

Pirra Jungku: How the loss of traditional fire management has changed desert fire regimes

In brief

Summary in Karajarri language (by Jess Bangu)

Yulpurujangka photo ngangara kankarajangka jungkujangka Karajarrikura ngurrangka, kulurrangujanga pirranga nangn jungku janjaja rangersju kampanya. Kulurrangujku kampayana wupatu jungku. Jauja nangu jungku kampanya wupatu jauja, wartujangka jungu kamanya ngurra wakay. Nangujanga wupatajanga jungku kuwi nyangara malurrangu, nganinaku warrkamku.

Indigenous people have used traditional fire management practices in Australia for thousands of years. In desert landscapes, regular, intentional burning of many small-scale fires created a fine-grained mosaic of post-fire regrowth patches that may have limited the spread of the massive wildfires that are common today in these regions.

This project focuses on the traditional lands of the Karajarri people of the north-western deserts of central Australia, and was instigated by and co-designed with the Karajarri Rangers, with oversight by senior cultural advisors.

We aimed to understand how loss of traditional Indigenous fire management practices over time has impacted landscape-wide changes to fire regimes. We compared contemporary satellite imagery with aerial photographs of Karajarri Country from the 1940s, when Karajarri

people were still living in the desert, and traditional fire management practices were still in use.

We found that Traditional Owners exerted a strong influence on historic fire patterns in the region, at least during years of average rainfall. Fires in the late 1940s were smaller, more numerous and dispersed at a finer grain across the landscape; the fire frequency was about half of what it is today, and the extent

of longer unburnt vegetation was greater. Those patterns have now been replaced by a larger-grained mosaic of fewer, larger fires burning more frequently, which may have significant implications for biodiversity in these desert regions.

This study can help inform contemporary fire management objectives to shift fire regimes so that they more closely resemble historical patterns.



Sheen, Gulu, Sarah and Jacko during a vegetation survey. Image: Phoebe Martin



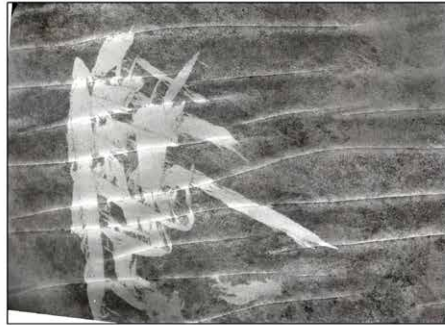
LEFT: Marissa setting up a camera trap along a drift fence. Image: Nicolas Rakotopare

Background

Australia is the most fire-prone continent, with fire playing a dominant role in shaping many of Australia's ecosystems over evolutionary time scales. Many species are adapted to fire or tolerant of it, surviving fires well to rapidly recover their populations. Indigenous people managed fires intensively for a range of resource management and cultural purposes for millennia.

The loss of Indigenous fire management across the deserts of Australia, where fire is a particularly dominant disturbance, along with the spread of introduced herbivores and predators, is associated with substantial biodiversity loss in these regions. Traditional fire management created a complex fine-grained mosaic of post-fire growth stages, known as seral stages, that may have benefited some plants and animals and limited the spread of the extensive wildfires that are common today. Reinstating desert fire regimes that replicate traditional burning practices is a common objective in contemporary conservation planning.

However, the extent to which traditional burning in arid ecosystems affected fire regimes across space and time is contested.



ABOVE: a) Photos of fire scars in Desert Country taken from a plane in the 1940's. b) How we mapped fire scar patches using the age of vegetation. Credit: Ed Blackwood. Imagery provided by National Library of Australia

Burning may have produced fine-scale mosaics only in localised areas rather than over the whole desert landscape, and any fine-scale mosaics may have been ineffective at preventing the spread of the very extensive wildfires that follow the widespread and prolonged rainfall that occurs infrequently and irregularly in the deserts.

Reconstructing the influence of traditional management on landscape-scale fire regimes is challenging. Three types of evidence have been used to describe the nature and scale of traditional burning: first and second-hand accounts of Indigenous people, information in European explorers' diaries, and analysis of aerial imagery from the 1940s to 1960s. Each has its own interpretational problems. First-hand knowledge of Indigenous people is available from localised areas or is incomplete.

