
*‘Fire regimes that cause biodiversity decline’ as a Key
Threatening Process (KTP)*

*Submission to the Threatened Species Scientific
Committee from The Leeuwin Group of Scientists*

The Leeuwin Group (TLG) is an independent group of scientists who are committed to the conservation and protection of Western Australia's biodiversity and natural environment. TLG's purpose is to: Provide high-level independent scientific commentary and advice on environmental matters to Government, industry, environmental organisations and managers. (see <http://www.theleeuwingroup.org.au>).

With a decline in rainfall in southwest Australia and higher incidence of wildfires there is a growing interest and perceived need for the deployment of planned fire as a tool to reduce fuel loads (Burrows, 2008, Burrows and McCaw, 2013, McCaw, 2013, Howard *et al.*, 2020, Weir and Scasta, 2021). There is no doubt of the need to protect human life and property from wildfire, but a growing body of research has highlighted the negative impact of too frequent planned ‘European’ fire, or prescribed burning, on plant and animal biodiversity (Bradshaw *et al.*, 2018, Lindenmayer, 2020) often with catastrophic long-term or, indeed permanent impacts on species and ecosystem integrity.

The Leeuwin Group supports the Committee’s draft, listing fire regimes as a Key Threatening Process (KTP) and offers evidence from the southwest of Western Australia (WA) that was recognised over two decades ago as a global biodiversity ‘hotspot’ due to threats caused by habitat destruction and degradation (Myers *et al.*, 2000).

Imposed European fire in the biodiversity hotspot, based on the evidence The Leeuwin Group has reviewed, represents a major ongoing threat to ecosystem integrity and species’ persistence. With just 10.8% of the southwest biodiversity hotspot remaining uncleared, the KTP is a critical component for ensuring that the last remaining native ecosystems are carefully and scientifically managed to ensure their protection in perpetuity. Importantly the KTP for the southwest highlights the need for the precautionary principle, i.e. in the absence of conservation-critical science to demonstrate an absence of negative impacts, applied fire must be minimised.

In addition, prescribed burning as practised on the remaining native vegetation of the hotspot must be done with full, informed and free consent of Indigenous custodians as outlined in the KTP. TLG fully endorses this position.

Evidence presented by The Leeuwin Group focuses on Questions 5, 7 and 9 from ‘Consultation Questions’ and is structured in three main parts:

- firstly, a number of prescribed burns in the southwest of WA that have escaped control and negatively impacted biodiversity are documented and,

- secondly, selected case studies of the impact of frequent prescribed burning on vulnerable plants and animals are presented.
- Thirdly, scant managerial regard for the precautionary principle is evident in the fire management of biodiverse peat swamps in the southwest of WA.

This is followed by two short sections in which:

- the efficacy of prescribed burning in preventing or mitigating wildfires is discussed (noting that this is not the remit of the KTP but is fundamental to the major purpose for imposing European fire onto landscapes) and
- Future mitigation strategies are outlined

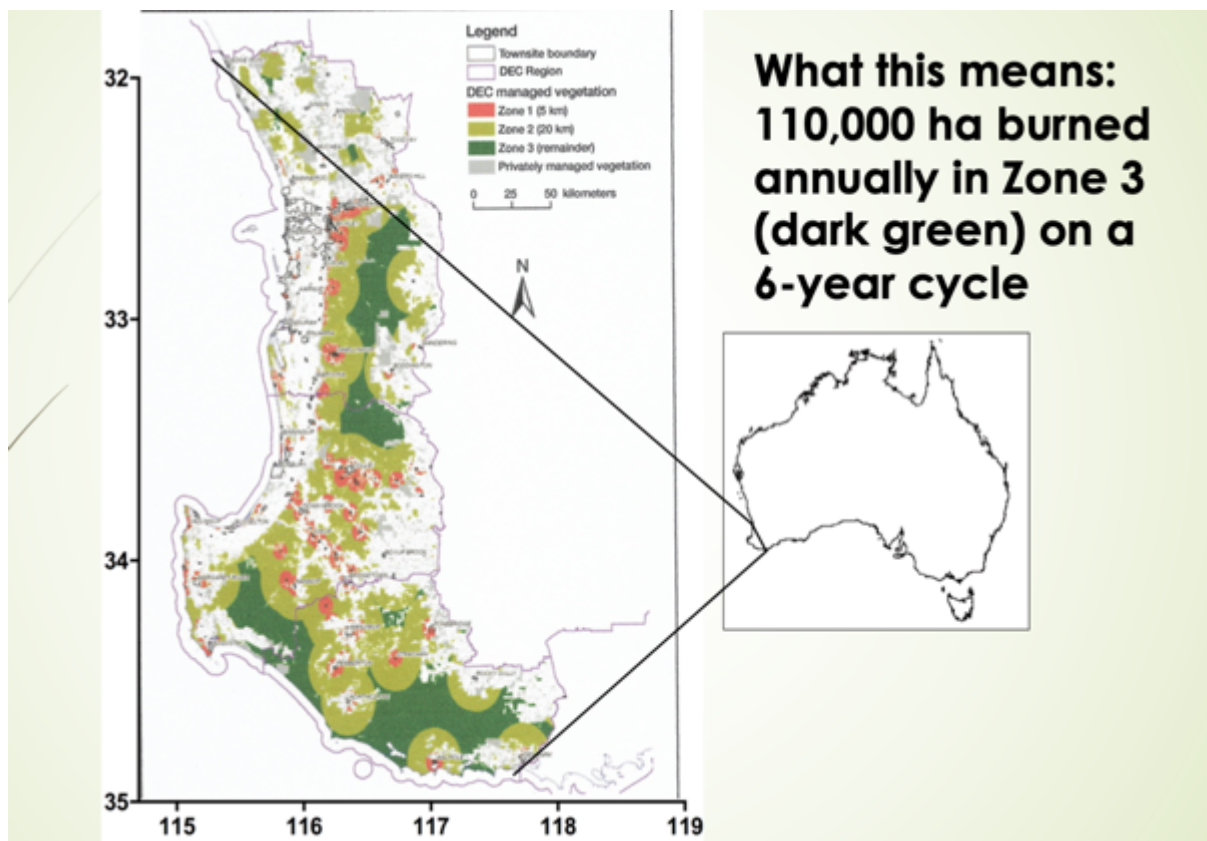
Background to the Southwest Biodiversity Hotspot and the use of European Fire

The southwest of WA is divided into three Land Management Zones (LMZs) by the State Government's Department of Biodiversity, Conservation and Attractions (DBCA, formerly CALM, DEC and DPaW), which has a remit to burn 200,000 ha *per annum*. A notional target of 30,000 ha is set for LMZ1, 5km from townsites, 60,000 ha for LMZ2 that is 20km from townsites, and the remaining 110,000 ha to be prescribe burned is in LMZ3, representing the major forested bushland areas of the southwest.

