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A 150-year fire history of mulga (*Acacia aneura* F. Muell. ex Benth.) dominated vegetation in semiarid Queensland, Australia

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Abstract. Changes to fire regimes associated with European colonisation are implicated in declines in biodiversity and productivity in rangelands globally. However, for many areas there is incomplete knowledge of historical fire regimes and purported changes can become accepted wisdom with little empirical evidence. In the Mulga Lands of south-western Queensland, the dominant narrative implicates reduced fire frequency as a cause of woody vegetation thickening. We present a fire history of the Mulga Lands since pastoral exploration in the 1840s based on a review of explorer and early pastoralist journals, newspaper articles, interviews with long-term landholders and collation of satellite imagery. Fires in mulga communities are infrequent and only occur after at least two years of above-average summer rainfall. The assumption of regular pre-pastoral fires is not supported by available evidence. Since pastoral settlement in the 1860s, fire events affecting >1000 km^2 have occurred seven times (1891–1892, 1904, 1918, 1950–1951, 1956–1957, 1976–1979 and 2011–2013), with only the 1950s fires affecting a >10% of the total area of mulga-dominated vegetation. We argue that fire is limited by fuel loads, which are in turn limited by rainfall events occurring only a few times a century. Even in the absence of grazing and active fire suppression fire intervals would be extremely long, perhaps 30–50 years in relatively fire-prone communities and much longer throughout most of the region. Combined with quantitative studies of fire and tree and shrub population dynamics, detailed fire histories will allow for more informed and nuanced debates about the role of fire in rangelands subject to abrupt management upheavals.

Additional keywords: fire frequency, mulga scrub, semiarid shrublands, vegetation structure.

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Introduction

Altered fire regimes over the past two centuries are implicated in vegetation structural change, biodiversity loss, land degradation and declining productivity in forests and rangelands globally. In some areas, wildfires are thought to have become larger and more intense with the breakdown of traditional burning practices and/or active suppression of regular low-intensity fires, which created fine-scale mosaics (Russell-Smith *et al.* 2003; Bliege Bird *et al.* 2008; Miller *et al.* 2009; McAdoo *et al.* 2013; Aldrich *et al.* 2014; Fulé *et al.* 2014; Spoon *et al.* 2015). In others, wildfires are purported to have become less frequent due to lower biomass with livestock grazing and active suppression by land managers, particularly since the advent of large machinery (Moore *et al.* 2001; Briggs *et al.* 2002; Fuhlendorf and Engle 2004; Stanton *et al.* 2014). This in turn can lead to increased tree and shrub densities, further reducing fire frequency and intensity (Noble 1997; Roques *et al.* 2001). Fire regimes which diverge from the historical regime to which plants and animals are adapted can have wide-ranging consequences for both biodiversity conservation (Bowman and Panton 1993; Russell-Smith *et al.* 2002; Gregory *et al.* 2010; Augustine and Derner 2015; Kelly *et al.* 2015; Lawes *et al.* 2015) and primary production (Reynolds and Carter 1993; Busso 1997; Craig 1999).

Debates about fire management are often characterised by an incomplete understanding of historical fire regimes. This is especially so where changes to land management were swift and preceded formal study or documentation (Keeley and Fotheringham 2001; Goforth and Minnich 2007; Williams and Baker 2012; Silcock *et al.* 2013). Further, little is known about fire ecology and its relation to long-term vegetation dynamics and biodiversity in many ecosystems (Savage and Swetnam 1990; Williams *et al.* 2003; Andersen *et al.* 2005; Parr and Andersen 2006; Stephan *et al.* 2010). This uncertainty has generated considerable controversy about what constitutes 'natural' fire regimes across vast areas, with implications for contemporary land management.

The Mulga Lands of semiarid eastern Australia epitomise this quandary. The expansion of the pastoral frontier and dispossession of Aboriginal people was so swift (Bottoms 2013) that we have only crude knowledge of their land management practices. Furthermore, some populations declined dramatically well ahead of the frontier due to disease (Reynolds 1995; Hunter and Carmody 2015) meaning that land management practices were disrupted before 'exploration' commenced in the 1840s. Under traditional burning regimes in Central Australia, fires in mulga (*Acacia aneura*) communities seem to have been rare (Kimber 1983). In Western Australia, mulga was generally not deliberately lit by Aboriginal people, and most patch burning was limited to co-occurring spinifex associations (Fox 1986; Start 1986). When fires did occur in mulga, they were associated with build-up of fuel following successive wet seasons. However, mulga does burn more frequently in central than eastern Australia due to being embedded in a highly flammable spinifex-dominated landscape (Nano and Clarke 2008; Nicholas *et al.* 2009). Evidence suggests that the cessation of traditional Aboriginal patch burning of spinifex has led to shorter fire intervals in mulga communities across central and Western Australia, with negative impacts on mulga persistence (Bowman *et al.* 2008; Ward *et al.* 2014).

In contrast, fires in eastern Australian mulga communities have been infrequent since pastoral settlement in the 1860s. Most studies have involved small experimental burn plots, sometimes requiring the spreading of straw or hay to allow the passage of fire (Griffin and Hodgkinson 1986; Hodgkinson 1991, 1998). As a result, we have limited understanding of fire ecology in these communities, including the relationship between fire intensity and mortality of tree and shrub species including mulga, their ability to resprout post-fire and the effect of fire on germination (Wilson and Mulham 1979; Hodgkinson and Griffin 1982; Pressland 1982; Scanlan and Presland 1984; Jones and Burrows 1994).

Despite limited knowledge of mulga fire history and ecology, a dominant narrative posits that exclusion of fire due to high total grazing pressure and active suppression by pastoralists has led to woody vegetation thickening throughout the Mulga Lands (Moore 1973; Beale *et al.* 1986; Reynolds and Carter 1993; Noble 1997; Moore *et al.* 2001; Beale 2004; Witt 2013). This narrative has its roots early in pastoral settlement. For example, pastoralist J. T. Quinn told the 1901 NSW Royal Commission that the West Bogan country was open forest and 'remained like that until 1874, when it became stocked, and the bush fires, that previously every summer swept through it and kept down the scrub and undergrowth, became less frequent, and the scrub then grew to an enormous extent' (cited in Hodgkinson and Harrington 1985; p. 65). Early scientific articles cited only such anecdotal sources, often recorded during the 1901 Royal Commission, but these articles were then cited by others as authoritative evidence of change (Witt *et al.* 2006). Recent reports, policy documents and scientific publications typically begin with a statement categorising mulga country as highly degraded due to overgrazing and lack of fire (Moore *et al.* 2001; Beeton *et al.* 2005; Boyland 2006; Department of Natural Resources and Mines 2013; Eldridge *et al.* 2013), further entrenching this paradigm.

There is scant evidence to either support or refute assumed changes in fire regimes. Numerous authors have noted that fire would never have been a regular occurrence in mulga communities historically due to sparse biomass in most seasons (Dawson *et al.* 1975; Hodgkinson 2002; Bradstock 2010). Others argue that regular fires were critical in maintaining an open woodland structure and controlling densities of understorey shrubs (Mills 1986; Jones and Burrows 1994; Beale 2004). Here we present a fire history of the Mulga Lands of Queensland based on a review of explorer journals, early pastoralist diaries, newspaper articles, interviews with long-term landholders and examination of fire scars mapped from satellite data. This history will provide a basis for more informed and nuanced debates about the role of fire in the mulga-dominated communities of eastern Australia.

Methods

Study area

Mulga associations occur in a discontinuous belt from near the Western Australian coast across the central deserts to western New South Wales and Queensland between latitudes 20 and 35°S, and are estimated to occupy 1.5 million km^2 or 20% of the continent (Williams 2002). The Mulga Lands Biogeographic Region (Thackway and Cresswell 1995) – herein referred to as Mulga Lands – contains the most extensive tracts of mulga woodland and shrubland in eastern Australia. In Queensland they extend from Windorah and Thargomindah in the west to Augathella and St George in the east and encompass 79 000 km^2 of mulga-dominated communities (pre-clearing extent ≈111 000 km^2) (Fig. 1). The mulga belt continues for some distance south into New South Wales. The climate is semiarid, with rainfall decreasing from 500 mm in the east and north to 250 mm in the south-west. Rainfall is highly variable between years and is summer-dominant through Queensland, although winter rain becomes more common to the south. Summer temperatures are hot with maximums through December–February averaging 33–35°C, whereas short winters are characterised by cold nights (4–6°C) and warm days averaging 19–22°C through June–August.

Queensland's Mulga Lands are dominated by sandy red earths supporting woodlands and shrublands of mulga (*Acacia aneura*). *Eucalyptus* species including poplar box (*E. populnea*) and silver-leaf ironbark (*E. melanophloia*) are common components of mulga woodlands and shrublands, with yellow-jacket (*E. intertexta*) common in the east and western bloodwood (*Corymbia terminalis*) west of the Warrego River. Mulga becomes more open and stunted with decreasing rainfall and shrubs such as bastard mulga (*A. clivicola*, *A. sibirica*), turpentine/turkey bushes (*Eremophila* spp.) and hop-bush (*Dodonaea* spp.) become prevalent in the understorey. A broad distinction is made between 'soft' and 'hard' mulga based on soil depth and rockiness and vegetation height and density (Mills 1980). Botanical nomenclature follows Bostock and Holland (2007).

The Kunja, Budgiti, Kullilli, Mardigan and Bidjara people have lived in the Mulga Lands for at least 14 000 years (McKellar

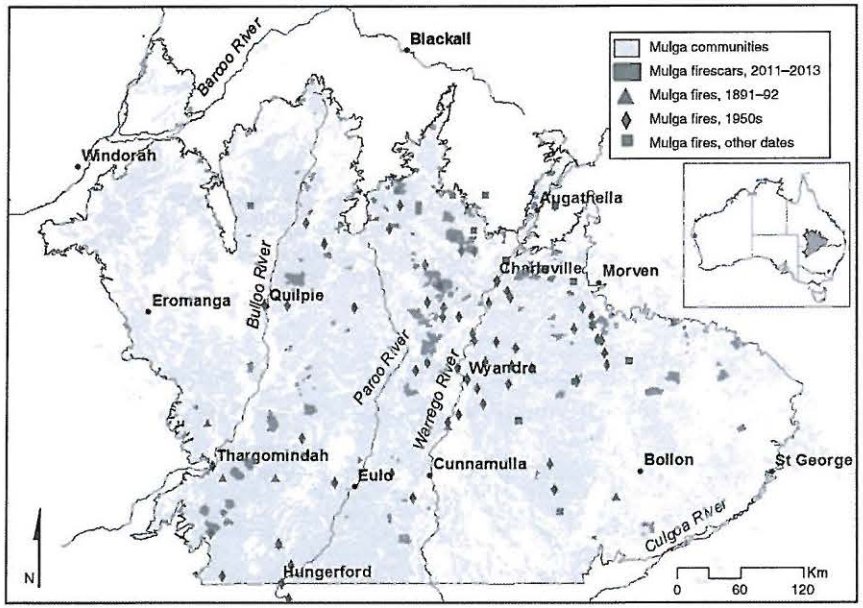

Fig. 1. Location map, showing Queensland portion of Mulga Lands biogeographic region, major towns and rivers. Remnant mulga-dominated communities are shaded grey; 2011–2013 fire scars in remnant mulga mapped from satellite are shaded dark grey. 1891–1892 mulga fires denoted by triangles, 1950s fire diamonds, other fires (mostly 1904–1921) squares.