Observations by explorers lack context on the purpose of fires and were not always systematically made. Finally, archived aerial imagery was collected intermittently, only overlapping with people living on country over a short window, and only in parts of the continent.

People left the northwestern deserts for coastal settlements relatively late; the last Karajarri desert nomads left their country in the 1960s. The earliest aerial photography for this region, from the 1940s, pre-dates this departure, providing an opportunity to document the effect of traditional burning on desert fire regimes. This project focused on the traditional lands of the Karajarri people and was instigated by and co-designed with the Karajarri Rangers, with oversight by senior cultural advisors.



The dwarf bearded dragon (*Pogona minor*). Image: Nicolas Rakotopare



The desert spadefoot frog (*Notaden nichollsi*).
Image: Sarah Legge

Research aims

The project aimed to support Karajarri Ranger and Traditional Owner's fire management goals by describing fire patterns in the desert when people were still living on desert Country. We also aimed to contribute to knowledge about the role of Indigenous people in shaping fire regimes in desert ecosystems.



Kamahl and Moonie recording survey data. Image: Nicolas Rakotopare

What we did

The study was completed on the Karajarri Indigenous Protected Area (IPA) south-west of Broome, with the study area stretching from the west coast to the Great Sandy Desert. The study area covers 18,000km².

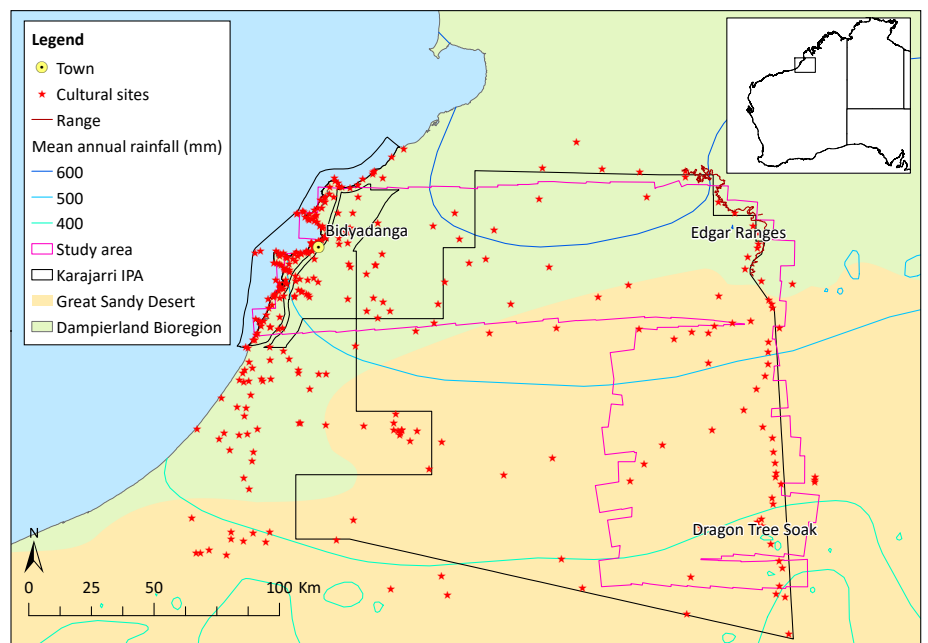
We used archived aerial imagery from the late 1940s to describe fire patterns at local and landscape scales and compared these historical fire patterns to contemporary fire patterns, described using high resolution Sentinel satellite imagery. If Karajarri people were managing fire intensively, and this fire management was effective at influencing landscape scale fire patterns, we expected to find differences in a range of fire pattern metrics between the 1940s and today. We also explored whether traditional fire management was focussed on localised areas rather than occurring across the landscape, by examining fire pattern metrics near and far from sites of cultural significance.

Fire scar patches up to several years old could be mapped and 'aged' from both the aerial and the satellite imagery. We compared fire patterns

based on a number of spatial characteristics. These included average patch size, distance between neighbouring patches, number of patches for each age class, areal extent of seral stages, and fire frequency. We used a map provided by Karajarri Traditional Lands Association to analyse fire patterns around cultural sites in the 1940s and made comparisons to

fire patterns in areas away from these sites. We also incorporated the north to south gradient of rainfall on Karajarri Country to analyse the influence of rain on these fire patterns.