This target of 200,000 ha to be burned annually in southwest 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 hectare* (CALM, 1994). It was subsequently justified in Parliament in 2015 in response to a question to the Minister who pointed to the results of a long-term study by the Department of Environment and Conservation in which ...*"burning of about eight percent of the landscape each year significantly reduced the incidence and extent of unplanned fire."* ...*"As this equated to approximately 2.6 million hectares of forested estate under Departmental management in the south-west, eight percent of this equates to treating approximately 208,000 hectares per annum. Achieving this degree of treatment each year will facilitate approximately 45 percent of the forested estate to carry fuel loads that are less than six years old."*¹

After the large fire at Waroona/Yarloop 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) despite evidence of much of the landscape burnt being farmland with highly discontinuous bushland.

¹ Hansard: Question Without Notice No. 547 asked in the Legislative Council of WA on 13 May 2015 by Hon Lynn MacLaren of the Minister responding, the Hon A.P. Jacob.



The imposition of controlled fire by DBCA has thus created a fire regime of frequent fire in forested areas of southwest WA where, prior to European settlement, the frequency of scorch fires in the jarrah forest has been measured at 81 years (Burrows et al., 1995). Prescribed burns are intended to be ‘cool’ burns that reduce accumulated litter in the undergrowth without burning the forest canopy. In general, litter accumulation figures of 8 tonnes/ha are taken as levels that require burning. Spring is favoured over late summer and autumn as a time for prescribed burning, because of lower temperatures and less risk of the fires burning out of control. Nevertheless, prescribed burns in the southwest of WA continue to escape control, resulting in significant damage, both to property and to the natural environment.

Importantly, imposed fire does not preclude the incidence of wildfires; hence, the increase in frequency is and will continue to exceed the ecological tolerances of many ecosystems and species.

(A) Three examples of Prescribed Burns that have escaped control

(1) Layman-Ballan prescribed burn (Wiltshire-Butler and Blackwood River National Parks, October 2010)

The Layman Forest, 25 km south west of the town of Nannup was subject to a DEC planned fire (DEC ID# BS120) in spring 2010 with ignition occurring on the 16th and 19th of October 2010. DEC’s advertised primary objective for the fire was biodiversity conservation with specific reference made to the Critically Endangered (CE) Western ringtail possum (*Pseudocheirus occidentalis*) and two species of fish: the Vulnerable (V) Balston’s pygmy

perch (*Nannatherina balstoni*) and the Critically Endangered (CE) Western mud minnow (*Galaxiella munda*).²

DEC planned to burn a total of 9,772 ha (7,055 ha in Wiltshire – Butler NP and 2,717 ha in Blackwood River NP). In addition to the primary purpose, a secondary purpose was strategic protection of nearby housing developments. The intention was to burn 60 – 80% of the riparian and forest areas of *Agonis flexuosa* (peppermint), a species associated with the Western ringtail possum and in so doing “reduce the risk of a wildfire negatively impacting on the possum population in the two national parks”.³ Similarly, DEC reported that burning the riparian vegetation at lower intensities than would occur in a summer wildfire would have less of an impact on the vegetation fringing the streams and therefore be less damaging to the two fish species⁴.

DEC planned for less than 30% crown scorch across the total forested area (DEC, Prescribed Fire Plan, Layman Ballan, 2007). A cost of \$74,373 was attributable to this planned burn.

- The fire burned with a far greater intensity than was predicted and escaped. The total area burned was 12,272 hectares (8,289 ha in Wiltshire-Butler NP, 2,717 ha in Blackwood River NP and 1,266 ha in Rosa and Butler forest blocks)
- More than 90% of the riparian area containing *Agonis flexuosa* was burned and approximately 70% of the forest canopy was fully crown scorched
- The total cost of the burn and its consequences was \$647,982

The two National Parks are known to provide nesting and feeding habitat for locally endemic and endangered Black Cockatoo species as well as Western ringtail possums (*Pseudocheirus occidentalis*), Quenda (*Isoodon fusciventer*) and Western brush wallabies (*Notamacropus irma*). DEC was also aware of Declared Rare Flora, *Daviesia elongata* and seven species of Priority Flora; *Acacia tayloriana*, *Astroloma* sp. Nannup, *Chordiflex gracilior*, *Hybanthus volubilis*, *Leptinella drummondii*, *Darwinia* sp and *Eucalyptus relicta*.

This escaped prescribed burn had a significant detrimental effect on the habitat values of the two National Parks and it will take many years for the forest to recover.

(2) D’Entrecasteaux National Park prescribed burn (Fly Brook Forest/ Greater Hawke National Park and D’Entrecasteaux National Park Pemberton, New Year’s Eve 2010)

Fly Brook Forest Block / Greater Hawke National Park, 15 km west of Pemberton, was subject to a planned burn (DEC ID# DP 008) by DEC in spring and summer 2010. DEC lost control of the fire and it escaped into the adjoining D’Entrecasteaux National Park burning through more than 23,000 hectares of forest and bushland. Ignition occurred on 15 days in September, October, November and December, with the final ignition being carried out in mid-summer and peak tourist season on 30th December 2010.⁵

² DEC, Prescribed Fire Plan, Layman Ballan, 2007

³ Hansard: WA Legislative Council, Questions on Notice, 2010 p9835

⁴ Hansard: WA Legislative Council, Question on Notice, 2010, p9836

⁵ Hansard: WA Legislative Council, Question on Notice, No. 4248, 2011.