1984; Robins 1993). Although the Australian desert had some of the lowest densities on record for human populations (Smith 2013), the Mulga Lands were a well peopled country (Robins 1997). People adapted to aridity by being highly mobile, making opportunistic use of temporary water and food sources after rains and falling back on permanent waterholes and springs as the country dried out (Robins 1993; Holdaway *et al.* 2000; Simmons 2007).

Europeans had been in Australia for 60 years before the first European set foot in the Mulga Lands. In 1847, Edmund Kennedy followed the Warrego River from its headwaters to south of present-day Cunnamulla (Beale 1983). Over a decade later, William Landsborough led one of four expeditions ostensibly in search of Burke and Wills but with a keen eye on the pastoral potential of the country. The last leg of his journey was through the northern Mulga Lands and down the Warrego River (Landsborough 1862). From the 1860s, pastoral settlement occurred alongside continued exploration. As Landsborough was 'exploring' the Warrego, Thomas Dangar had already established a station, whereas Vincent Dowling was laying claim to vast tracts of country to the south and west (Dowling 1859–1863). Thus there were just 10 years between Kennedy's expedition and the arrival of the first pastoralists. Within the next two decades, the pastoral frontier had enveloped nearly all of Queensland's Mulga Lands.

Sources used

Explorer journals, diaries of early pastoralists, property records, newspaper archives, historical documents and reports were searched for records of fires. The National Library of Australia (NLA 2015) has digitised a searchable record of Australian newspapers dating from 1805 to the mid-1950s, when copyright applies, and a limited number of newspapers post-1955 where the publisher's agreement has been given. Although state-wide newspapers *The Queenslander* and *Brisbane Courier* were established in the mid-1860s, papers covering western Queensland (chiefly the *Western Star* and *Western Champion*) were not established until the late 1870s. The Trove database was searched using the advanced search mode for articles with the words 'mulga' and 'fire' appearing anywhere within them including tags and comments. The names of all towns in the Mulga Lands and the word 'fire' were also entered into the search engine. More than 90 articles contained information about bushfires in the study area and the corrected text was saved in Microsoft Word documents. All relevant articles were imported into NVivo software analysis program and coding schemes created. Microfiche copies of the *Western Times* and *Cunnamulla Watchman* were searched at the Queensland State Library for the wet periods 1956–1960 and 1974–1980. Long-term land managers and residents of south-west Queensland were interviewed between 2012 and 2015 about their recollections and anecdotal knowledge of fires, which typically dated from the 1950s.

For each fire documented, the approximate area of mulga-dominated communities burnt was inferred through vegetation mapping, local knowledge and details of fire location and extent contained in the historical record. Broad-scale clearing of mulga-dominated communities occurred in the eastern Mulga Lands from the 1950s, with the highest rates of clearing occurring in the past 20 years. Today, 71% of original mulga-dominated communities remain classified as remnant vegetation (defined under the *Vegetation Management Act 1999* as vegetation covering more than 50% of the undisturbed predominant canopy, averaging more than 70% of the vegetation's undisturbed height, and composed of species characteristic of the vegetation's undisturbed predominant canopy) (Accad and Neldner 2015). In the Mulga Lands, this typically translates to uncleared woodlands and shrublands, although individual trees and/or patches may have been cut or pushed for fodder. The Queensland Herbarium's pre-clearing Regional Ecosystem (RE) mapping was used for calculating area of mulga burnt for pre-1990 fires, before widespread land clearing.

It should be noted that the sources for this study are limited to the post-contact period of 1850, and significant mortality through diseases had already occurred in Aboriginal populations across Australia well ahead of the frontier (Reynolds 1995; Hunter and Carmody 2015). These major population declines may have disrupted populations and their traditional land management practices for decades before the arrival of the first explorers and pastoralists. Not all fires would have been documented in newspaper articles, or recorded or remembered by long-term property owners. However, large fire events seem unlikely to have gone completely unrecorded. Thus although our results are not a comprehensive documentation of all fires occurring between the 1860s and 2005, they present a reasonable history of major fire events.

Fire scars (burnt areas) were mapped using satellite data from the North Australian Fire Information (NAFI) website for the years 2006–2014. This fire scar mapping is based on analysis of imagery from the Moderate Resolution Imaging Spectroradiometer on NASA's Terra satellite. The data are vector polygons derived from an image with a resolution of 250 m per pixel and each polygon is tagged with the month the fire was detected. The data extend across all of Queensland to 29°S latitude, but have not been validated by aerial and on-ground transects south of 20°, which includes the entire Mulga Lands (NAFI 2015). The 2011–2014 imagery was validated through phone calls to landholders and ground-truthing of more accessible fire scars; results indicated that the NAFI imagery detected >90% of large fires across the study area for this period, and few false fires were mapped.

The Landsat fire scars Queensland series is available from 1987 to 2014 (Department of Science, Information Technology and Innovation 2015). These datasets are statewide maps of fire scars as captured in a yearly series by all available Landsat imagery. In these products, on average, over 80% of fire scars captured in Landsat imagery have been correctly mapped with less than 30% false fire rate (Goodwin and Collett 2014). These data were used to detect fires preceding NAFI coverage of the study area (1987–2004), but were interpreted with caution as it was produced through completely automated mapping with no editing or quality checking (Lisa Collett, pers. comm., July 2015). Comparison of the 2010–2013 unvalidated fire scars with the NAFI product revealed that nearly all smaller fires were false fires, and all fires <1 km^2 were removed, whereas interviews with landholders and local knowledge also revealed some of the larger fires to be false. Non-fire-related groundcover changes (e.g. along rivers due to flooding) were also removed. The results presented here are still likely to overestimate mulga fires between 1987 and 2006.

These fire scar mapping products were projected to Albers Australian MGA94 projection and overlaid with remnant mulga communities (defined as mulga-dominated RE mapped by the Queensland Herbarium; Table 1). These totalled ~79 000 km^2 of mapped remnant mulga. Fires that burnt in other ecosystems (e.g. grasslands, creeklines) were excluded, as were fires in non-remnant (cleared) mulga. Area of each fire and total area burnt per year were calculated in ArcGIS 10.0.

Rainfall data for points on a 1-km grid spanning the Queensland Mulga Lands were obtained from the Queensland Government's Scientific Information for Land Owners (SILO 2015) and averaged for the study area. This average was used to derive a 2-year Foley's index (Foley 1957), calculated as actual rainfall for 2 years preceding every month minus expected 2-year rainfall divided by mean annual rainfall. This index was graphed to highlight conditions preceding major fire events (Fig. 2). Historical monthly and annual rainfall data from towns close to significant fire events from the Bureau of Meteorology (2015) were also examined.

Results

Over 140 references to fires in mulga country were located in the historical record between 1886 and 1980 (Appendix 1). They indicate fire events affecting between 3 and 10 properties occurred in the early 1890s, 1904, 1911 and 1918. The only region-wide fire event occurred in the early 1950s with >100 properties affected between January 1950 and November 1951. Substantial fire events affecting 20–40 properties occurred in the late-1970s and between 2011 and 2013. Smaller fires occurred infrequently between these times. It is often not clear from newspaper articles what types of country were burnt, but examination of historical run maps and vegetation mapping allows inferences to be made.

Pre-pastoral fires

There were no references to fire in mulga-dominated communities in the four explorer and early pastoralist journals examined: Edmund Kennedy and his second-in-command Alfred Turner in 1847 (both journals published in Beale 1983), William

Table 1. Mulga-dominated Regional Ecosystems (RE) as mapped by the Queensland Herbarium (2015) with brief description and notes on fire occurrence since 1860

Some similar ecosystems have been grouped. ML = Mulga Lands biogeographic region. Botanical nomenclature according to Bostock and Holland (2007)

