

FIRE NOTE

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HISTORICAL PATTERNS OF BUSHFIRE IN SOUTHERN WESTERN AUSTRALIA

Bushfire patterns in semi-arid southern WA have changed, or are likely to change in future, as a result of increased human activity and climate change. Understanding these changes and the potential effects on ecosystems is important for fire management planning. Knowledge of fire history provides a baseline against which future fire regimes can be compared.

BACKGROUND

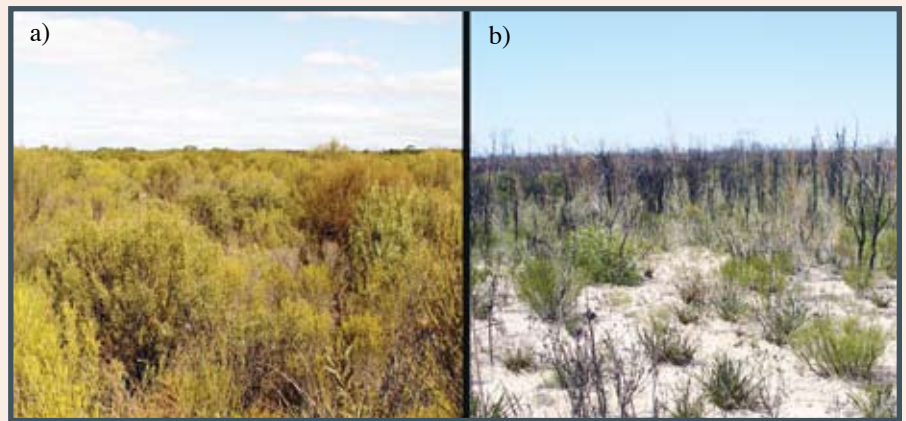
Bushfires are common in the semi-arid ecosystems of southern WA and can strongly influence ecosystem structure, composition, function, and long-term survival. There is increasing concern that changes to fire regimes as a result of human activities and a changing climate may lead to dramatic shifts in these ecosystem properties. Greater understanding of the natural range of variation in bushfire patterns in southern WA is needed to:

- 1) provide a benchmark to assess the significance of recent extensive fires
- 2) guide fire management of semi-arid ecosystems, and
- 3) understand and predict the potential impacts of human and climatic influences on future fire regimes.

BUSHFIRE CRC RESEARCH

The Lake Johnston region in southern Western Australia is unparalleled among most of the world's semi-arid regions in that it is relatively unaltered by human activities, including fire management. All fires that have occurred there in the past half-century are believed to have been ignited by lightning and only two of these are known to have been directly influenced by fire suppression activities such as back burning. This means that the Lake Johnston region offers a unique opportunity to study natural bushfire patterns.

The fire history of the 1.5-million-hectare study region from 1940 to 2005 was reconstructed by mapping fire areas visible in aerial photographs and satellite images, and



▲ a) Long unburnt (more than 50 years) and b) recently burnt (3 years) shrubland in the Lake Johnston Region, southern WA.

SUMMARY

This project aimed to develop an understanding of historical variation in bushfire patterns in semi-arid southern Western Australia. The study area incorporates part of the internationally significant Great Western Woodlands. Fire frequency and extent in the study area were strongly influenced by the distribution of major vegetation types, fuel ages, and natural fuel breaks such as salt lakes in the landscape, and by variation in climatic extremes over time. The results of this research can be used to guide fire management and predict potential impacts of climate change on bushfire regimes in southern Western Australia.

ABOUT THIS PROJECT

This research is from B1.1 Managing Fires in Forested Landscapes in South Western Australia and B 4.2 Multi-Scale Patterns in Ecological Processes and Fire Regime Impacts. Both projects are within Program B: Fire in the Landscape.

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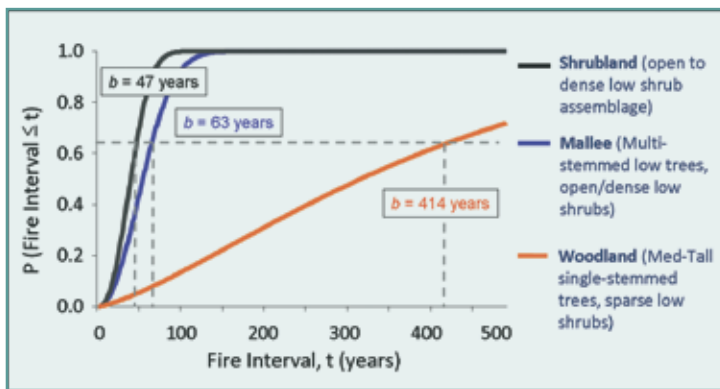
using dendrochronological techniques, which involve studying the growth rings of trees to determine the date of fire events. The analysis

determined: 1) historical 'natural' variation in bushfire frequency and extent, and 2) the influence of vegetation type, fuel age, climate, and topographic fire barriers such as salt lakes on patterns of fire frequency and extent.