In this work, the Karajarri Traditional Lands Association partnered with researchers from The University of Queensland, the Karajarri Rangers and Environs Kimberley.



Location of study area in north-western Australia. Credit: Ed Blackwood; Cultural mapping provided by Karajarri Traditional Lands Association; Spatial data from Geoscience Australia, BoM, DAWE.

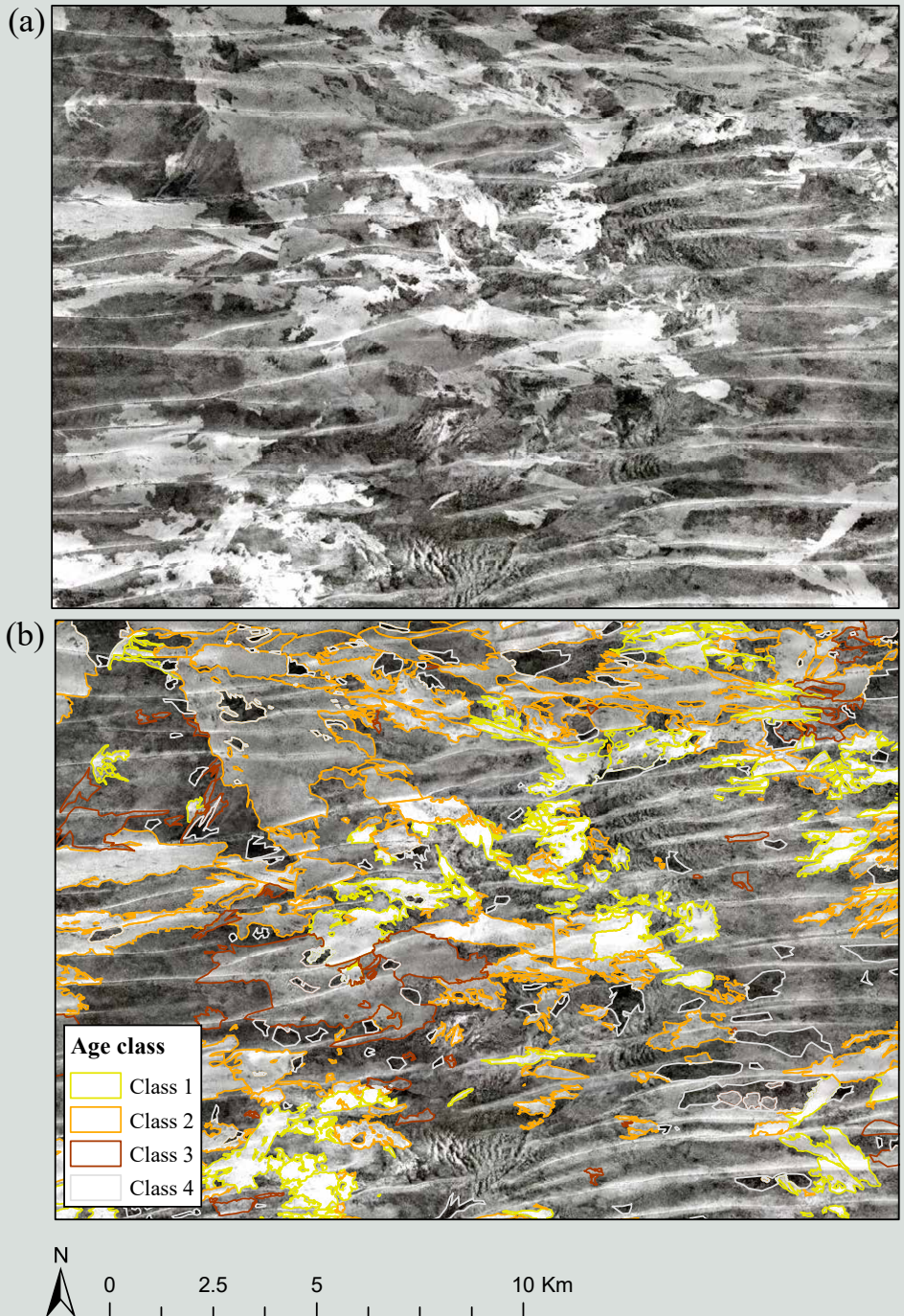


Key findings

We found that in the 1940s, Traditional Owners were exerting a strong influence over fire regimes, and that fires were more numerous, smaller and dispersed at a finer grain across the study area than they are today. The fire frequency was lower, and the areal extent of older post-fire vegetation classes was larger.