RE	Description (occurrence)	Fire notes
	Soft mulga	
6.5.1, 6.5.2	*Acacia aneura, Eucalyptus populnea, E. melanophloia* open forest on undulating lowlands or Quaternary sediments (Eastern ML)	Big fires south of Morven in 1951 + smaller 2011 fires
6.5.3	*Eucalyptus populnea, Acacia aneura* ± *Eremophila mitchellii* woodland within *A. aneura* communities (Far-eastern ML)	Some fires in 1950s and 2011–2012; extensively cleared
6.5.5	*Eucalyptus populnea* ± *E. intertexta* +/– *Acacia aneura* +/–*Callitris glaucophylla* woodland (Bollon area)	No fires documented
6.5.6, 6.5.7	*Acacia aneura, Eucalyptus populnea* (+/– *E. intertexta* east of Warrego River) low woodland on run-on areas (Small occurrences west of Warrego, extensive to east)	Large areas burnt in 1951, occasional fires west of Warrego in 2011–2012; some cleared
6.5.8, 6.5.14	*Acacia aneura, Eucalyptus populnea* +/– *Eremophila gilesii* low woodland (Typical soft mulga of western ML)	Some 1891–1892, 1918, 1950s and 2012–2013 fires burnt into these communities
6.5.9	*Acacia aneura, Eucalyptus populnea* +/– *E. melanophloia* shrubby low woodland on Quaternary sediments	Far north-east; much cleared; infrequently burnt
6.5.10	*Acacia aneura* +/– *Eucalyptus populnea* +/– *Grevillea striata, A. excelsa, Hakea ivoryi* low woodland on sand plains (Mostly east of Warrego River)	Large areas burnt in 1951; no recent fires
6.5.11, 6.5.13	*Acacia aneura* +/– *Eucalyptus populnea* (+/– *E. melano–phloia and Brachychiton populneus* east of Charleville) low woodland on sand plains (Central–east ML)	Some burnt in 1950s + some relatively large fires in 2011–2012
6.5.15	*Acacia aneura, Eucalyptus populnea* +/– *Eremophila sturtii* tall open shrubland on sand plains (Hungerford area + along Bulloo River)	More fire prone than most mulga RE: fires in 1891, 1950s, 1974 and 2012–2013
6.5.18	*Acacia aneura* +/– *Eucalyptus populnea* +/– *E.melanophloia* +/– *Eremophila mitchellii* low open woodland on plains (Centred on Paroo River)	Some fires in north
	Low dunefields	
6.3.21	*Acacia aneura, A. excelsa* and/or *Geijera parviflora* low woodland on low alluvial sand dunes (South-east of Cunnamulla)	Few fires recorded
6.6.1, 6.6.1b	*Atalaya hemiglauca* +/– *Acacia aneura* +/– *Acacia* spp. +/– *Corymbia terminalis* tall open shrubland on low dunes over alluvium (North-west of Hungerford and Eromanga)	1950s fires would have burnt some of this country around Hungerford; no fires documented around Eromanga
	Hard mulga	
6.5.16	*Acacia aneura* groved with *Corymbia terminalis* or *C.blakei* tall open shrubland on Quaternary sediments (North-western ML)	Generally not fire prone due to low groundcover
6.7.9	*Acacia aneura* +/– *A. clivicola* +/– *Eremophila latrobei* tall open shrubland on residuals (Extensive in west)	Some areas burnt in south-west in 1950s, 1970s and 2012–2013
6.7.10	*Acacia aneura* +/– *Eucalyptus populnea* +/– *Corymbia terminalis* tall shrubland on residuals (West of Warrego)	Some burnt in 1950s and small areas in 2011–2012
6.7.11	*Acacia aneura* +/– *Eucalyptus cambageana* +/– *E.thozetiana* tall shrubland on residuals (Far north-east)	Much cleared; small fires post-2009
6.7.12	*Acacia aneura* +/– *Eucalyptus populnea* +/– *E.melanophloia* +/– *Eremophila gilesii* tall shrubland on residuals (Extensive in western and central ML)	Some small fires in 1950s and 2011–2012
6.7.17	*Eriachne mucronata* open grassland wooded with *Acacia aneura* and/or *Corymbia terminalis* on plains or flat tops of residuals (Scattered in western ML)	Grades into 6.7.9; can burn after good years

Landsborough in 1861 (Landsborough 1862) and Vincent Dowling's diaries between 1859 and 1863 (Dowling 1859–1863). These journals encompass ~1500 km travelled through mulga woodlands, including in summer of 1847 when Aboriginal people were firing the spinifex around Charleville and Cunnamulla. Vincent Dowling's diaries record country 'all being burnt' on 13 June 1861, but this was when travelling across floodplain country on the lower Warrego rather than in mulga. In areas that were regularly burnt by people, this was noted by the explorers (Vigilante 2001; Silcock *et al.* 2013). Thus, it seems that the mulga communities of western Queensland were not regularly burnt. However, Tommy Green, 'king of the Warrego blacks' talked of devastating droughts and wildfires, probably dating to around the 1850s (reported in the *Brisbane Courier*, April 22 1913, p. 6), indicating that occasional wildfires did occur.

The first decades of pastoralism: 1860s–1900

The first written reference to fire in Queensland's mulga country was found in Oxley (1987), who found property records

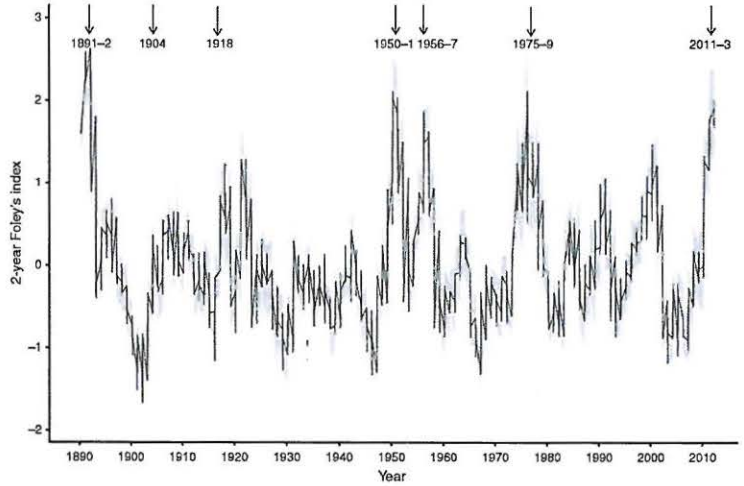

Fig. 2. Two-year Foley's drought index (actual rainfall for 2 years preceding every month minus expected 2-year rainfall divided by the mean annual rainfall) averaged for the Queensland Mulga Lands. Arrows denote fire events affecting >100 km^2. Rainfall records are not available before 1890, but there were fires c.1850 (see text).

indicating that 'thick mulga and box' on Thurulgoona–Bundaleer Run south-east of Cunnamulla was burnt and killed in 1886. This site is now on present-day Murra Murra, but no further details of the fire are given. An article published in *The Sydney Morning Herald* (20 December 1884, p. 16) described drought-stricken country across north-western New South Wales, including 'sticks that once were mulga trees, now dead by fire or effusion of time'.

The first large bushfires spanning multiple properties were recorded in the early 1890s, when large areas of mulga were burnt in the Cunnamulla and Thargomindah districts following extremely wet years in 1890–1891; in both years Cunnamulla received more than double its average annual rainfall. Bushfires were reported on five properties in the Cunnamulla district in January 1892 (*West Australian*, 15 January 1892, p. 1). These would have burnt large areas of grassland along the Warrego River, and a correspondent who visited Coongoola north of Cunnamulla in the winter of 1894 reported that '...mulga has been largely destroyed by the extensive fires which prevailed some time ago, thousands and thousands of acres having been decimated' (*Brisbane Courier*, 4 June 1894, p. 3).

After leaving Coongoola, the same correspondent travelled west to Thargomindah, reporting that 'From [Lake Bindegolly] right on to Thargomindah, the country is partly mulga (which, however, to a large extent had been destroyed by fire)...' This would refer to large fires in November 1891, which were reported to be raging on Boorara, Dynevor Downs, Thargomindah and Norley runs, as well as on numerous properties in New South Wales (*Sydney Morning Herald*, 13 November 1891, p. 6). These fires feature in evidence tendered in the Land Court between 1897 and 1899, and were central to a dispute regarding lease valuations for Norley and Thargomindah Pastoral Runs, as reported in the *Brisbane Courier* and *The Queenslander*. The lessee, Mr F. W. Armytage, and the Crown witnesses had differing opinions about the condition of the mulga and effects of the 1891–1892 summer fires. Mr Armytage and his legal team stated that 70–80% of mulga had been killed and was not regenerating due to high rabbit and stock numbers, whereas the grass was not growing on the burnt country (*Brisbane Courier*, 8 October 1897, p. 7). However, Crown witnesses estimated that only one-eighth of the mulga had been destroyed, and mulga regeneration and grass growth were actually improved by fire (*The Queenslander*, 30 July 1898, p. 232; *Brisbane Courier*, 11 August 1899, p. 7).

The Thargomindah fires were probably contemporaneous with those which occurred south-east of Cunnamulla, which were reported in later Land Court hearings with similarly divergent opinions about their effect on the country. On Yancho North, 'there were large stages where the mulga had been burnt down by bush fires, with the result that the grass had been growing more vigorously and was more nutritious than before'. However, the manager of neighbouring Fernlee reported that 'the mulga had been burnt by bush fires, and now there was a thick scrub of box suckers growing there' (*Western Star*, 3 March 1897, pp. 2–3). The remainder of the 1890s was dry and no further fires are reported.

1900–1950

The period from 1900 to 1950 is characterised by infrequent bushfires, mostly restricted to between 1 and 10 properties, even though means of controlling these fires were rudimentary (e.g. *Western Star*, 10 December 1904, p. 2; *Sunday Times*, 4 December 1921, p. 3; Bunning 1933). Substantial areas of mulga (~500–2000 km^2) were burnt in three fire events over this 50-year period: south-east of Charleville in December 1904 and September–October 1911 and north-west of Charleville in 1918. Other fires documented were restricted to one or two properties and burnt only small areas of mulga (Table 2; Appendix 1).

In December 1904, a wildfire burnt for 3 weeks on Tomoo, Clifton, Bendena and Cobbrum stations north-east of Cunnamulla. The *Cunnamulla Watchman* reported that there had been no stock on Tomoo for some time, and the grass was high and the mulga 'thick and dry'. This fire spread through predominantly mulga communities to Clifton and Cobbrum blocks some 80 km to the south-east, which were also unstocked (*Western Star*, 10 December 1904, p. 2). Fires started by lightning on Gowrie, Dillalah and Murweh in the Charleville district (*Western Star*, 10 December 1904, p. 2) probably burnt some mulga, but other vegetation types are dominant on these properties. A large wildfire on Norley and Ardoch north of Thargomindah in December 1906 (*Queensland Times*, 15 December 1906, p. 8) probably burnt mostly floodplain country along the Bulloo River.

Fires along Nebine Creek south-east of Charleville and between Morven and Charleville in September–October 1911 (*Sydney Morning Herald*, 30 September 1911, p. 17; *Northern Miner*, 26 January 1912, p. 5) would have burnt <500 km^2 of mulga-dominated vegetation. Large fires occurred on Auburn Vale west of Charleville in March 1918 (*Brisbane Courier*, 7 March 1918, p. 6) and on Mt Morris and neighbouring stations in November 1918. The latter was crowning through the mulga on Mt Morris and swept east to Koreelah and Oak Park, more than 80 km away, with 'beaters' from Charleville refusing to work due to a pay dispute:

> *'As the country is heavily timbered in places, the flames ascend overhead, and it is impossible to control them. The fire swept across to Koreelah and Oak Park... A number of beaters in the Charleville district demand £3 per night, and on this being refused, they would not go out'* (*The Farmer and Settler*, 26 November 1918, p. 4).

