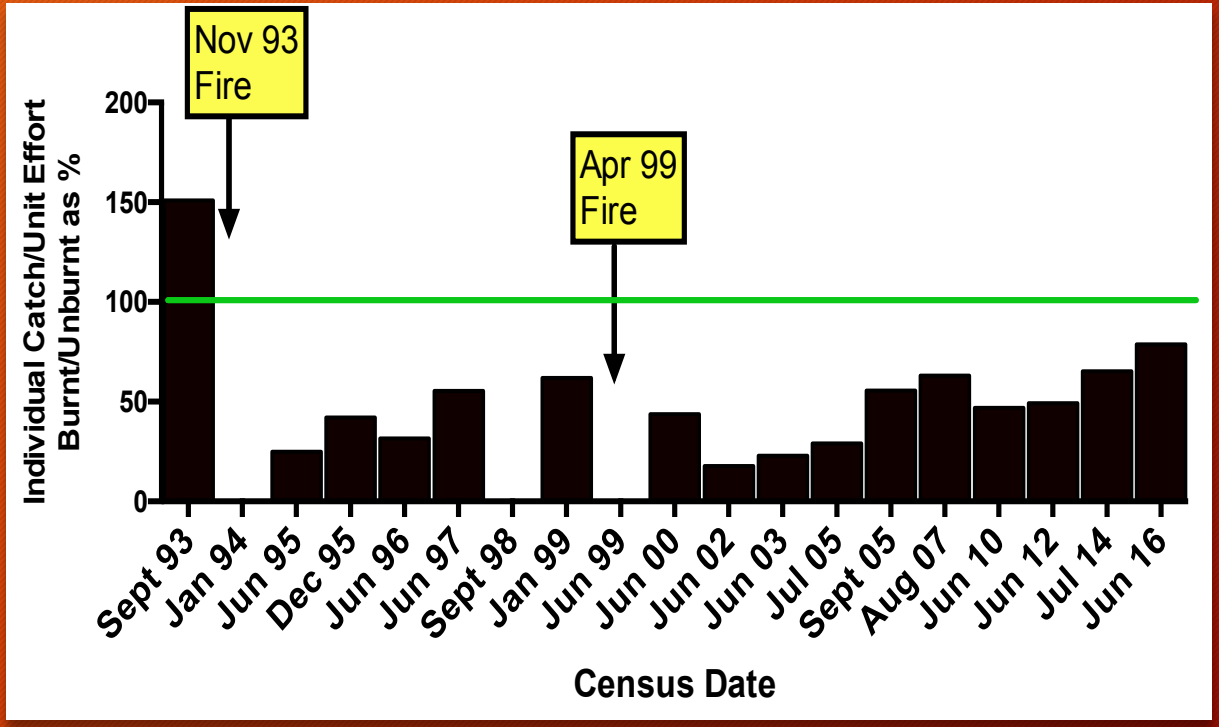
Figure 6. *Actual distribution of fuel age classes in 2004 and 2013 and the theoretical distribution under a zoning fire-management strategy (assuming 200 000 ha annually was prescribed burned) for the Central Jarrah LCU.*

How will this change in the age structure of forests affect Endangered Species?

Species	Critical Fire Interval
Tammar wallaby	25-30 years
Woylie	25-30
Honey possum	25.6
Quokka	30-40
Western Ringtail possum	>11
Numbat	25-30
Splendid Fairy-wren	>12
Red-winged Fairy-wren	>12
Mallee Fowl	20->55

For example, a long-term study of the impact of two CALM-lit fires 6 years apart on Honey possums in Scott National Patrk found it will take 25.6 years for the population to recover

- By January 1999 the population had recovered to just over 50% of pre-fire levels
- The second fire in April 1999 again killed all individuals north of the road and recovery was again slow, reaching only 75% of pre-fire levels by June 2016, 17 years after the second fire



Smoke and human health

- Fires produce smoke, which is composed of particulate matter. The larger particles are about 10 microns in size (PM_{10}) and the smaller, 2.5 microns in size ($PM_{2.5}$). Both are a health hazard with $PM_{2.5}$ being the most dangerous. The table shows that emissions from prescribed burns (PB) dramatically exceed those from Wildfires