DEC planned to burn 8,328 ha for “strategic protection” purposes 15 km west of Pemberton. DEC said that it intended to achieve strategic protection of private property, tourism infrastructure and regrowth forest by applying “fire under prescribed conditions”. The secondary purpose according to prescription documents was to “*protect and maintain biodiversity values and ecological processes... to achieve a mosaic of fire intensities of burnt and unburnt areas at both a landscape and local scale*”.⁶

- The prescribed fire escaped into the adjoining D’Entrecasteaux National Park and burned out of control, stranding 50 people in the National Park, threatening huts and burning at high intensities through more than 15,000 ha of highly biodiverse and ecologically significant bushland.
- A total of 23,442 ha was burnt as a result of this burn, nearly three times the intended area.⁷

The burnt area is known habitat for the threatened mainland quokka (*Setonix brachyurus*). At the time the mainland quokka was listed as ‘Vulnerable’ and “fauna that is likely to become extinct or is rare” in accordance with the Wildlife Conservation Act 1950 (WA). It is also listed as “threatened fauna” in accordance with the national Environmental Protection and Biodiversity Conservation Act 1999. Mortality of quokkas as a result of the fire was significant and DEC informed the WA Parliament in 2011 that post-fire monitoring of the quokka population would be carried out. The results of any such monitoring do not appear to have been published, but some indication of the probable mortality of quokkas can be gauged from the later Northcliffe wildfire in the summer of 2015. This affected an area of 98,000 ha and resulted in the loss of 77% of known sub-populations of quokkas and the loss of approximately 500 individuals (Bain *et al.*, 2016).

DEC set fire to Flybrook Block / Greater Hawke National Park throughout spring and into summer 2010 claiming that the application of fire under prescribed conditions would reduce the risk of wildfire in the area and thereby protect tourism infrastructure, private property and biodiversity. The result was quite the opposite. The National Parks are well used by tourists and locals during the wildflower season and Christmas period. During the fire, supplies had to be airlifted to people staying in huts on both sides of the Donnelly River who were stranded when the fire burned uncontrolled over the river threatening the huts and cutting off accesses.⁸

The financial cost of this fire exceeded \$1.27 million – it is arguable that such a significant sum might have been better spent on improved response times, safer and more effective use of fire in more appropriate locations, and improved management.

⁶ DEC, Fly Brook DP 008, Aug 2010

⁷ Hansard: WA Legislative Council, Question on Notice, No. 4248, 2011

⁸ Massey & Burke, The West Australian, Dec 2010.



D'Entrecasteaux National Park scorched by DEC escaped prescribed burn 2010

(3) Margaret River/Gnarabup bushfire – November 2011

The bushfire that devastated swathes of Margaret River's iconic coastline over several days in November 2011 stunned and dismayed Western Australians. These feelings were intensified by the knowledge that the fire arose from a prescribed burn (BS520 and BS255) being undertaken by DEC; a burn that was planned and implemented with the intention of protecting the various communities that were in the path of that bushfire. Although no lives were lost, the fire presented serious risk to human life.

- More than 3,400 ha of coastal heathland and bush were burnt, and
- 32 houses, including historic Wallcliffe House (see below) nine chalets and four outbuildings were destroyed.
- Partial damage was also sustained by 16 houses, one shop and four sheds.⁹

The Government commissioned Mr Mick Keelty AO to report on the fire and its causes and he concluded that “...*prescribed burning was a complex task and despite “exhaustive” planning, the implementation of the prescribed burn did not fully take into account the risks associated with re-ignition of the prescribed burn through a flare-up and “escape of the fire”. “With the benefit of hindsight, planning and operational decisions did not adequately take into account the forecast weather conditions for 23 November 2011”.*¹⁰

The Keelty Report (Keelty, 2011) acknowledged that serious mistakes were made, such as the lack of monitoring of the Ellen Brook burn, particularly overnight on 22 November, and the decision to commence another prescribed burn nearby at Prevelly, using incendiaries dropped by helicopter, despite the challenges being faced with the Ellen Brook burn. On 23

⁹ Smith, R 2011 Report on – “investigation of the house losses in the Margaret River bushfire 23rd November 2011, DFES.

¹⁰ Keelty, M. 2011, ‘Appreciating the Risk Report of the Special Inquiry into the November 2011 Margaret River Bushfire’, WA Government.

November 2011, a fire broke containment lines from a prescribed burn in Leeuwin-Naturaliste National Park, forcing hundreds to evacuate their homes. Approximately 300 people were expected to register at the Margaret River Cultural Centre. Residents were forced to evacuate over a three-day period, with some residents whose home remained intact unable to return home due to pollution from asbestos and other contaminants spread by the fire.

The Margaret River fire was finally brought under control on 26 November 2011.



Post-fire landscape at Gnarabup



The remains of historic Wallcliffe House

Much of the Margaret River fire destroyed large tracts of coastal heathland in Gnarabup that supports a rich bird, reptile and invertebrate fauna. Moving away from the coast, large areas of peppermint forest (*Agonis flexuosa*), which is the preferred habitat of the Critically Endangered Western ringtail possum (*Pseudocheirus occidentalis*), were also destroyed. The Keelty Report makes no mention of damage to wildlife but Ms Uta Wicke, President of the Possum Centre in Busselton, estimated that 90% of the possum population was killed by the fire. Approximately 20 badly-burned possums were found alive by rescue workers, but most of these needed to be euthanised because of the extent of their injuries.



Translocated Western Ringtail Possum: Prescribed Burn, Warragup Springs Nature Reserve, May 2017