Table 2. Major fire events in mulga-dominated communities (>50 km^2 of mulga-dominated communities burnt), 1880s–present, based on newspaper archives, property records and interviews
For details of fires and sources see Appendix 1

Month/year	Region	Properties affected	Mulga burnt (km^2)	Notes
1886	South-east of Cunnamulla	1	<100	Single fire, burnt mulga and box
Dec. 1891	Thargomindah	4	650	Large fires on Boomara, Dynevor Downs, Norley and Thargomindah Runs
Jan. 1892	Cunnamulla	6	400	Mostly grassland along Warrego River; mulga burnt on Coongoola, Fernlee and Yancho
Dec. 1904	North-east of Cunnamulla	5	2000	Burnt through unstocked mulga and long grass, from Tomoo to Cobbrum (~80 km)
Sept.–Oct. 1911	South and east of Charleville	4	500	Along Nebine Creek
Mar. 1918	West of Charleville	1	200	Auburn Vale fire
Nov. 1918	North-west of Charleville	5	1500	Burnt from Mt Morris to Oak Park (~80 km), crowning through mulga
Dec. 1921	North-west of Adavale	3	100	Fire on back of Milo
Oct. 1941	Stonehenge	1	50	Fire in thick mulga on Barcoonah
Jan. 1950	Wyandra	13	800	Extensive wildfires, including Warrego grassland and mulga
Jan. 1950	Adavale	4	400	Multiple but relatively small fires
Dec. 1950–Mar. 1951	North-west of Charleville	11	1500	Four large fires: two centred on Ambathala, Ricartoon/ Guestling and Inkerman to Cairns
Jan.–Feb. 1951	Wyandra-Charleville	60	10 000	Largest fire event in European history; details of properties and areas in Appendix 1
Feb. 1951	Quilpie	2	100	Centred on Comongin
July–Nov. 1951	Morven-Charleville	20	2000	Series of fires, largest one centred on Boatman in Sept.–Oct. 1951
Jan. 1957	Hungerford	>5	1500	Leapt the NSW border and burnt north to Dynevor Lakes (~100 km)
1976–1979	Wyandra, Cunnamulla and Quilpie	~20	<2000	Fires recorded, but none on the scale of the 1950s
Feb.–Mar. 2011	North-eastern Mulga Lands	6	100	Series of mostly small fires, some deliberately lit; largest burnt 74 km^2
Aug.–Nov. 2011	Northern Mulga Lands, from Adavale to Mitchell	21	790	Mostly small fires started by lightning; largest 162 km^2 (Koreelah); all fires >30 km^2 around Charleville
Oct. 2012–Jan. 2013	Central and western Mulga Lands	35	2000	Larger, higher intensity fires around Thargomindah and west of Charleville

These fires occurred on the back of exceptional rainfall in 1917 and into early 1918 (Charleville recorded 856 mm between September 1917 and March 1918), followed by the sudden onset of dry conditions (Bureau of Meteorology records; Fig. 2). It is difficult to reliably estimate the area of mulga burnt, but mapping all mulga communities on the affected stations, these fires could have burnt up to 1500 km^2 of mostly 'hard' mulga (RE 6.5.8 and 6.5.14; Table 1).

Western Queensland did not experience the huge conflagrations which engulfed the Bourke and Cobar districts of western New South Wales in November 1921 and January 1932, in which ~8000 and 12 000 km^2 were burnt (*Sydney Stock and Station Journal*, 8 November 1921, p. 11; *Sydney Morning Herald*, 13 January 1932, p. 13; Kerle 2008). In contrast, Queensland's mulga fires during the 1920s–1940s were localised and burnt only small areas of mulga (Table 2; Appendix 1). A large fire on Milo north-west of Adavale in December 1921 would have burnt a mixture of grassland and mulga (*Cairns Post*, 14 December 1921, p. 2). Bushfires around Cunnamulla in November 1922 (*Cairns Post*, 21 November 1922, p. 5) and south-west of Thargomindah in February 1927 (*Townsville Daily Bulletin*, 17 February 1927, p. 5) probably burnt mostly grassland, while bushfire smoke was mentioned around Charleville in October 1928 but no further details are given (*Brisbane Courier*, 20 October 1928, p. 1). In 1941, 12 000 acres (48 km^2) of 'heavily timbered mulga country' on Bancoorah west of Stonehenge were burnt in a wildfire, which burnt from Warbreccan up the western side of the Thomson River for ~30 km (*The Morning Bulletin*, 11 October 1941, p. 4).

1950s fires

The 1950s were characterised by two periods of exceptional summer rainfall (Fig. 2) and subsequent massive wildfires. Charleville and Cunnamulla experienced twice their annual average rainfall in 1949 and 1950, the latter being the wettest year since 1890. Fires began in January 1950 between Charleville and Cunnamulla, with the *National Advocate* reporting that:

> *'Men from homesteads are fighting the fires with bags and branches and an urgent call for help is being sent out. The fires are reported to be spreading from the Paroo River to the Warrego about 40 miles away. They have already burnt out thousands of acres...'* (3 January 1950, p. 1).

Over the next month, at least 10 more fires broke out around Adavale, Charleville and Wyandra (Table 2; Fig. 1). Some of these were substantial, burning up to 100 000 acres (400 km^2). Mr R. P. Healy of Queensland's Rural Fire Board warned that conditions were similar to those experienced in 1918, which had been the last severe year of bushfires in western Queensland (*Sunday Mail* 18 June 1950, p. 2). It seems that the general lack of fires in the first half of the 20th century had bred complacency, as the paper reported that there were no firebreaks or bush fire brigades west of Nindigully near St George at this time.

A fire on Ambathala north-west of Charleville in December 1950 (*Morning Bulletin*, 30 December 1950, p. 4) heralded the start of a catastrophic fire period. Between January and March 1951 an estimated seven million acres (28 300 km^2) were burnt in the Charleville, Adavale, Augathella, Cunnamulla, Thargomindah and Wyandra areas (*Cairns Post*, 23 July 1951, p. 1; Table 2). The fires were described in >50 newspaper articles in apocalyptic language, with descriptions of clouds of smoke, dead and burnt animals and vast tracts of scorched earth (Appendix 1).

The largest fires were centred on Wyandra, with at least 30 separate fires reported in January and February 1951. These sometimes merged into massive fire fronts spanning up to 100 km, which burnt for weeks. Children were evacuated and businesses closed in Charleville to provide reinforcements for the hundreds of men who had been fighting fires for many days (*Sydney Morning Herald*, 19 January 1951, p. 3). Local graziers remember standing outside at night and seeing flames and smoke in all directions (Peter Crook-King, pers. comm., April 2012; Don Moody, pers. comm., June 2015). Aerial surveys in the aftermath of the fires revealed that 62 properties were affected and some were almost completely burnt out.

Although there is no doubting the extent or severity of these fires, some newspaper articles were exaggerated or inaccurate and need to be interpreted with care. For example, the *Northern Miner* carried a report of a '90-mile [fire] front from 36 miles south of Charleville north-west to Coniston' (13 February 1951, p. 1). Coniston is actually south-east of Charleville, and the distance between the locations is 55 miles. This is still a huge fire, but cautions against taking the figures of areas burnt too literally. Taking a conservation approach based on newspaper articles, interviews and vegetation mapping, 10 000 km^2 of mulga-dominated vegetation may have been burnt in the Wyandra district in January–February 1951. This is close to the 2.5 million acres of burnt mulga estimated by the Lands Minister Mr Foley after an aerial reconnaissance (*Courier Mail*, 2 April 1951, p. 4).

There were also fires north-west and west of Charleville, north of Quilpie, west of Cunnamulla and between Hungerford and Thargomindah during these months (Appendix 1). The largest of these burnt from the Vinegar Hill railway siding 40 km south-west of Charleville some 60 km north-west to Cairns and Warilda through a mosaic of hard (RE 6.7.12) and soft (RE 6.5.8) mulga country in February 1951 (Table 2). The following month, a wildfire burnt through 120 km^2 encompassing five properties north-west of Charleville, a total distance of 50 km. Barbara Marks remembers fighting this massive fire with only two small tractors and pieces of damp hessian and leather on sticks. It eventually stopped at the Langlo River (Barbara Marks, pers. comm., April 2012).

Following a dry winter, the fires began again July–August 1951 to the south of Morven (Table 2; Appendix 1). The largest fire burnt from the Balonne highway to Morven in September–October 1951, burning a total of 800 km^2 over 25 days, much of it mulga country (Peter Crook-King, personal records). These fires were fanned by extreme weather conditions, as described by the *Courier Mail*:

> *'Swirling dust storms last night blanketed 100 000 square miles of far south-western Queensland. They sent bushfires leaping away from fire fighters and cut visibility to a few hundred yards...'* (27 November 1951, p. 1).

The last of the large fires south of Morven occurred in early 1952, by which time an additional 1500 km^2 of mulga-dominated country had been burnt (inferred from Peter Crook-King's personal records). There were also five large fires reported in the Charleville district in October–November 1951, which killed 15 000 sheep (*Townsville Daily Bulletin*, 2 November 1951, p. 2) and smaller fires around Cunnamulla and Hungerford in August and October (*Courier Mail*, 20 August 1951, p. 3; *Courier Mail*, 17 October 1951, p. 1; *Queensland Country Life*, 27 December 1951, p. 11; Appendix 1).

By 1954, the bushfire risk across south-western Queensland was reported to have eased considerably (*Central Queensland Herald*, 16 December 1954, p. 24), although a couple of small fires occurred around Charleville. The *Central Queensland Herald* reported fires around Charleville and Cunnamulla at the start of 1956, the largest of which burnt 24 km^2 on Wallen north-west of Cunnamulla (12 January 1956, p. 29), whereas fires in the Cheepie and Quilpie districts in November 1956 burnt ~20 km^2 (Appendix 1).

In January 1957, following the wettest year since 1890 at Hungerford, a huge fire which had burnt over half-a-million acres (2000 km^2) in New South leapt the dingo fence on the Queensland border and burnt uncontrolled into Currawinya, Moombidary and Zenoni stations to the north of Hungerford. *The Canberra Times* (8 January 1957, p. 1) reported that on Currawinya the fire had jumped breaks and was threatening the Moombidary homestead, meaning it had travelled at least 30 km. Part of the fire had burnt 400 km^2 at Zenoni 40 km to the north-west, and the fires could be seen at stations 50 miles away. The wildfire was finally halted at the Dynevor Lakes (Ian Pike, pers. comm.), by which time it had burnt a distance of ~100 km from Hungerford, probably including at least 1500 km^2 of mulga-dominated communities in Queensland. This is mostly relatively open mulga on sandplains and low dunes sometimes with an *Eremophila*-dominated understorey (RE 6.5.15 and 6.6.1) and harder stunted open mulga (RE 6.7.9) grading into *Eriachne mucronata* grassland with scattered mulga (RE 6.7.17) (Table 1).