Year	PM_{10}		$PM_{2.5}$	
	Wildfire	PB	Wildfire	PB
2018	5	15	3	17
2019	5	5	7	11
2020	1	11	4	25
2021	2	17	4	34
Totals	**13**	48	**18**	**87**

Greenhouse Gas Emissions

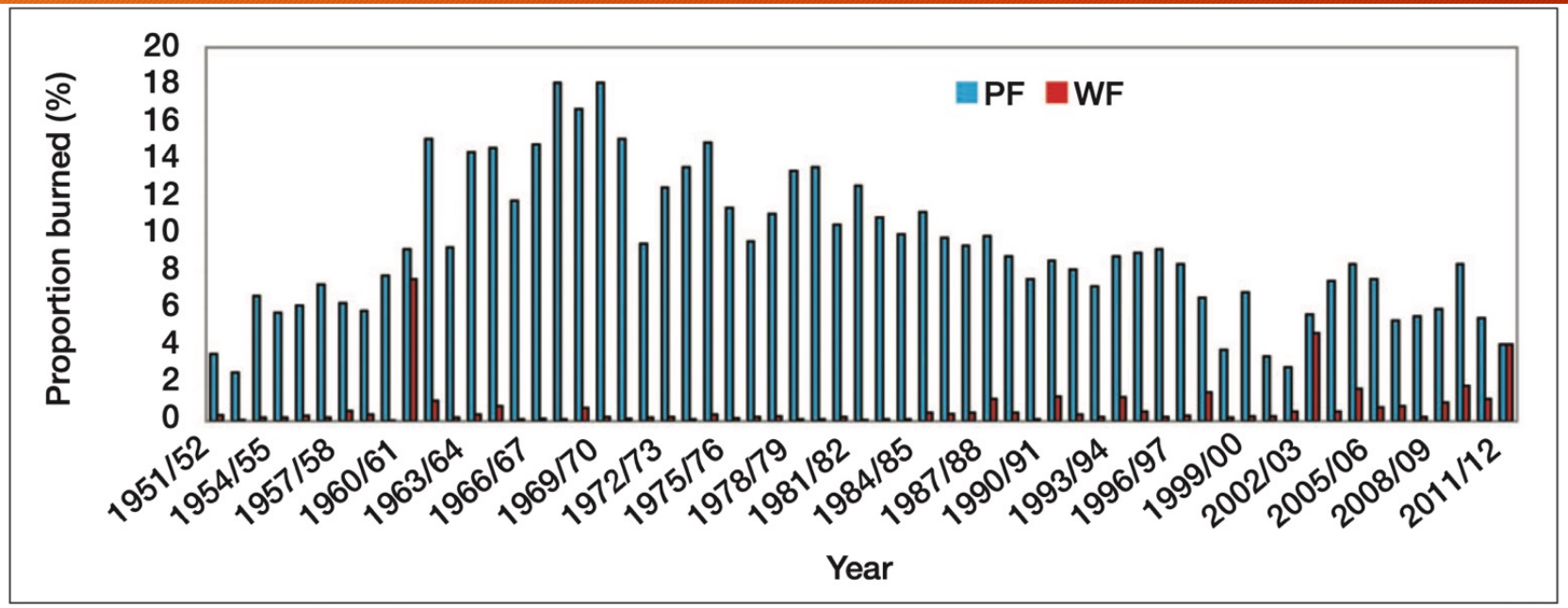


Figure 2. *Proportion of the southwestern Australian forest region (~2.5 million ha) treated with prescribed fire (PF) and wildfire (WF) per year since 1951–1952.*

DBCA Burning Data

Period	Prescribed Burns (PB)	Wildfires (WF)	Ratio PB/WF
1981-2002	4,548,456 ha	293,796 ha	15.48
2002-2023	3,293,325	911,603	3.61
Totals	**7,841,781**	**1,205,399**	**6.50**

Calculating Greenhouse Gas Emissions (GHG)