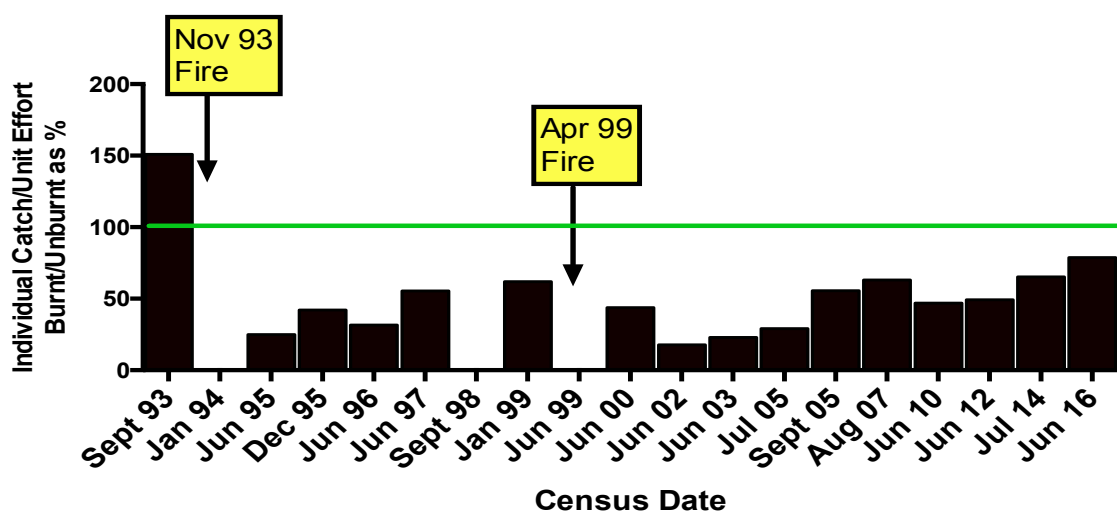
The Ellensbrook area contains a Threatened Ecological Community (TEC) that had not been burnt since 1982. One declared rare flora species (*Caladenia excelsa*) and four priority flora species (*Acacia subracemosa*, *Bossiaea disticha* and *Banksia sessilis* var *cordata*) also occur in the area but there are no data available on the impact of the fire.

(B) Selected case studies of the impact of frequent Prescribed (European) Burning on vulnerable flora and fauna

(1) The marsupial Honey possum, *Tarsipes rostratus*

Although not listed as threatened at this time, the geographical range of the once widespread Honey possum (*Tarsipes rostratus*) has been dramatically reduced since European settlement with the last specimen collected in the Perth area in Shenton Park in 1941. The tiny 10 g marsupial Honey possum is the only non-volant vertebrate that completely depends on nectar and pollen for its survival (Bradshaw and Bradshaw, 2012) and is thus extremely vulnerable to fire. Field studies using isotopic turnovers in free-ranging individuals have shown that a 9 g adult consumes 7 mL of nectar and 1 g of pollen per day and will die within days without access to fresh blossoms (Bradshaw and Bradshaw, 1999). A long-term field study in Scott National Park, in the extreme southwest of WA, inadvertently provided an opportunity to study the impact on a population of this species of two fires, 6 years apart.

Fire from a farmer's property entered the National Park in November 1993 and CALM, concerned that it could reach the housing development on Molloy Island, backburned the Park north of Scott River Road. This killed half the population of Honey possums in the study site; the remaining half occupied territory to the south of the road. Post-fire trapping in the burnt area indicated that the population was recovering but, six years later in April 1999, the scenario was repeated and CALM backburned again. Recovery of the population after the second fire has been very slow and regression analysis indicates that it will take 25.6 years for the population to return to pre-burn densities (Bradshaw and Bradshaw, 2017).



Capture rates in the burnt relative to the unburnt area from 1993 to 2016

An extensive trapping survey in *Banksia* woodland, 30 km north of Perth, found *Tarsipes rostratus* to be the most common of the nine native species recorded, and densities were greatest in areas that had not been burned for 20–26 years (Wilson et al., 2014). In the

Fitzgerald River National Park on the south coast of Western Australia, capture rates of Honey possums increased to a peak 30 years after fire, with a slight decline in vegetation unburnt for 50–60 years (Everaardt, 2003, Wooller and Wooller, 2014). These data from long-term field studies of the Honey possum reinforce the need for survival of many other species of long-unburnt vegetation. These include quokkas (*Setonix brachyurus*), mardo (*Antechinus flavipes*) (Christensen and Kimber, 1975, Hindmarsh and Majer, 1977), tammar wallaby (*Notamacropus eugenii*) (Christensen, 1980), Noisy Scrub-bird (*Atrichornis clamosus*) (Smith, 1985) and Mallee fowl (*Leipoa ocellata*) (Parsons and Gosper, 2011).

(2) The Numbat, *Myrmecobius fasciatus*

The numbat is a small marsupial that is unique in almost every aspect of its biology. Feeding exclusively on termites (20,000 per day), it is the only marsupial that is truly diurnal (active during daylight hours), with the highest visual acuity of any marsupial studied (Arrese *et al.*, 2000), and the only species in its own family, Myrmecobiidae. Once widespread throughout arid and semi-arid regions of WA, NT and SA, it is now only found in two small localities in WA, focused on Dryandra Woodland and Perup Nature Reserve in the southwest.



A Numbat in characteristic watching pose

On 25 April 2021, a fire lit by DBCA in the Weinup block (DON_100 burn), adjacent to Perup Nature Reserve, was catastrophic for the numbat and its habitat. A very hot burn, lit by incendiaries dropped from a helicopter, destroyed approximately 5,000 habitat trees and completely burned the fallen logs housing the termites on which the numbats feed, leaving any surviving animals without cover and protection from predators. It is noteworthy that the fire proceeded against the recommendation of DBCA's own Threatened Species Committee.



Photo showing intensity of burn

Large trees completely incinerated

The fire was planned at the most critical ecological time for the species with regard to the breeding cycle of numbat and shows a fundamental lack of appreciation of numbat biology. A spokesperson from DBCA stated: *“the burn was undertaken outside the period where numbats have young in their dens so the younger animals were mature enough to access refuge areas during and after the fire.”*