Based on the historical record and vegetation mapping, over 15 000 km^2 of mulga-dominated communities were burnt between January 1950 and December 1951. The fires were invariably reported in a negative light, with grave concerns expressed about the loss of valuable mulga fodder reserves (e.g. *Courier Mail*, 2 April 1951, p. 4; *Morning Bulletin*, 4 May 1951, p. 6), which had also been affected by fodder harvesting and dieback during the 1940s drought and was not regenerating in most areas (*Queensland Country Life*, 10 October 1946, p. 4; 28 November 1946, p. 1; 18 December 1947, p. 11). A grazier reported that 'all the young mulga sent up by the heavy rains has been destroyed in the burnt areas...It will take years to grow again' (*The Courier Mail*, 19 February 1951, p. 5). A scientific study found that day fires had killed large expanses of mature mulga, but in areas burnt at night few trees were killed (Everist *et al.* 1958). No newspaper or scientific articles were found which perceived the fires as beneficial.

1960s–2000s

In the wake of the 1950s fires, there was a shift away from reactive fire-fighting to active prevention of fires. This goal was aided by the advent of large machinery to construct breaks, faster and more reliable means of transport and aeroplanes, which were able to 'spot' fires (*Courier Mail*, 14 February 1951; *Morning Bulletin*, 4 May 1951). No references to fire were found for the 1960s which, with the exception of 1961–1962, was a decade of below-average rainfall across the study area (Fig. 2).

Fires occurred through the central and western Mulga Lands following the wet summers of the mid-1970s (Fig. 2), but were able to be controlled quickly and effectively relative to the 1950s (Bean Schmidt, pers. comm., April 2013; Barbara Marks, pers. comm., May 2013). Western Queensland did not experience the huge wildfires of central and south-western New South Wales, which burnt 40 000 km^2 in December 1974 and January 1955 (Wilson and Mulham 1979). A fire north-east of Quilpie in December 1974 burnt 7000 acres (~30 km^2) of mostly hard mulga interspersed with *Eriachne mucronata* grassy ridges (*Western Times*, 12 December 1974, p. 1). Bushfires occurred around Cunnamulla in November and December 1976, burning out more than 1200 km^2 of 'grassland and mulga' fanned by wild stormy conditions (*Cunnamulla Watchman*, 17 November 1976, p. 4; 8 December 1976, p. 1). Newspapers carried warnings about the 'novel' wildfire risk due to the body of grass resulting from good seasons, with the *Watchman* reporting:

> *'Some sound organisation of the Bush Fire Brigades in the district kept most of the fires to a minimum, with the exception being a fire east of Cunnamulla which covered an area of 121 500 ha...Brigades...are in the best organised condition in their history...It is refreshing to report sound preparedness in an area which, for various reasons, has not suffered severe fire damage for many seasons'* (*Cunnamulla Watchman*, 1 February 1978, p. 5).

United Graziers Association general secretary Arthur Stephens called summer fires 'the scourge of the pastoralist', and the *Western Times* (21 December 1978, p. 5) carried a warning that graziers would be liable for damage to neighbour's property and pasture if they did not take 'prompt and efficient' action to extinguish a fire. There were later fires around Wyandra in 1979–1980 during dry conditions, but these were mostly contained and burnt relatively small areas. A wildfire on mulga sandplains near Eulo in 1979 is documented by Evenson and Connolly (1992).

Satellite imagery from 1987 to 2004 is uncorrected and many 'false fires' are mapped (see Methods). Nevertheless, only small sporadic fires occurred in remnant mulga, with 1991 being the only year where apparently >20 km^2 of mulga-dominated communities were burnt (Table 3). From 2005–2010, the data are corrected. There were no fires between 2005 and 2008, whereas 2008 and 2009 saw 10 small fires in the far north-east of the Mulga Lands. However, no fires burnt considerable areas of mulga in the period 1987–2010. Even including the 'false fires' only 169 km^2 or 2% of remnant mulga was burnt in this 23-year period.

2010 to present

The year 2010 was the wettest since the 1950s across the Mulga Lands, and the wettest year since 1890 in the north (Fig. 2). There were small fires in the far north-east of the Mulga Lands in

Table 3. Fires in mulga-dominated communities, Queensland, mapped from satellite imagery (1987–2014)
The 1987–2004 data are uncorrected and includes some 'false fires' (see Methods)

Year	Number of fires detected	Area burnt, km^2	Mean fire area (range), km^2	Months
1987	0	0.00	n/a	n/a
1988	2	3.73	1.87 (1.03–2.7)	Nov.
1989	5	10.29	2.06 (1.09–3.51)	Jan.–Mar., Dec.
1990	8	15.23	1.90 (1.17–2.93)	Sept.–Dec.
1991	4	27.8	6.94 (1.1–23.6)	Jan., Dec.
1992	0	0.00	n/a	n/a
1993	1	2.36	2.36	Mar.
1994	0	0.00	n/a	n/a
1995	2	3.59	1.80 (1.48–2.11)	Jan., Dec.
1996	4	17.34	4.34 (1.38–7.84)	Feb.–Mar., Dec.
1997	2	2.48	1.24 (1.14–1.34)	Aug., Dec.
1998	0	0.00	n/a	n/a
1999	6	18.03	4.34 (1.38–7.84)	Feb., Oct.
2000	5	13.72	2.74 (1.22–4.68)	Jan., Nov.
2001	5	11.63	2.33 (1.23–5.27)	Feb., Sept.–Nov.
2002	1	2.41	2.41	Jan.
2003	0	0.00	n/a	n/a
2004	1	4.91	4.91	Dec.
2005	1	2.59	2.59	April
2006	0	0	n/a	n/a
2007	0	0	n/a	n/a
2008	5	18.55	3.71 (0.35–9.02)	Oct.–Nov.
2009	5	14.51	2.90 (1.04–5.51)	Oct.–Dec.
2010	0	0	n/a	n/a
2011	41	894.31	21.81 (0.28–162.32)	Feb., Aug.–Nov.
2012	58	1782.96	30.74 (2.06–166.03)	May–Dec.
2013	19	335.98	17.68 (1.91–104.52)	Jan.–Feb., May, Oct.–Dec.
2014	6	28.07	4.68 (1.25–17.52)	Jan.–Sept.

February–March 2011, which burnt ~100 km^2 of mulga. Following good late summer rain and a dry autumn and winter, almost 800 km^2 of mulga was burnt between September 2011 and the first summer rains in December 2011 and January 2012, mostly in the Charleville area (Table 3). These fires were mostly caused by lightning strikes, but some were deliberately or accidentally lit. All fires were patchy at various scales, and even diurnal fires tended to pull up within 50–60 m where mulga density increased. Where it did burn through thick mulga, it did not usually get hot enough to kill mature trees (J. Silcock, unpubl. data).

On the back of a dry winter–spring period, a series of hot wildfires occurred through the central and south-western Mulga Lands in spring–summer of 2012–2013. Almost 80 fires were mapped in mulga-dominated communities, burning ~2000 km^2, mostly in December 2012 (Table 3). These fires were typically of high intensity, with one crowning through hard open mulga on stony ridges and leaping the Hungerford–Thargomindah road in October 2012. These fires, along with spectacular pictures, were reported in newspapers and television reports across Australia, and killed >80% of mulga trees (J. Silcock, unpubl. data). The total area burnt in 2011–2013, the only significant fire event in the past 40 years, was 3040 km^2 (3.8% of remnant mulga-dominated communities). Since February 2013, there have been only scattered small fires in mulga communities, as the groundcover returns to the low levels typical of dry seasons.

Discussion

Our results clearly demonstrate that fires are not a regular feature of mulga communities in south-western Queensland, and arise following unusual weather events. Fire events affecting multiple properties occurred in 1891–1892, 1904, 1911 and 1918, 1950–1951, 1956–1957 and the 1970s. The total area burnt in all fires documented between pastoral settlement in the 1860s and 1949 is estimated at 6000 km^2 (or 7% of pre-clearing mulga extent) across 30–40 properties (Table 1; Appendix 1). The only wildfires since pastoral settlement which burnt a substantial area of mulga at a regional scale occurred between January 1950 and November 1951, affecting ~90 properties in the Wyandra–Charleville–Morven area and a further 15 north-west of Charleville. Including later fires in 1956–1957, most notably north of Hungerford, a total of 16 000 km^2 or ~20% of pre-clearing mulga-dominated communities burnt during the 1950s. The summer fires experienced between 2011 and 2013 seem to have been of a similar extent and intensity to the 1891–1892, 1911 and possibly the 1970s fires, but affected larger areas than the 1904 and 1918 fires. Fire regimes have changed to the extent that, once ignited, fires since the 1950s have burnt smaller areas due to improved ability, both proactive and reactive, to contain them.

All fire events, with the exception of 1904, occurred with the onset of dry conditions following at least 2 years of well above-average summer rainfall, which provided sufficient groundcover, predominantly grasses, to carry fire. The 1904

event was a single wildfire, which burnt through unstocked properties after the worst drought on record (Fig. 2) – which killed extensive areas of mulga (Anon. 1903) – had been broken by 670 mm of rainfall during the previous 12 months. These results confirm that fire occurrence in mulga communities is strongly dependent upon unusually high groundcover following irregular high-rainfall periods (Dawson *et al.* 1975; Hodgkinson 2002; Turner *et al.* 2011).

Is it possible that in the pre-pastoral landscape without livestock and much lower densities of native herbivores (Silcock *et al.* 2013) and a more open vegetation structure in some areas (Witt *et al.* 2009) fire could have been more prevalent? The assumption of frequent pre-pastoral fires, whether deliberately lit or started by lightning, is not supported by the explorer or early pastoralist record or our knowledge of mulga fire history in areas of central and Western Australia where pastoralism is not pervasive (Kimber 1983; Fox 1986; Start 1986). Fires in mulga communities are naturally rare and pastoral management has not, on the whole, created the contemporary fire regime. Assertions that fires 'swept through' and 'cleaned up' vegetation on a regular basis, such as were made during the 1901 Royal Commission (Noble 1997), are patently false. Fires can only burn appreciable areas of these naturally low-productivity communities in exceptional seasons. For most of the time, even in the absence of grazing, herbaceous fuel loads are insufficient and too patchy to carry fires. After above-average summer rainfall, fuel loads of between 0.39 and 1.31 tonnes per hectare were recorded at three central Mulga Lands exclosures protected from grazing, including macropods, for the past 25 years (Fensham *et al.* 2011).