- GHG can be calculated from a figure of 40 tonnes/ha CO_2 for prescribed burns and 79 tonnes/ha for wildfires , the difference resulting from the increased patch area and fraction of biomass consumed in wildfires. This difference is more than compensated for, however, by the dominance of prescribed burns over wildfires. Prescribed burning over the period 1981-2023 resulted in a total of almost 314 million tonnes of CO_2 compared with 9.5 million tonnes from wildfires.
- **Prescribed burning of 200,000 ha every year in the southwest biodiversity hotspot thus results in the emission of approximately 8 million tonnes of CO_2 which is equivalent to almost 10% of Western Australia's total emissions of 83 million tonnes of GHG.**

What needs to change …

1. The current fire regime, with 45% of the forest bushland burned at less than 6 years, is highly detrimental to much of WA's unique bird and mammal fauna
2. Even 'cool burns' can be disastrous if account is not taken of vertical flame spread
3. The protection of long-unburnt habitats is essential for the survival of many of our iconic species
4. The current fire interval is based on the assumed protection afforded by prescribed burning but, recent research has shown that prescribed burning does not reduce the risk of wildfire in the southwest
5. There is no scientific basis for the burning of 200,000 ha of remote bushland every year in WA's threatened biodiversity hotspot and the target should be abandoned
6. The Leeuwin Group recommends that prescribed burning should be focused on protecting townsites and a priority placed on rapid detection and suppression, with a focus on the protection of long-unburnt habitats

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- Five examples of ‘escaped’ burns
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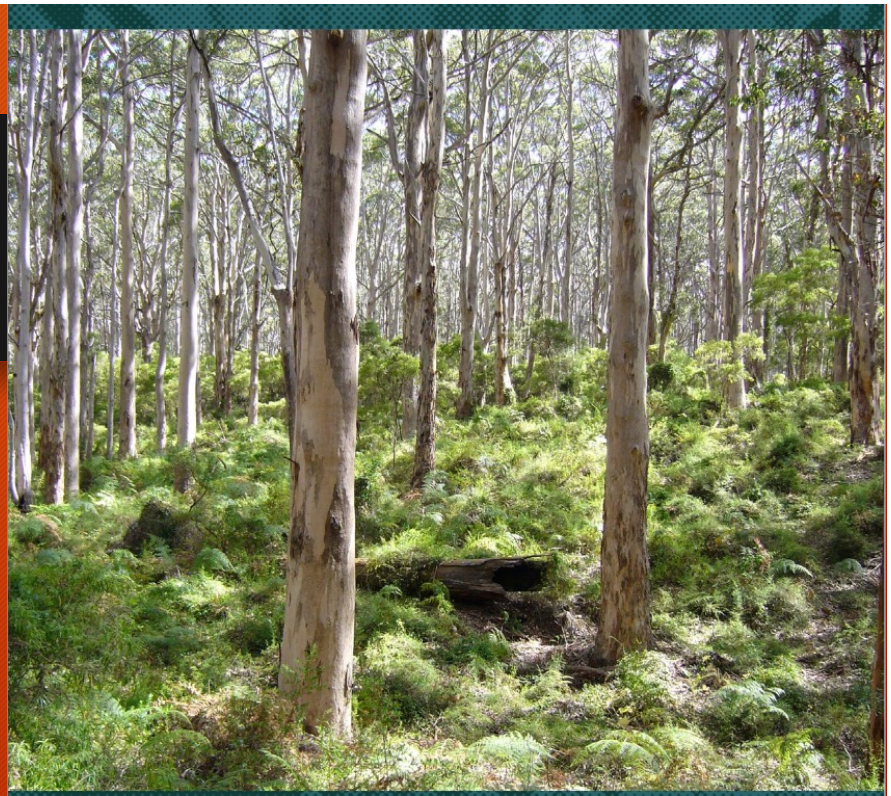
- Does Prescribed Burning Prevent Wildfires?
- Smoke and Human Health
- Politics of Prescribed Burning
- An Answer to the Question



To Burn, or Not to Burn

A Critical Perspective

By Emeritus Professor Don Bradshaw