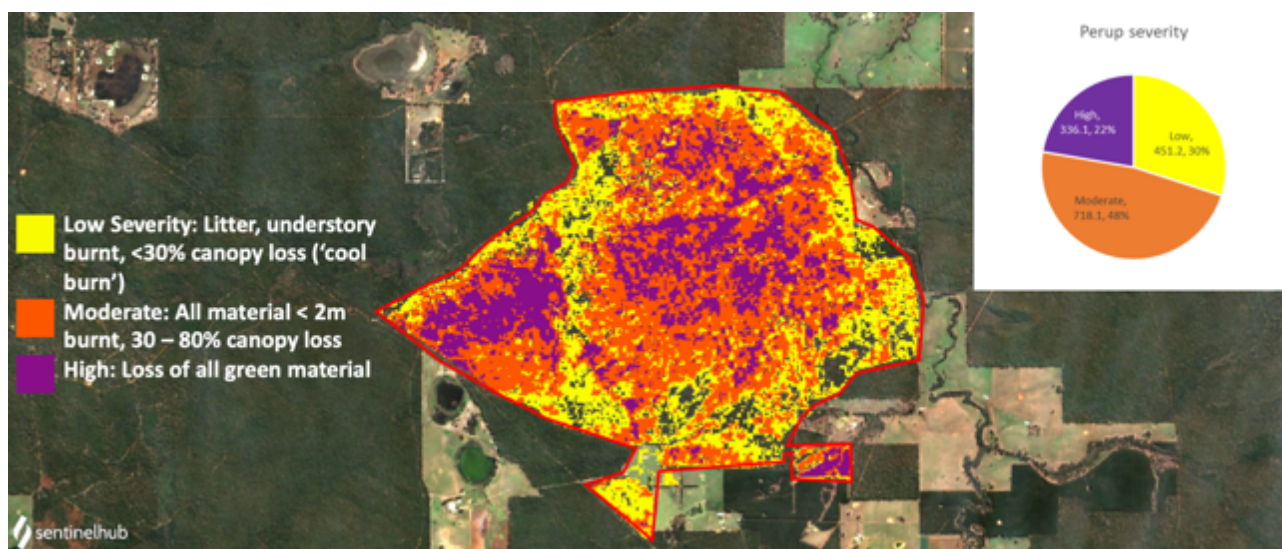
Numbats mate in January and give birth to young two weeks later. The young remain with the mother and in the den until July and they are not weaned until late October or November (Power *et al.*, 2009). The fire in late April thus coincided with the time that all the females were carrying young, which would have been killed along with their mothers.

Inspections of the site post-burn by Fire and Biodiversity WA found only one marker of a historic numbat den, which was partially burnt, and no evidence of raking or other measures to protect the den. It is therefore considered highly unlikely that the advice from DBCA to the Premier that *“all known numbat dens that DBCA and adjacent property owners identified prior to the burn were protected”* is correct.

Satellite imagery prior to and following the burn, using short wave (bare earth) and near infrared (chlorophyll) satellite imagery from Sentinel 2, enable a measure of the intensity of the burn.



Satellite image of Weinup burn area, March 2021



Burn intensity of Weinup burn site, April 2021

The analysis, post-burn by satellite, shows that 22% of the area experienced a high-intensity burn (equivalent to a catastrophic level fire) with complete loss of all green material and a further 48% was moderate, with 30-80% of the canopy lost.

There was intense media interest in the fire and much speculation over the fate of the numbats. It was clear that the size of the numbat population had not been assessed prior to the fire and DBCA agreed to undertake an internal investigation. In a letter to The Leeuwin Group from the Minister, she noted “...During the implementation of the burn, there were some areas that experienced higher levels of fire intensity than were planned for. ...In this particular case, sections of the burn did not go as planned and lessons learnt from the operational review and ongoing forest monitoring will be incorporated into future operations, consistent with DBCA’s adaptive management approach.”¹¹

Numbats are listed on the IUCN’s Red List of Threatened Species. The species is one of the world’s rarest mammals and has been the focus of an intensive multi-decadal breeding programme at Perth Zoo aimed at returning animals to their natural habitat. In 2014 its conservation status was elevated to ‘Endangered’ with an estimated total population of less than 1000 individuals in the wild.¹² For one of the world’s rarest mammals and at the highest level of threat, the actions of DBCA show the critical importance of the KTP and a Threat Abatement Plan (TAP) as a vital ‘check and balance’ in the system. Similar ignition patterns and thermal impacts continue to be deployed throughout the southwest forests.

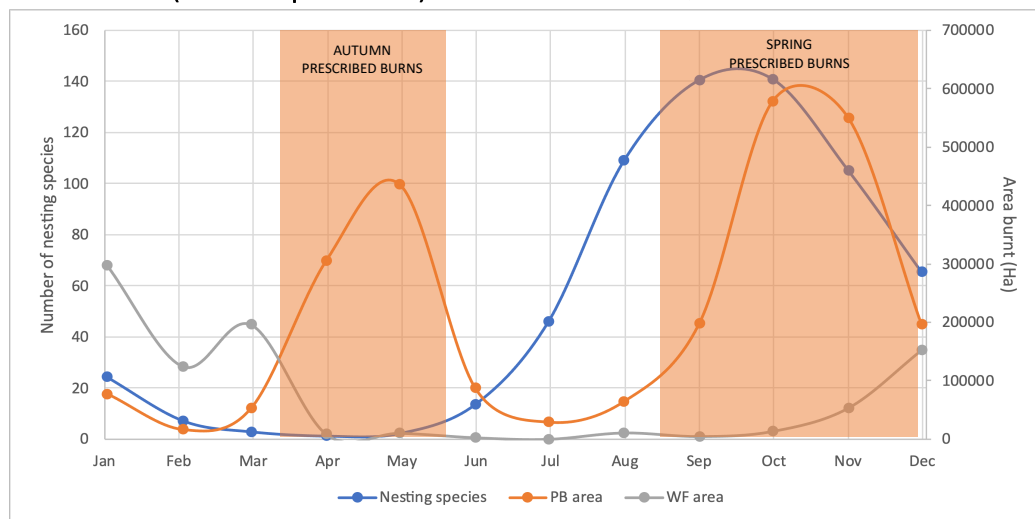
¹¹ Letter dated 30 June 2021 from the Minister the Hon Amber-Jade Sanderson MLA to Emeritus Professor S.D. Bradshaw

¹² Woinarski, J.C.Z., A. Burbidge, and P.L. Harrison. The Action Plan for Australian Mammals 2012. Collingwood, Victoria: CSIRO Publishing, 2014.