- In the 1940s, the average patch size was 49.4 ha and the largest patch was 6,420 ha, while under the contemporary regime it is over 10 times larger at 582 ha, with the largest patch being 63,700 ha.
- Fire patches of the same post-fire age were on average 367 m apart in the 1940s; under the contemporary regime this increased to 555 m.
- In the 1940s, fires typically occurred every five to six years, and this was reduced to every three to four years in contemporary times.
- The most common post-fire vegetation age was four or more years in the 1940s, covering 87% of the study area. In contemporary imagery, the most common post-fire vegetation age was 2-3 years, and this covered 68% of the study area.

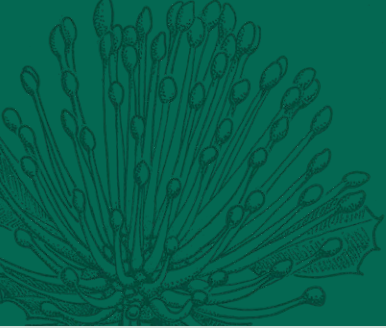
Rainfall has increased over the past several decades, and this could explain some of the fire pattern changes. However, rainfall has increased from an annual average over the preceding decade of 405 mm in 1949 to 591 mm in 2020, which lies within the gradient of north to south rainfall experienced on Karajarri country in recent years, yet the fire patch size of the driest areas now was still much



ABOVE: a) Photos of fire scars in Desert Country taken from a plane in the 1940's. b) How we mapped fire scar patches using the age of vegetation. Credit: Ed Blackwood. Imagery provided by National Library of Australia

larger than the fire patch size of the wettest areas in the 1940s, suggesting that rainfall increase alone cannot explain the fire pattern changes we observed.

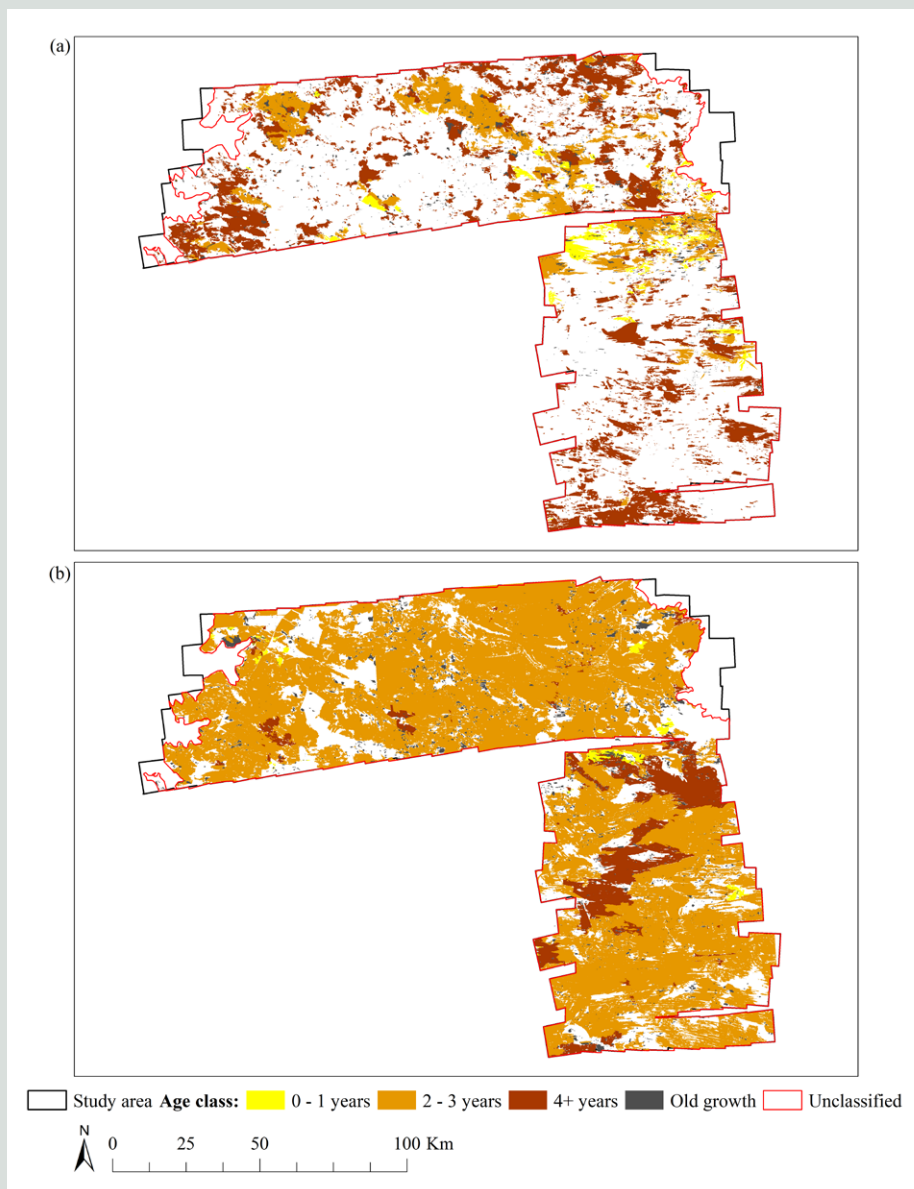
Our study showed that rainfall affected components of the fire regime differently in the 1940s.