RESEARCH OUTCOMES

The distribution of major vegetation types, fuel ages, and topographic fire barriers strongly influenced the time intervals between fires in the region. As shown in Figure 1, in eucalypt woodland, time intervals between fires were much longer than those in mallee and shrubland. Interestingly, the typical length of time intervals between fires in shrubland vegetation was similar to those of the Californian Chaparral (b = 33-61 years; Moritz 2003, Moritz et al 2009). [For an explanation of the Weibull formula on which Figure 1 is based, see 'Definitions' box.]

The study showed that the probability of a fire occurring in mallee and shrubland vegetation



▲ **Figure 1:** Cumulative probability form of the Weibull fire interval distribution for different vegetation types in the Lake Johnston Region, southern WA. Weibull 'b' (Shape) parameters represent the interval that will be exceeded 37% of the time (i.e. 63% of fires occur before time, t, from the last fire) and has been suggested as a measure of the characteristic time-scale of a fire regime (Moritz et al 2009).

increased with fuel age (time since fire). This suggests that immediately following fire, there may be an insufficient amount of fuels to sustain a fire, but increases in the amount and connectedness of fuels with age may lead to greater capacity to sustain fire spread. In contrast, the probability of burning in woodland vegetation appears to be relatively independent of fuel age. Woodlands were unlikely to carry fires, despite increases in fuel age, presumably because of an insufficient mass of fuels as well as large gaps in the distribution of fuels. However, some areas of woodland have been burnt by high-intensity fires within the study period.

The position of natural fuel breaks (i.e. lakes) in the landscape influenced the distribution of fires. Intervals between fires were significantly longer in areas adjacent to, or surrounded by, salt lakes than in more connected landscape positions.

Inter-annual (July-June) variation in rainfall and temperature strongly influenced the occurrence and extent of bushfires. Years in which small fires (covering less than 25,000 ha) occurred were not associated with extremes of climate. However, years of extensive fire activity (more than 100,000 ha) were typically associated with below-average rainfall and were preceded by a year of above-average rainfall and low temperatures. This sequence of cool-wet conditions followed by dry conditions may lead to extensive fire activity by promoting the accumulation and connectedness of fine fuels (i.e. grass, leaves and bark) and their subsequent drying.

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END USER STATEMENT

This research project directly addresses the need to better understand the role of fire in conserving and managing the Great Western Woodlands of Western Australia, an internationally significant area of great biological diversity covering almost 16 million hectares. Although the area is remote and sparsely populated, fire management is necessary to conserve biodiversity and environmental values while at the same time protecting local communities and mining camps, pastoral leases and critical infrastructure including roads, railways, pipelines and electricity transmission lines. This study makes an important contribution to informing fire management planning by documenting fire regimes at a landscape scale and over a long period."

– **Roger Armstrong,**
Senior Planning Officer, Fire Management Services Branch,
WA Dept Environment and Conservation

DEFINITION

Weibull:

In broad terms the Weibull distribution model is a statistical method of modelling the probable time period until failure of a particular regime. In fire research it measures the probability of fires occurring under certain conditions and in certain time periods.

HOW THE RESEARCH IS BEING USED

This project provides valuable insight for land managers into the historical range of variation in bushfire patterns. The fire history database generated by this project has been incorporated into a database maintained by the Department of Environment and Conservation WA to guide fire management in the south coast region, and is also being used by researchers associated with the Gondwana Link project to examine responses of vegetation to different fire frequencies (www.gondwanalink.org).

The findings indicate typical time-frames for the recurrence of fire in different vegetation types and provide guidance for land managers seeking to maintain or reinstate fire regimes to conserve the structure, composition, and function of vegetation communities in the region. This has important implications for the development of management plans for the long-term conservation of the Great Western Woodlands area (Watson et al. 2008) and for

the management of altered and/or fragmented bushland in the Wheatbelt region, where natural fire processes no longer operate.

Knowledge of the relationship between climate and fire activity also provides land managers with a basis to predict potential impacts of climate change on fire regimes in southern WA.

FUTURE DIRECTIONS

The project provides a quantitative understanding of broad-scale fire patterns in semi-arid shrublands and woodlands of southern WA. There is a critical need to develop a similar understanding of historical bushfire patterns in other Australian ecosystems, particularly those of conservation significance, to guide management and assess threats of human activities and climate change.

The findings of this research suggest that climate is a strong driver of fire frequency and extent in southern WA. Further research is needed to understand how predicted changes in climate and, subsequently, fire regimes will affect individual organisms and/or communities in this and other similar areas.

FURTHER READING

Moritz, M. A. 2003. Spatiotemporal analysis of controls of shrubland fires regimes: age dependency and fire hazard. *Ecology* 84:351-361.

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Watson, A. W. T., S. Judd, J. Watson, A. Lam, and D. McKenzie. 2008. *The extraordinary nature of the Great Western Woodlands*. The Wilderness Society of WA Inc., Perth, Western Australia.