WOODLAND

RECOVERY AFTER FIRE

A collaborative research project has investigated the changes that occur in gimlet woodlands following burning by large, high-intensity bushfires, revealing just how long these ecosystems take to recover. The information is being used to support improved ecological fire management in the Great Western Woodlands.

by Carl Gosper, Suzanne Prober and Colin Yates

The eastern Wheatbelt and Goldfields are renowned for their iconic woodlands – decorated by the various hues of eucalypt trunks which colour the landscape with pink, orange and silver, depending on the species and time of the day. Along with the more well-known salmon gum (*Eucalyptus salmonophloia*), gimlet (*E. salubris*) is a common tree in the woodlands. Its smooth bark ranges in colour from a blazing orange when fresh in autumn (especially when viewed in the dawn or evening sun) through to bronze at other times of year, and the fluted trunk often bulges and twists into a variety of remarkable shapes. While gimlet woodlands in the Wheatbelt have been reduced to isolated remnants, extensive areas remain in the Great Western Woodlands (GWW).

The GWW is an internationally significant area with great biological and cultural richness, arguably comprising the largest and most intact area of temperate woodland remaining on Earth. It extends across approximately 16 million hectares from Southern Cross east to Balladonia, and from Norseman north to Kalgoorlie. It is globally unique among Mediterranean-climate regions in terms of the extent and stature of woodlands occurring at such low mean annual rainfall (200–350mm), with trees regularly exceeding 20m in height and 1m in width (see 'The Great Western Woodlands,' *LANDSCOPE*, Summer 2010–11).

Like other Mediterranean-climate regions, and indeed most terrestrial WA ecosystems, the woodlands are subject to recurrent fires which shape the landscape affecting species composition, diversity and structure of vegetation. Fires burn most frequently in the Great Western Woodlands' diverse shrublands and mallee vegetation, where fuel, made up of leaf litter, twigs, bark and standing vegetation, is most continuous. In contrast, mature eucalypt woodlands are less prone to

Left Morning light illuminates gimlet bark.
Photo – Sallyanne Cousans
Inset Fire in the gimlet woodlands.
Photo – Lachie McCaw/Parks and Wildlife

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burning because of their open tree canopy structure and patchier distribution of shrubs and litter. However, mature woodlands will burn during severe fire weather when conditions are very hot, dry and windy and when flame lengths are longer and can bridge gaps between the patchily distributed fuel. In the past few decades, a number of very large fires (more than 100,000ha) have collectively burnt a substantial proportion of the GWW. These fires have impacted people and their assets, and concerns have been expressed about the impact of the fires on the region's biodiversity, especially for the iconic woodlands. Previous research in mallee and shrubland vegetation in the region (see 'To burn or not to burn,' *LANDSCOPE*, Summer 2010–11) has shown that these ecosystems are resilient to burning by recurrent fires providing they don't occur more often than every 30 to 40 years. However, much less is known about how long it takes for woodlands to recover following burning by high intensity fires and how vulnerable recovering woodlands are to burning again before they have matured.

This knowledge is critical for fire planning and management of the GWW. A collaborative partnership between Parks and Wildlife and CSIRO Land and Water Flagship has been investigating these topics to improve the scientific basis of ecological fire management in the area.

HOW OLD ARE THE TREES?

A crucial first step to understanding the recovery of gimlet woodlands after fire was to develop a method to age gimlet stands, as it was apparent that many woodlands had not burnt in the time covered by records and remotely-sensed Landsat (satellite) imagery. Developing a method to age long-unburnt stands helped answer two important questions. First, the current age-class structure (the proportion of the vegetation in different time-since-fire classes) of gimlet woodlands could be estimated and provide insight into whether recent extensive bushfires in the woodlands were unprecedented. Second, it enabled the establishment of a chronosequence (sites sampled concurrently but of different times since the last fire) which provided the basis for research into temporal changes and how the woodlands recover over time since fire.

Top Gimlet woodland near Lake Johnston. *Photo – Suzanne Prober/CSIRO*

Far left A view from a rocky outcrop over the extensive woodlands of the GWW.

Left *Grevillea acuaria*.

Above A trunk section of a sapling gimlet showing the unusual fluted trunk shape and the growth rings used to estimate plant age. *Photos – Carl Gosper/Parks and Wildlife*

Gimlet has very thin bark and is killed by the intensity of fires typical of bushfires in the woodlands. There is no evidence that mild surface fires in eucalypt woodlands in the GWW have occurred in recent decades, and local Ngadju people report that they did not usually burn woodlands. Therefore, we can conclude that the tree age is unlikely to be greater than the time since the last bushfire.

In gimlet stands burnt in the time covered by the Landsat record (from 1972 to present), growth ring counts were made on trunk sections and compared to the known time since the last fire. This confirmed that growth rings formed annually and could be used to estimate plant age. The tendency for gimlet to develop hollow trunks precluded the use of growth ring counts to estimate the age of trees more than about 100 years old. So the age of older trees was determined from a model estimating growth ring count from tree diameter.