(3) Black Cockatoos and other Birds

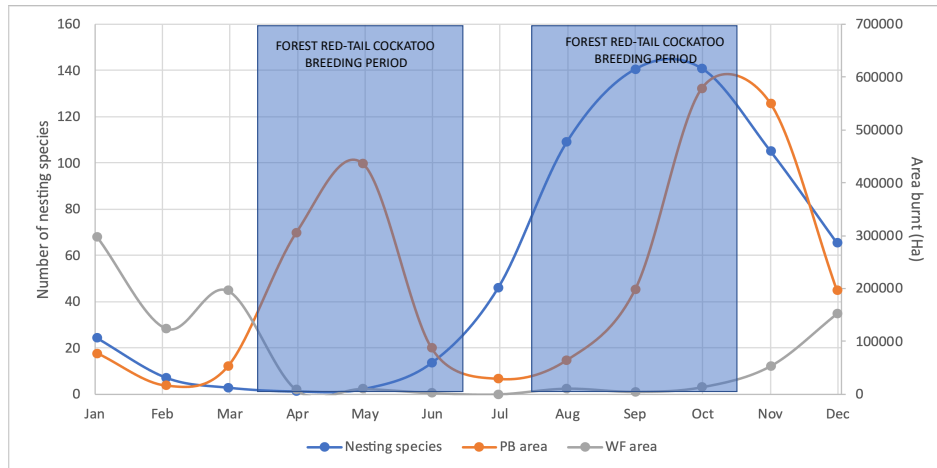
All three species of Black cockatoos in southwest Western Australia are listed under Matters of National Environmental Significance (MNES), the Forest Red-Tailed black cockatoo (*Calyptorhynchus banksii*), Carnaby's White-tailed black cockatoo (*Calyptorhynchus latirostris*) and Baudin's White-Tailed black cockatoo (*Calyptorhynchus baudinii*), with the two white-tailed species listed as endangered. The impact that prescribed burning has on these species has been little studied but the coincidence of spring burning with the breeding season of 170 bird species from the southwest of WA is suggestive. Wildfires, representing the 'natural' fire regime, peak from December to March, when few birds nest. Prescribed burning usually occurs in spring, imposing an additional fire impact at the most critical time when birds are fledging their young. Long-term field studies of the Splendid fairy wren, *Malurus splendens*, show that optimum densities require fire intervals of at least 12 years between fires, which must not occur during the winter/spring breeding season (Rowley and Brooker, 1987).

Fire regimes and nesting periods for southwest birds
(170 species) Data: Mark Henryon Birdlife Int



Forest red-tailed black cockatoos in southwest WA (subspecies *samuelyi*) are unusual, however, in having two nesting periods: one in spring and the other in autumn (Saunders, 1977) thus exposing them to fire whenever they breed.

Fire regimes and Black Cockatoo nesting



The vulnerability of Black cockatoos to high temperatures was highlighted by the death of 145 Carnaby's Black Cockatoos during the period from 6th to 8th January 2010, in Hopetoun on the south coast of Western Australia. Over the same period, 63 Carnaby's black cockatoos died while roosting in trees in a small Blue Gum *Eucalyptus globulus* plantation south of Munglinup about 75 km east of Hopetoun. Pathological examination of the dead birds confirmed that they had died from heat stress (Saunders *et al.*, 2011). This highlights their vulnerability to fire, with both the impact from direct heat plus the reduction in canopy protection due to prescribed fire. Old marri trees (*Corymbia calophylla*), with hollows used for breeding by endangered Forest red-tailed black cockatoos in the northern jarrah forest in Western Australia, average 220 years in age and need to be protected against fire (Johnstone *et al.*, 2013). Carnaby's black cockatoo also relies on hollows in old wandoo and salmon-gum eucalypt woodlands for breeding and is threatened by recurrent fire and climate change. A major study in the Great Western Woodlands has highlighted that multi-century periods since fire in an intact woodland landscape are pivotal for the survival of many bird species (Gosper *et al.*, 2019). This study complements earlier work on the Eyre Peninsula showing that large unburnt areas, rather than small unburnt patches, are critical for bird survival (Berry *et al.*, 2015), and in the Lofty Ranges in South Australia (Prowse *et al.*, 2017).

(4) Banksias and other vulnerable plant species

The Australian National Botanic Gardens has listed 76 species of *Banksia*, with 60 unique to southwestern Australia. Although this number has increased with the addition of *Dryandra* to the genus (Thiele and Ladiges, 1996), it still remains that the centre of diversification of the genus is in the Southwest Hotspot. This Proteaceae genus has clear Gondwanan origins, with a fossil cone of *Banksia archaeocarpa*, dated at 43 million years, found in the Kennedy Range east of Carnarvon. Banksias are important sources of nectar and pollen for a wide range of birds, insects and, especially in Australia, of small mammals (Bradshaw, 2014b).

Banksias are also particularly vulnerable to frequent fire and a variety of studies has identified essential time-since-fire intervals for their long-term persistence, which range from 10 to 30 years. The vulnerability of banksias, the primary food source of Honey possums (Bradshaw, 2014a), is highlighted by a study of flowering and fruiting of *Banksia baueri*, *B. nutans* and *B. baxteri* in kwonkgan heathland on the southwest coast of Western Australia in which all three were extinguished from an area burnt twice with an interval of nine years (Wooller et al., 2002). The Critically Endangered *Banksia brownii* has a long juvenile period of five to six years in populations north of Albany and more than eight years in upland Stirling Range populations, making it particularly vulnerable to short fire intervals (Monks et al., 2019).

The rôle that fire may play in bringing about the virtual extinction of a *Banksia* species is exemplified by the case of *Banksia cuneata*. This is a small shrub or tree growing to 5m and, in the 1980s, a total of only 340 adult plants were known to occur in seven small populations in the WA wheatbelt. It was argued, despite opposition from botanical specialists, that the trees in a road-side verge population near the town of Quairading were ‘overmature’ and in need of fire for their regeneration. They were duly burnt in a hot fire by CALM (an early predecessor of DBCA) in May 1987 that “consumed most of the leaves of all 18 *B. cuneata* plants present.” (Lamont et al., 1991). All the 30-year-old *Banksia cuneata* trees were killed by the fire and survivorship of seedlings that germinated after the fire was 0.8%. All that remains of the species today is a single tree on a road verge east of Quairading and a small population in Badjaling Reserve, both of which are at risk of extinction at any time from fire.