As in other semiarid environments, the passage of fire depends on exceptional antecedent rainfall to produce sufficient fuel mass and spatial continuity (Swetnam and Betancourt 1990; Veblen *et al.* 1999; Grissino-Mayer *et al.* 2004; Krawchuk and Moritz 2011; O'Donnell *et al.* 2011, 2014). Extreme weather conditions (high winds and low humidity) are also required to fan large hot fires, due to the inherent spatial patchiness of fuel loads even in good seasons. Our fire history suggests that one-third of the total area of mulga-dominated communities in Queensland has burnt since pastoral settlement (more than 150 years). However, some areas are very unlikely to burn due to inherently low or patchy groundcover even after exceptional rainfall, notably the low dunefields and sandplains in the south-east of the Mulga Lands and groved hard mulga in the north-west (RE 6.3.21, 6.5.16 and 6.7.12; Table 1). Other areas appear multiple times in the fire history, notably around Wyandra (1904, 1911, 1950s and 1970s), north-west of Charleville (1918, 1951, 2011–2012) and the Thargomindah district (1891, 1951, 1957, 2012–2013), encompassing more open mulga with poplar box and open shrublands with perennial grassy groundlayers dominated by *Eriachne mucronata* ± *E. helmsii* ± *Amphipogon caricinus* (Table 2). Nevertheless, even the most fire-prone sites have only burnt a maximum of three times in the past 150 years (suggesting a fire return interval of ~50 years), whereas two-thirds of mulga communities have not burnt since pastoral settlement. This is a much lower frequency than previous estimates of average fire returns in mulga-dominated communities of ~30 years (Pressland 1982; Hodgkinson 2002).

Conclusion

Close examination of the historical record shows that fires in mulga-dominated communities are infrequent events requiring specific climatic sequences, and have burnt relatively small areas since pastoral settlement. We cannot say definitively the extent to which 150 years of pastoralism has limited opportunities to burn, through reduced fuel loads and increased shrub and tree densities in some areas particularly since the 1950s (Witt *et al.* 2009). However, available evidence suggests that fires only occur after exceptional seasons. This finding is consistent with semiarid regions around the world (Swetnam and Betancourt 1990; Grissino-Mayer *et al.* 2004; Krawchuk and Moritz 2011) and in Australia (O'Donnell *et al.* 2014; Gosper *et al.* 2016). Vegetation communities that burn more frequently occur in higher-rainfall environments and/or have vegetation that promotes build-up of highly flammable litter, bark or dead plant material (Noble *et al.* 1980; Allan and Southgate 2002; Felderhof and Gillieson 2006; Murphy *et al.* 2010). Given the constraints of climate on fuel loads in mulga-dominated communities, fires at intervals greater than 30–50 years seem unlikely, even with destocking and macropod suppression. Sweeping continental narratives reinforcing the ecological importance of frequent fires (e.g. Flannery 1994; Gammage 2011) are not applicable to low-productivity, dry ecosystems such as the mulga-dominated vegetation of eastern Australia where fire events are limited to infrequent and exceptional circumstances.

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Appendix 1. References to fires in Queensland's Mulga Lands found in historical record, 1847–1960, in chronological order

Fires which burnt >50 km^2 of mulga-dominated communities are bolded. These events are mapped in Fig. 1 and summarised in Table 2. All newspaper articles prior to 1957 were accessed through the National Library of Australia Trove website (NLA 2015); later newspaper articles are held at the Queensland State Library

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km^2)
Nov.	1847	South of Charleville	–26.517	146.119	Edmund Kennedy, in Beale (1983)	Aboriginal people burning grass on the floodplain/poplar box woodland along Warrego River or spinifex further back from river	0
Nov.	1847	South-east of Cunnamulla	–28.716	145.930	Edmund Kennedy, in Beale (1983)	Probably spinifex (*Triodia marginata*) grassfires	0
??	c.1850s	Charleville area	–26.407	146.244	Brisbane Courier, 22 April 1918, p. 6	Tommy Green, Aboriginal elder, remembers devastating drought and vast wildfire in Charleville district sometime around 1850s	??
June	1861	Lower Warrego, Fords Bridge district	–29.686	145.433	Dowling (1859–1863)	Commented that 'country had all been burnt' along lower Warrego River; probably mostly floodplain	0
Mar.	1881	Norley, Thargomindah	–27.432	143.611	Queenslander, 19 March 1881, p. 366	'Bush on fire to the north' [of Norley]	??
Dec.	1884	Bourke district	–30.095	145.943	Sydney Morning Herald, 20 December 1884, p. 16	Long article describing drought-stricken country across north-western NSW, including 'sticks that once were mulga trees, now dead by fire or effusion of time.'	??
??	**1886**	**Thurulgoona, Cunnamulla**	**–28.381**	**146.776**	**Oxley (1987)**	**Thick mulga and box burnt and killed; same area not burnt in 1950s**	**<100**
Dec	1887	South-east of Bourke	–30.662	146.419	Wagga Wagga Advertiser, 24 December 1887, p. 5	A bush fire which had been raging south-east from [Bourke] for some days was extinguished by the rain	??
??	1887	Boorara, Hungerford	–28.657	144.384	Brisbane Courier, 12 October 1897, p. 7	Evidence tendered to Land Court: 'There was no big fires before 1887. It took the country a long time to improve after a fire.'	??
??	1890s	General (western Queensland)	n/a	n/a	Bunning, in Courier Mail 20 September 1933, p. 20	Recollections of large bushfires in 1890s following good seasons + description of methods used to fight them	??
Nov.	**1891**	**Boorara, Hungerford**	**–28.657**	**144.384**	**Sydney Morning Herald, 13 November 1891, p. 6**	**Big fires raging on these stations, as well as others to the south and west**	**See below**
Nov.	**1891**	**Norley, Thargomindah**	**–27.615**	**143.773**	**Sydney Morning Herald, 13 November 1891, p. 6**	**Big fires raging on these stations, as well as others to the south and west**	**See below**
Nov.	**1891**	**Thargomindah Station**	**–28.085**	**143.905**	**Sydney Morning Herald, 13 November 1891, p. 6**	**Big fires raging on these stations, as well as others to the south and west**	**See below**
Nov.	**1891**	**Dynevor Downs, Thargomindah**	**–28.086**	**144.356**	**Sydney Morning Herald, 13 November 1891, p. 6**	**Big fires raging on these stations, as well as others to the south and west**	**See below**

(*continued next page*)

Appendix 1. (*continued*)

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km^2)
Nov.	**1891**	**Norley, Thargomindah**	**–27.615**	**143.773**	**Brisbane Courier, 8 October 1897, p. 7**	**'The fires which injured the mulga were in the end of 1891, when over 80 per cent of the bush was burnt on Norley, and ~70 per cent on Thargomindah. The mulga had not recovered, and in his opinion never would. Young mulga was not springing up owing to the want of seasonable rains, and would not spring up until the stock was eased off. The rabbits, too, kept it back.'**	**200**
Nov.	**1891**	**Thargomindah Station**	**–28.085**	**143.905**	**Brisbane Courier, 8 October 1897, p. 7**	**...~70 per cent [of the bush burnt] on Thargomindah. As above.**	**150**
Nov.	**1891**	**Norley and Thargomindah Stations, Thargomindah**	**–28.085**	**143.905**	**Brisbane Courier, 11 October 1897, p. 7**	**...since [the best seasons known] there had been destruction of the mulga by fire and the influx of rabbits...There was a dispute as to the area of mulga destroyed, and Mr. Gibson approximated it at one-eighth, but Mr. Powell, after a visit of a few days, said that nearly all of it was destroyed. That was an extraordinary contradiction. (Mr. Powell: 'I was living there when it was burnt.') The only way the mulga could be killed was by a fire in heavy grass.'**	**??**
Nov.	**1891**	**Boorara, Hungerford**	**–28.657**	**144.384**	**Brisbane Courier, 11 October 1897, p. 7**	**Had heavy fires on the run in 1891, and some of it had never recovered**	**??**
Nov.	**1891**	**East of Thargomindah**	**–28.020**	**144.017**	**Brisbane Courier, 4 June 1894, p. 3**	**From [Lake Bindegolly] right on to Thargomindah, the country is partly mulga (which, however, to a large extent had been destroyed by fire...**	**300**
Jan.	1892	Coongoola, Cunnamulla	–27.652	145.824	West Australian, 15 January 1892, p. 1	'Bushfires...have done much damage to the fences'; large areas of grassland along Warrego River but also apparently burnt large areas of mulga (see below)	0
Jan.	**1892**	**Coongoola, Cunnamulla**	**–27.652**	**145.824**	**Brisbane Courier, 4 June 1894, p. 3**	**'Unfortunately mulga has been largely destroyed by the extensive fires which prevailed some time ago, thousands and thousands of acres having been decimated.'**	**400**