The oldest stands sampled were thought to be more than 300 years old so it can be concluded that mature gimlet woodlands in the GWW have not experienced bushfire for at least several centuries. By this calculation, gimlet woodlands are thought to be among the least-frequently burnt eucalypt-dominated communities nationally, on par with the tall and wet ash forests of south-eastern Australia. This was a remarkable finding given the context of these woodlands, which occur in a relatively flat landscape with limited topographic barriers to fire spread, regular occurrence of severe fire weather and being distributed in a mosaic with shrublands and mallee that burn much more frequently.

POST-FIRE SUCCESSION

To study changes that occur among the plants and animals of gimlet communities after fire, we established a chronosequence along the western edge of the GWW, sampling sites ranging in time since fire from two to more than 300 years. In the hundreds of years after a fire, gimlet communities pass through an ordered vegetation succession before they return to the iconic open woodlands characterised by large, widely spaced trees.

In the years immediately following fire, dense regeneration of gimlet and other obligate seeding plants becomes established, taking advantage of lower levels of competition in the absence of mature trees. A range of post-fire ephemerals also feature in the above-ground vegetation. Several decades later the dense gimlet regeneration grows to a size in which competition for light and water between individuals becomes intense. Diversity in lower vegetation layers declines, presumably suppressed by competition from the dominant canopy trees. Peak canopy and litter cover is reached, which suggests that regenerating woodlands may burn under milder weather conditions than mature woodlands, although this is yet to be tested experimentally. After a protracted period of intense competition occurring over more than 100 years, gradual thinning of sapling gimlets enables surviving individuals to increase in size while ground-layer plants can exploit increasing availability of light and water such that mature woodlands have unique composition and maximum plant richness and evenness. This pattern of change in diversity with time since fire, being high in recently burnt and long-unburnt woodlands but lower over the intervening period, is rare throughout the world.

Similarly, animals exhibit predictable post-fire changes, albeit largely in response to the changes in vegetation composition and structure rather than due to the passage of time since fire itself. Ant species that thrive in hot conditions favour the more open habitats of recently burnt and long-unburnt woodlands, where canopy and litter cover is lower and exposure to the sun at the ground surface is greater. In contrast, groups of ants that favour less-exposed habitats are more prominent at intermediate times since fire, mirroring the non-linear post-fire changes in canopy and litter cover.

It would have been impossible to document these multi-century changes in plant and animal communities based solely on the remote sensing record, demonstrating the importance of developing alternative methods for describing the fire history and guiding landscape fire management in infrequently burnt communities like gimlet woodlands.

WHAT DOES THE FUTURE HOLD?

Gimlet woodlands are resilient to very occasional bushfires. However, increases in the frequency of bushfires or in their extent across the landscape are likely to have substantial adverse implications for the conservation values of gimlet woodlands, due to the very long period over which post-fire recovery occurs. Climate changes are predicted to increase the incidence of weather conditions conducive to bushfires, which may lead to greater frequency and extent of bushfire, although how changes in weather interact with changes in the rates of fuel accumulation makes predicting future fire regimes uncertain. If an area of woodland of an intermediate length of time since fire is indeed more flammable as the changes in canopy and litter cover indicate, replacement of mature woodlands with intermediate time-since-fire woodlands may instigate a self-reinforcing fire regime shift favouring larger and more uniform fires. This would be detrimental for mature woodlands, which have important conservation and cultural values.

Fire management by Parks and Wildlife in the GWW aims to maintain long-unburnt woodlands. To this end, a number of fire management initiatives have been recently implemented or are planned. Fire management infrastructure has been upgraded to enable more rapid and safer access to prescribed and unplanned fires. Landscape fire management trials and research are ongoing to operationally test the feasibility of lowering fuel loads in surrounding shrublands to reduce the occurrence and intensity of shrubland fires under the severe weather conditions when such fires can spread into woodlands. Opportunities to increase the involvement of traditional owners in fire management are also being explored. This aims to instil a degree of ownership in fire management on country and enhance local capacity to respond quickly to unplanned fires, potentially containing them before the occurrence of more severe fire weather initiates more rapid and less containable fire spread.

Above Banks Rock, GWW.
Photo – Marie Lochman

Experiencing the beauty of gimlet woodlands...

There are many opportunities for people to get out and explore the Great Western Woodlands. Walks and drives through magnificent stands of gimlet or other eucalypt woodland communities lead visitors on a journey to discover the area's Aboriginal and colonial history, geology as well as its many fascinating and spectacular landscapes. If you're lucky, you might come across some curious native animals along the way. Camping spots include the proposed Credo and Jaurdi conservation reserves and Peak Charles National Park (all managed by Parks and Wildlife), and touring routes include the Granite and Woodlands Discovery Trail, Golden Quest Discovery Trail, Green Trail and the Golden Pipeline Heritage Trail. See www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-western-woodlands for more information and tips for safe travel or grab a copy of *Guide to the Great Western Woodlands* from shop.dpaw.wa.gov.au, from Parks and Wildlife offices and good bookshops for $29.95.

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