Fire sensitive plants
One third of the plant diversity
and keystone resource species

- *Banksia cuneata* 20-30y
Lamont et al. (1991)
- *Banksia goodii* 15-20y
Drechsler et al. (1999)
- *Banksia hookeriana* 15-18 y
Enright et al. (1996)
- *Banksia shrubland* 10-14 y
Enright et al., 2011
- *Banksia* forage recovery 16 y
- Native heaths, sedges 15 y
Meney et al 1998



Some of the last extant plants of *Banksia cuneata* in Badjaling Reserve near Quairading

Banksia verticillata is another Critically Endangered species that has a very restricted distribution, occurring in three small disjunct populations from Walpole to Cheyne Beach, east of Albany where it grows on granite rocks in coastal heaths and forested landscapes (Yates et al., 2021). Historically, the species has been recorded from 36 populations with seven of these now locally extinct, and a significant decline occurring across most remaining

populations. An analysis of fire frequency over a 30-year period in coastal granite reserves in the region showed that 51% of the area had burnt once, 35% twice and 8% three times (Barrett *et al.*, 2009).

One of the most significant remaining populations of this *Banksia* species was almost eliminated by an escape from a prescribed burn in the Nuyts Forest Block Poison Hill in Walpole National Park in 2018. The prescribed burn was being conducted during the second driest autumn on record for the SW land division, the lowest since 1914. The burn was conducted under the extremely dry conditions despite the knowledge that the area was rich in relictual species and unique stands of Red tingle (*Eucalyptus jacksonii*).



Incinerated quokka from Poison Hill as the result of an escaped prescribed burn

Although seedling recruitment is now evident at the site, another fire within the next 20 years will have irreversible impacts on the population (Yates *et al.*, 2021). The population of Poison Hill quokkas (*Setonix brachyurus*) was also severely depleted with eight dead observed soon after the fire (see photo). Post fire veterinary advice was that quokkas that escaped the flames died post fire due to starvation.

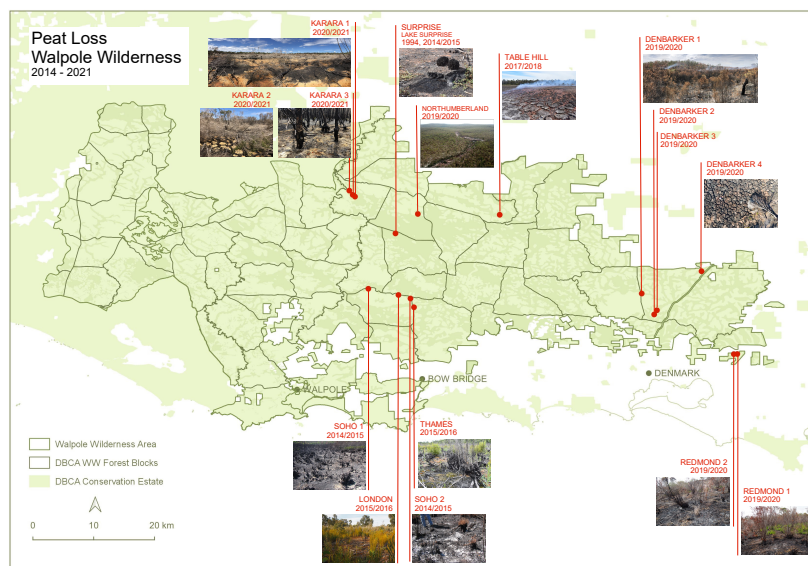
The management plan for the area states “*The immediate impact on fire on fauna and their recovery rate is directly proportional to scale, intensity and patchiness of the fire and intervals between fires*”. Such statements have not been heeded. Once fire is recognised as a key threatening process, management should be guided to be more cautious and risk management should account for the risk of frequent fires for many species. The occurrence of two fires within 13 years, for example, caused the almost complete regeneration failure of *Hakea petiolaris* ssp. *trichophylla* in a granite outcrop community of the southwest Australian floristic region (Yates *et al.*, 2003).

With regard to other species, burning at three-to-four-year intervals resulted in a significant reduction in the abundance of key obligate seeder species, such as *Acacia browniana* and *Crocea angustifolia* (Burrows and Wardell-Johnson, 2003). Some species, such as *Dryandra* (now *Banksia*) *sessilis*, may flower within three to four years after fire, but do not set seed until eight years and reach maximum nectar production only after 12 to 15 years (Muir, 1985), with important forage implications for threatened seed-eating parrots (Saunders,

1990). With prescribed burning every six years, for example, plants will produce visually abundant flowers, but little if any nectar and seed.

(C) A decade of damage to the Peat systems of the Walpole Wilderness

DBCA prescribed burns impacting ancient peat-bog systems have been widespread in the Walpole/Denmark area as shown on the map below for the period 2014-2021. Since 2014, Walpole community members have raised concern as to the irreversible damage being done to the substrate of wetlands and peats ignited as part of the process to burn out blocks of the conservation estate using aerial ignition methods. Although the nationally recognised systems of the Soho block were damaged irreversibly in 2014 this did not result in better outcomes over the next 8 years. The lack of departmental accountability or due consideration being given to commitments in existing management plans has resulted in the loss of special areas of habitat for rare species. A specific example was the DBCA prescribed burn in the Thames Forest block of the Walpole Wilderness, north of Bow Bridge, during the summer of 2015/16 which caused the peaty substrate of a large seasonally wet area to ignite and burn for many months (see graphic and location on map below). Vegetation accumulating in swamps slowly decomposes and is converted to peat, which may reach thicknesses of up to a metre with an age of 5,000 years. These ancient peat swamps and organic mound springs in the southwest of WA are unique ecosystems supporting many vulnerable species, such as the spectacular Sunset frog *Spicospina flammocaerulea*,¹³ the endemic freshwater crayfish *Engaewa subcoerulea* and *E. walpolea* (Horwitz, 1994) and the mollusc *Westralunio carteri*. These swamps are at risk, both due to hydrological changes with global warming (Horwitz *et al.*, 2008) and changes in fire regimes (Horwitz and Sommer, 2005). Substrate loss has resulted in major changes to the vegetation and loss of



habitat for the threatened Sunset frog, known to have been calling from this location. Only 13 populations were known to exist at the time of the fire. The habitat of two of the other populations has also been degraded by prescribed fires over the last decade.

¹³ Burbidge AA and Roberts JD (2001). Sunset Frog Recovery Plan 2001-2005. CALM, Western Australia Threatened Species and Communities Unit.