Key findings (continued)

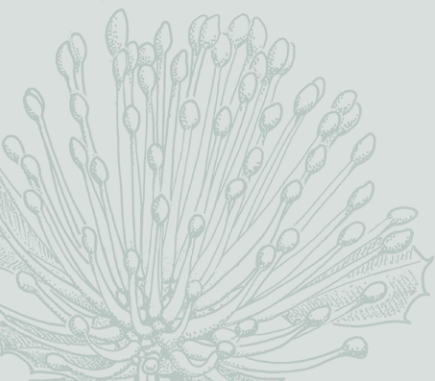
During the 1940s, patches were larger and closer together in higher rainfall areas, nearest to the coast, than in lower rainfall areas. In the contemporary period we saw the opposite trend. Patches in the higher rainfall areas were smaller, with larger distances between them than in lower rainfall areas. These differences could be due to a spatial shift in human activity, as people have moved off the desert lands and are now concentrated near the coast, in Bidyadanga, the outstations and on the pastoral leases. These areas likely experience more intensive prescribed burning and fire suppression activities as a consequence. Conversely, large wildfires are more able to spread across the remote desert regions.

The fire patterns around cultural sites were similar to fire patterns across the broader landscape. This could mean that Traditional Owners were burning the entire landscape evenly. Alternatively, the cultural site mapping has some positional inaccuracy and is incomplete, which could have undermined our comparison. It is also possible people may have visited, or burnt, regularly at some sites but not others.



ABOVE: The fire scars showed that in the 1940's (the top map) (a) fires were smaller, more spread out, and happened less often than now (the bottom map) (b). Credit: Ed Blackwood

RIGHT: Beno doing a vegetation survey.
Image: Nicolas Rakotopare





Bayo checks a funnel trap. Image: Sarah Legge



The desert spadefoot frog (*Notaden nichollsi*). Image: Sarah Legge



The lesser hairy-footed dunnart (*Sminthopsis youngsoni*). Image: Sarah Legge

How can this information be used

The findings of this study can help Traditional Owners and Rangers to shift current fire patterns to be more like when Traditional Owners still lived across Desert Country.

Rangers and Traditional Owners should continue with the burning program, aiming to burn more smaller-scale fires from the air. This will help to prevent the spread of large hot wildfires. They could also choose some trial areas where many smaller fires could be lit from the ground, and then compare the fire patterns at these places with aerial burning results. The biodiversity monitoring that the rangers are doing will show what type of fire management works best for animals and plants.

More information

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Kamahl and Moonie recording survey data. Image: Nicolas Rakotopare



Marissa, Elton and Jacko digging a trench to set up a drift fence. Image: Nicolas Rakotopare



Karajarri and Nurrara Rangers and partners on one of the field trips. Image: Nicolas Rakotopare



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