Jan.	1892	Charlotte Plains, Cunnamulla	–28.077	146.180	West Australian, 15 January 1892, p. 1	As above; probably burnt flooded country + possibly some mulga ridges	10
Jan.	1892	Weelamurra, Cunnamulla	–28.220	146.209	West Australian, 15 January 1892, p. 1	As above; little mulga on Weelamurra	0
Jan.	1892	Bundaleer, Cunnamulla	–28.665	146.551	West Australian, 15 January 1892, p. 1	As above; little mulga on Bundaleer	0
Jan.	1892	Thurulgoona, Cunnamulla	–28.711	145.922	West Australian, 15 January 1892, p. 1	'Bushfires. . .have done much damage to the fences'; large areas of grassland and spinifex + mulga in east of original Run	10
??	1890s	Yancho North, Bollon	–28.253	147.254	Western Star and Roma Advertiser, 3 March 1897	[Land Court hearing on Yancho North]: '. . .The back country was all alike, there were large stages where the mulga had been burnt down by bush fires, with the result that the grass had been growing more vigorously and was more nutritious than before.'	100
??	1890s	Fernlee, Bollon	–28.272	142.036	Western Star and Roma Advertiser, 3 March 1897	Manager of neighbouring Fernlee had a different view of these fires: 'The mulga had been burnt by bush fires, and now there was a thick scrub of box suckers growing there.'	100
Dec.	1904	Tomoo, south-east of Charleville	–27.095	147.367	Western Star and Roma Advertiser, 10 December 1904, p. 2	'During the past three weeks a fire has been raging on Tomoo station, on which place there has been no stock for some time, and the grass is consequently very high. The mulga is also thick and dry.'	1000
Dec.	1904	Clifton, south-east of Charleville	–27.592	1146.720	Western Star and Roma Advertiser, 10 December 1904, p. 2	'The fire spread from Tomoo to Clifton, Bendena and Bonna Vonna stations. On Thursday day night last the fire at Clifton (~80 miles from Cunnamulla) must have been very fierce, as the glare was seen by many townspeople. The country at Clifton where the fire is burning is composed of dry mulga and long dry grass.'	700
Dec.	1904	Cobbrum blocks, south-east of Charleville	–27.603	146.423	Western Star and Roma Advertiser, 10 December 1904, p. 2	'It is reported in town that the fire has spread to the Cobbram Blocks (Bendena), which are unstocked, and where there is grass –2ft. high. There are also several other fires round about. . .'	300
Dec.	1904	Gowrie, Charleville	–26.229	146.315	Western Star and Roma Advertiser, 10 December 1904, p. 2	Gowrie station, near Charleville, on fire	20

(continued next page)

Appendix 1. (*continued*)

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km²)
Dec.	1904	Dillalah-Murweh, Charleville	–26.858	145.933	Western Star and Roma Advertiser, 10 December 1904, p. 2	'. . .also Dillalah and Murweh, the latter of which is supposed to have been caused by lightning. All attempts to extinguish the conflagrations on Dillalah and Murweh have been futile, and the sheep have been mustered and removed out of danger. Some of the fires in the Charleville district were extinguished on Sunday last through thunderstorms.'	30
Dec.	1906	Norley, Thargomindah	–27.709	143.892	Queensland Times, 15 December 1906, p. 8	Burnt hundreds of miles of grass over four days; burning towards Ardoch; probably grassland fires along Bulloo River	10
Feb.	1907	Dillalah, Charleville	–26.857	146.032	Western Star, 23 February 1907, p. 2	500 miles of country burnt; probably including some mulga	20
Sept.	1911	Yarrawonga, Charleville	–26.281	146.371	Sydney Morning Herald, 29 September 1911, p. 1	Large bushfire on resumed portion of Yarrawonga; probably burnt some mulga	30
Sept.	1911	Ularunda, Morven	–26.787	147.051	Sydney Morning Herald, 30 September 1911, p. 17	. . .lost over 200 sheep + emus running around blind and badly burnt	50
Sept.	1911	Boatman/Clifton, south-east of Charleville	–27.267	146.905	Sydney Morning Herald, 30 September 1911, p. 17	'Immense areas of grass were destroyed on Boatman, Clifton and other stations on Nebine Creek. . .'; large expanses of mulga in this country	400
Oct.	1911	Upper Warrego River	–25.767	146.734	Maitland Weekly Mercury, 21 October 1911, p. 3	Several large bush fires are raging up the Warrego, at Burrendah, Nive Downs, and other places; little mulga on these properties	0
Oct.	1911	Alice Downs, Morven	–25.767	146.734	Northern Miner, 26 January 1912, p. 5	Bush fires broke out between [Charleville] and Morven, travelling five miles wide on the Alice Downs and Authoringa boundary right alongside the Western railway line. The 6.45 dawn mail train passed through a furnace of fire. A good deal of railway fence was burnt and many square miles of young mulga were destroyed. Several other bush fires are burning in the vicinity of Morven.	50
Dec.	1913	Alice Downs, Morven	–26.414	146.889	Capricornian, 6 December 1913, p. 34	'A large bushfire burning along the railway. . .about Alice Downs'; possibly burnt some mulga	10

Dec.	1913	Between Yarronvale and Charleville	–26.554	146.206	Capricornian, 6 December 1913, p. 34	'Large bushfires raging on reserve about 10 miles up the railway...' [10 miles towards Yarronovale is the old Trucking Reserve, dominated by spinifex]	0
Dec.	1917	Mt Morris, north-west of Charleville	–25.756	145.566	Capricornian, 15 December 1917, p. 21	Coming in from the north of the Run; fire front three miles and 3–6 ft high; extinguished by a storm the following day; would have burnt some mulga	30
March	1918	Auburn Vale, west of Charleville	–26.446	145.752	*Brisbane Courier*, March 7 1918, p. 6	Large bushfire; would have burnt mostly mulga	200
Nov.	1918	Mt Morris, north-west of Charleville	–25.636	145.389	Capricornian, 2 November 1918, p. 34	Unable to be extinguished on Mt Morris and heading towards Listowel Downs; would have burnt large areas of mulga	130
Nov.	1918	Wallal, south of Charleville	–26.600	146.173	Capricornian, 2 November 1918, p. 34	No further details	??
Nov.	1918	Mt Morris, north-west of Charleville	–25.810	145.570	Farmer and Settler, November 26 1918, p. 4	'Extensive bush-fires have swept over Mount Morris and Oakwood stations, Wade's selections and other grazing farms in the Charleville district. As the country is heavily timbered in places, the flames ascend overhead, and it is impossible to control them.' This fire would have burnt predominantly mulga	130
Nov.	1918	Oakwood, north-west of Charleville	–25.678	146.135	Farmer and Settler, November 26 1918, p. 4	As above	300
Nov.	1918	Wadeholme, north-west of Charleville	–25.678	145.856	Farmer and Settler, November 26 1918, p. 4	As above	250
Nov.	1918	Koreelah, north-west of Charleville	–26.032	145.868	Farmer and Settler, November 26 1918, p. 4	'The fire [above] swept across to Koreelah and Oak Park.' These properties are mostly mulga	200
Nov.	1918	Oak Park, north-west of Charleville	–25.977	146.040	Farmer and Settler, November 26 1918, p. 4	As above	200
Nov.	1918	Baramornie, south of Charleville	–26.834	146.092	Farmer and Settler, November 26 1918, p. 4	No further details; probably little mulga burnt	0
Dec.	1921	Milo, north-west of Adavale	–25.758	144.131	Cairns Post, 14 December 1921, p. 2	Large fire raging through back of Milo, towards Bulgroo and Powell Creek; front 40 miles long; would have burnt some mulga	<100
Nov.	1922	Bando, Wyandra	–27.302	145.845	Cairns Post, 21 November 1922, p. 5	Burning for days and out of control; threatening other stations; mostly grassland	20
Nov.	1922	Cunnamulla area	–28.071	145.695	Port Pirie Recorder, 30 November 1922, p. 1	Total of 11 000 acres burnt in Cunnamulla district; probably mostly grassland	20

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Appendix 1. (*continued*)

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km^2)
Feb.	1927	South-west of Thargomindah	–28.190	143.600	Townsville Daily Bulletin, 17 February 1927, p. 5	'The glare of bush fires was noticeable from the town in the direction of Clyde Station yesterday and several residents motored to Nooyea 10 miles from the town, to investigate the outbreak, which was apparently caused by lightning. The fire is still raging on a front of several miles.' Not much mulga in this area	10
Oct.	1928	Charleville area	–26.408	146.245	Brisbane Courier, 20 October 1928, p. 13	'A correspondent writing from the Charleville district states that living conditions are far from favourable at present; dust storms of varying intensity are of almost daily occurrence, and the position is rendered still more unpleasant by the smoke from bush fires	??
Oct.	1941	Barcoorah, Stonehenge	–24.308	143.205	Morning Bulletin, 11 October 1941, p. 0.4	12 000 acres of heavily timbered mulga country on Bancoorah destroyed; fire burnt from Warbreccan up western side of Thomson to Waterloo/Valetta	48
Dec.	1943	West of Dirranbandi	–28.698	147.765	Queensland Times, 24 December 1943, p. 1	110 000 acres of pasture destroyed, centred on Urandool but burning west towards Mulga Downs; would have burnt mostly grassland and open woodland along Culgoa + perhaps scattered mulga groves	10
Oct.	1948	Cunnamulla area	–28.071	145.695	Daily Mercury, 22 October 1948, p. 9	'Twenty men have been fighting a bush-fire in the Cunnamulla district for two days, and just when they thought they had it under control it broke out again...'; mostly grassland	10
Jan.	1950	Between Charleville and Cunnamulla	–27.108	145.644	National Advocate, 3 January 1950, p. 1	7 properties; men fighting with bags and branches	100
Jan.	1950	Yalli, Bando and Barooona	–27.171	145.551	Queensland Country Life, 30 September 1954, p. 19	...the big fire of 1950...flames on a 50-mile front tore through Baroona, Bando and Yalli.	500
Jan.	1950	Milo, north-west of Adavale	–27.171	145.551	Northern Miner, 11 January 1950, p. 2	100 000 acres burnt; probably some mulga	100
Jan.	1950	Near Adavale	–25.909	144.608	Northern Miner, 11 January 1950, p. 2	Two big fires surrounding town	200
Jan.	1950	Gumbardo, Adavale	–26.087	144.767	Northern Miner, 11 January 1950, p. 2	3-mile front; burning over several thousand acres	20