The Endangered Sunset frog Spicospina flammocaerulea



Exposed lignotuber and roots of a dead Homalospermum firmum due to burning of underlying 60 cm of peat



Example of the impact of a prescribed burn on a peat swamp north of Bow Bridge 2016/17



Albany Pitcher plants, Cephalotus follicularis, killed by the fire. This species is a Gondwanan relic of international significance

Because of their age and biodiversity, the Walpole peat swamps have recently been proposed for listing as a Threatened Ecological Community (TEC), with the *Empodisma* peatlands of this region providing critical habitat for a rich diversity of threatened, endemic and relictual taxa.

Empodisma is a genus within the Restionaceae with three known species distributed in Australia and New Zealand. *Empodisma gracillimum* is endemic to the southwest corner of Western Australia and is the predominant peat-forming plant with its densely branching root systems binding bryophytes and litter into the peat (Hodges and Rapson, 2010). Some of the other characteristic species that are found growing in peatlands include *Sporodanthus rivularis*, *Leptocarpus* sp, *Cosmelia rubra*, *Acidonia microcarpa*, *Cephalotus follicularis*, *Reedia spathacea*, *Drosera binata*, *Amperea protensa*, *Gonocarpus simplex* and *Microtis globula*. A total of 142 aquatic species of invertebrates have also been recorded in the peat swamps of which 36 are endemic to the south west (Penniford, 2018).

(D) The efficacy of prescribed burning in preventing or mitigating wildfires

The prime justification for prescribed burning in the southwest of WA is that it reduces the frequency and area burned by wildfires. Central to DBCA's argument is one scientific paper published in an international journal in 2009 detailing the results of an investigation on the impact of prescribed burning over a 50-year period in the Warren district of southwest WA (Boer *et al.*, 2009). Statistically significant negative correlations were found between the annual fire number and area affected by wildfires and the area prescribe-burned in the concurrent six years. The assumption was made that correlation equals causality and from the negative slope of the regression of wildfire area on area prescribe burned (0.26), a 'leverage' of approximately four was inferred (i.e. that roughly 4 ha needs to be burned to 'protect' 1 ha of land from wildfire).

Critically, the comparison of concurrent 6-year periods *cannot* identify a causal relationship with the treatment, as, by definition, much of the treatment period occurs *after* the supposed effects. The Boer paper in essence argues that the area of wildfire in a given year was affected by the area that was prescribe burned five-years later, because both years fall within the same window of concurrent years. For example, the mean for annual prescribed burn extent for 1961 to 1966 was correlated against the mean annual wildfire extent for 1961 to 1966. It is illogical to conclude from this that prescribed burns are exerting leverage on wildfire extent, as that would mean that wildfire extent in a given year is influenced by five years of prescribed fires *that have not yet occurred*. The correlation may also indicate that rates of prescribed burning increase in response to years with larger wildfire extent. The study also has other issues of concern.

TLG has replicated the results of this study but identified two important assumptions made that heavily influence the outcome of the analysis. The first is the treatment of wildfires themselves, which are not included when calculating prescribed fire areas. Thus, an area that had been burned by wildfire one year previously would still be classified as unburnt (by prescribed fire) even though its vegetation was in an early post-fire state. The second is only partially accounting for climate change with global warming over the past 20 years increasing the flammability of the vegetation and the likelihood of fire. When allowance is made for these assumptions and the analysis repeated, the negative correlations between wildfire and prescribed burning disappear (Zylstra *et al.* in prep; Campbell *et al.* in prep).

Furthermore, if the analysis is repeated in other forested areas of the southwest where adequate data are available the relationship in some cases becomes positive (i.e. northern Jarrah forest) indicating that prescribed burning actually enhances wildfire (Campbell *et al.* in prep). This highlights the danger of extrapolating the results of the Boer *et al.* analysis to other parts of Australia, and to other continents (Fernandes and Botelho, 2003, McCaw, 2013) – clearly on a continent of such diversity *one-size-does-not-fit-all*.

Another DBCA study reported little evidence for a short fire interval effect on flora and fauna in a jarrah/marri forest area, based on sites burned infrequently to frequently (i.e. 0-4 times) over a 30-year sample period (Wittkuhn *et al.*, 2011). Plant species richness was lower in the most frequently burned sites but differences were not statistically significant due to the small number of replicate sites per frequency group. Fauna was also poorly

sampled, with birds totally excluded from the study (see also (Enright and Fontaine, 2014) raising serious doubts about this study.

(E) Mitigation Strategies

The Leeuwin Group is not opposed to the practice of prescribed burning but believes that it should be focused on the fringe of towns and infrastructure, where it has been shown to provide a modest level of assistance, and be based on Traditional burning practices. We argue that the frequent and repetitive burning of tracts of bushland remote from habitation does not reduce the risk of wildfire (Enright *et al.*, 2011) and places wildlife and ecosystems at risk of irreversible damage.

The Leeuwin Group considers that the threatened biodiversity hotspot in southwest Western Australia requires special protection from frequent fire and has the following recommendations:

- Abandon the 110,000 ha per year target of prescribed burning in Land Management Zone 3 (LMZ3) but retain existing targets in Land Management Zones 1 and 2. The 110,000 ha target has no scientific basis and negatively impacts biodiversity in bushlands remote from habitation.
- Focus prescribed burning on protecting life and infrastructure associated with townsites, as prescribed burning within 0.5 km of assets has been shown to be more effective than burning 8 km away.¹⁴
- Divert existing funding to establishing rapid response units (detection, satellite imagery, mapping, water bombing) that will detect and suppress wildfires within 24 hours before they can become established.
- Undertake a public relations campaign on risk management to encourage landholders in fire-prone bushland areas to assume responsibility for their property and their decision to live in such areas.
- Develop strategies for the protection from wildfire of long-unburnt tracts of bushland and biodiversity-rich sites such as granite outcrops and peat swamps.
- A Fire Threat Abatement Plan (TAP) as the sister document to the KTP is critical for ensuring the necessary checks and balances are in place to pause the now widescale deployment of European fire in the Hotspot.

¹⁴ Gibbons, P., Van Bommel, L., Gill, A. M., Cary, G., Driscoll, D. A., Bradstock, R., Knight, E., Moritz, M. A., Stephens, S. L. & Lindenmayer, D. 2012. Land management practices associated with house loss in wildfires. PLOS ONE, 7, e29212.

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