??	1950	Budaleer-Thurulgoona, south-east of Cunnamulla	–28.189	146.732	Oxley (1987)	Burnt in 1950 wildfire; no further details	??
Jan.	1950	Leopardwood Park, Adavale	–27.757	144.584	Northern Miner, 11 January 1950, p. 2	No further details	10
Jan.	**1950**	**Wyandra area**	**–27.152**	**145.902**	**Queensland Times, 30 January 1950, p. 1**	**25-mile fire front; four stations threatened including Rosevale; this would have included large areas of grassland along the Warrego River as well as mulga**	**100**
Jan.	1950	20 miles north-west of Charleville	–26.155	146.043	Queensland Times, 30 January 1950, p. 1	No further details	??
Dec.	**1950**	**Ambathala, north-west of Charleville**	**–25.965**	**145.321**	**Morning Bulletin, 30 December 1950, p. 4**	**50 000 acres (200 km^2) burnt; probably mostly mulga**	**200**
Jan.	**1951**	**Charleville-Wyandra**	**–26.916**	**146.047**	**Sydney Morning Herald, 19 January 1951, p. 3**	**50-mile fire front between Charleville and Wyandra affecting at least 9 properties; >500 000 acres (2000 km^2) burnt, but much grassland in this area and difficult to estimate how much mulga burnt**	**500**
Jan.	1951	Auburn Vale, west of Charleville	–26.446	145.752	Sydney Morning Herald, 19 January 1951, p. 3	No further details	??
Jan.	**1951**	**Rocksberg (Rocksville?), Charleville**	**–26.143**	**145.933**	**Sydney Morning Herald, 19 January 1951, p. 3**	**15 × 12 miles (= 450 km^2)**	**200**
Jan.	1951	Dillalah/Werrina, Charleville	–26.857	146.032	Sydney Morning Herald, 19 January 1951, p. 3	10 000 (40 km^2) acres burnt	20
Jan.	**1951**	**Boatman/Tongy, east of Wyandra**	**–27.264**	**146.921**	**Sydney Morning Herald, 19 January 1951, p. 3;**	**100 000 (400 km^2) acres burnt + heavy losses of sheep; raged for >8 days**	**300**
Jan.	**1951**	**Guestling/Ricartoon, Charleville**	**–26.715**	**145.918**	**Courier Mail, 22 January 1951, p. 1**	**100 men fighting fire, confined it to within 480 square miles; 200 000 acres (800 km^2) burnt out, probably about half mulga**	**400**
Feb.	**1951**	**Vera Park, Charleville**	**–26.551**	**146.353**	**Warwick Daily News, 6 February 1951, p. 2**	**Three-quarters of Vera Park burnt out; total of 30–40 000 acres (160 km^2) burnt on Wallal, Mortlake and Vera Park; properties are ~75% mulga**	**120**
Feb.	**1951**	**Wallal, south of Charleville**	**–26.600**	**146.173**	**Warwick Daily News, 6 February 1951, p. 2**	**Three-quarters of property burnt out; total of 30–40 000 acres burnt on Wallal, Mortlake and Vera Park**	**See above**
Feb.	**1951**	**Mortlake, Charleville**	**–26.499**	**146.328**	**Warwick Daily News, 6 February 1951, p. 2**	**Three-quarters of property burnt out; total of 30–40 000 acres burnt on Wallal, Mortlake and Vera Park**	**See above**
Feb.	**1951**	**Wyandra area**	**–27.249**	**145.986**	**Courier Mail, 9 February 1951, p. 1**	**Worst bushfires in 60 years; 40-mile front; at least 37 fires and 17 stations wholly or partly burnt out**	**n/a (see below)**
Feb.	**1951**	**Warana, east of Wyandra**	**–27.293**	**146.342**	**Courier Mail, 9 February 1951, p. 1**	**34 000 acres (137 km^2) burnt + homestead threatened; mostly mulga**	**100**

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Appendix 1. (*continued*)

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km^2)
Feb.	1951	Airlie, Wyandra	–27.332	146.072	Courier Mail, 9 February 1951, p. 1	Roar of advancing flames could be heard a mile off	??
Feb.	**1951**	**Quilpie area**	**–26.614**	**144.267**	**Courier Mail, 9 February 1951, p. 1**	**60 000 acres (240 km^2) burnt out**	**Comongin fire (see below)**
Feb.	**1951**	**Comongin, Quilpie**	**–26.614**	**144.450**	**Farmer and Settler, 20 February 1953, p. 1**	**Agents...pointed out that fires in 1951 caused severe damage to the mulga**	**100**
Feb.	**1951**	**Lulworth, Wyandra**	**–27.126**	**147.174**	**Cairns Post, 12 February 1951, p. 1**	**On edge of garden, threatening homestead**	**50**
Feb.	**1951**	**Claverton Park, Wyandra**	**–27.099**	**146.147**	**Cairns Post, 12 February 1951, p. 1**	**15–17 000 (60 km^2) acres burnt out**	**60**
Feb.	1951	Thargomindah area	–27.992	143.817	Cairns Post, 12 February 1951, p. 1	1500 sheep burned; fires now under control; no further details	??
Feb.	1951	50 miles west of Cunnamulla (around Carpet Springs area)	–28.131	144.865	Cairns Post, 12 February 1951, p. 1	Major outbreak; all available men fighting fire	
Feb.	**1951**	**Charleville area**	**–27.134**	**146.369**	**Northern Miner, 13 February 1951, p. 1**	**3 600 000 acres (15 000 km^2) estimated burnt out; main fire on 90 mile front, from 36 miles south of Charleville north-west [actually north-east] to Coniston; more accurately a 50 mile firefront, still large areas of mulga burnt**	**10 000**
Feb.	**1951**	**Wheatleigh, east of Wyandra**	**–26.984**	**146.399**	**Courier Mail, 13 February 1951, p. 1**	**Photo caption: 'Leaping flames and billowing smoke as the fires raced through grass and mulga on Wheatleigh station...'**	**Included in above**
Feb.	**1951**	**Kenmore, east of Wyandra**	**–26.933**	**146.235**	**Courier Mail, 14 February 1951, p. 5**	**Flames rushing through mulga and grassland**	**Included in above**
Feb.	**1951**	**Inkerman/Vinegar Hill siding, west of Charleville**	**–26.592**	**145.650**	**Courier Mail, 15 February 1951, p. 3**	**Railway fettlers wives' fighting fires; spread to Inkerman and 3 neighbouring properties**	**30**
Feb.	**1951**	**Boin, west of Charleville**	**–26.638**	**145.786**	**Courier Mail, 15 February 1951, p. 3**	**Large fire; heat and noise terrific**	**30**
Feb.	**1951**	**Bodouna, west of Charleville**	**–26.712**	**145.778**	**Courier Mail, 15 February 1951, p. 3**	**Large fire; heat and noise terrific**	**30**
Feb.	**1951**	**Calabah, east of Wyandra**	**–27.151**	**146.538**	**Courier Mail, 16 February 1951, p. 5**	**All grass and mulga around homestead burning**	**Included in above**
Feb.	**1951**	**North-west of Charleville**	**–26.272**	**145.625**	**Courier Mail, 16 February 1951, p. 5**	**Vinegar Hill fire spread to here; >100 000 acres (400 km^2) of waist-high grass on fire on Cairns, Warilda, Burrandilla; would have burnt mostly mulga-dominated communities**	**300**

Feb.	**1951**	**Ardgour, Wyandra**	**–27.460**	**146.126**	**Townsville Daily Bulletin, 19 February 1951, p. 2**	**Completely burnt out**	**130**
Feb.	1951	Offham, Wyandra	–27.550	145.915	Courier Mail, 19 February 1951, p. 5	Thousands of acres blazing; spreading to Victoria; mostly grassland	20
Feb.	1951	Boorara/ Dynevor Downs, Hungerford	–28.657	144.384	Longreach Leader, 2 March 1951, p. 6	Both properties badly affected by fires, at same time as Nebine fires	??
March	**1951**	**North-west of Charleville**	**–25.758**	**145.412**	**Townsville Bulletin, 15 March 1951, p. 1**	**30 000 acre (120 km^2) fire, spreading from Bronte to Ambathala (including Bullecourt and Norahville) fanned by westerly breeze**	**100**
April	1951	Talyealye, Hungerford	–29.125	144.470	Western Herald, 6 April 1951, p. 4	Small bushfire; ~600 acres of grass and mulga destroyed	2
July	**1951**	**Coolamon, Morven**	**–26.910**	**147.097**	**Peter Crook-King, personal records**	**Burnt 132 km^2, mostly mulga**	**120**
July	**1951**	**Glenorie, Morven**	**–27.027**	**147.155**	**Peter Crook-King, personal records**	**Burnt 135 km^2, mostly mulga**	**120**
Aug.	**1951**	**Boatman, Morven**	**–27.262**	**146.915**	**Peter Crook-King, personal records**	**Burnt 80 km^2, approximately half mulga**	**40**
Aug.	1951	Ardglen/Rollo, Cunnamulla	–27.973	146.692	Courier Mail, 20 August 1951, p. 3	Three-mile front, 25 000 acre (100 km^2) fire; spread from Ardglen to Rollo, threatening homestead; some mulga in this country	20
Sept.-Oct.	**1951**	**East of Wyandra, centred on Boatman**	**–27.262**	**146.915**	**Queensland Times, 1 October 1951, p. 1; Peter Crook-King, personal records**	**One of biggest fires: burnt for 25 days over 800 km^2 in mostly mulga scrub**	**600**
Oct.	**1951**	**Moonjaree, Cunnamulla**	**–28.055**	**145.345**	**Courier Mail, 17 October 1951, p. 1**	**Storm started eight mile wide bushfire; burnt 20 000 acres (80 km^2) and spreading**	**40**
Oct.	**1951**	**Currawinya, Hungerford**	**–28.840**	**144.491**	**Queensland Country Life, 27 December 1951, p. 11**	**Reference to fighting a fire on Currawinya that burnt out within 25 miles perimeter; this was not as bad as others that had recently occurred in the district**	**20**
Oct.	**1951**	**Charleville**	**–26.407**	**146.244**	**Central Queensland Herald, 25 October 1951, p. 7**	**Charleville almost encircled by three huge bushfires ~30 miles from town**	**??**
Oct.	**1951**	**Urana, Morven**	**–26.918**	**147.130**	**Peter Crook-King, personal records**	**Burnt 130 km^2, mostly mulga**	**100**
Oct.	**1951**	**Ularunda, Morven**	**–26.787**	**147.051**	**Peter Crook-King, personal records**	**Burnt 480 km^2, ~75% mulga**	**360**
Nov.	**1951**	**Moorooka, Morven**	**–26.715**	**147.049**	**Peter Crook-King, personal records**	**Burnt 148 km^2, ~75% mulga**	**110**
Nov.	**1951**	**Noorooloo, Morven**	**–26.820**	**146.899**	**Peter Crook-King, personal records**	**Burnt 32 km^2, ~50% mulga**	**15**
Nov.	**1951**	**Millwood, Morven**	**–26.634**	**146.971**	**Peter Crook-King, personal records**	**Burnt 56 km^2, ~33% mulga**	**20**
Nov.	**1951**	**Alice Downs, Morven**	**–25.767**	**146.734**	**Peter Crook-King, personal records**	**Burnt 32 km^2, mostly mulga**	**30**

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Appendix 1. (*continued*)

Month	Year	Property/area	Lat. (°S)	Long. (°E)	Source	Details	Rough area of mulga burnt (km^2)
Nov.	**1951**	**Charleville area**	**–26.407**	**146.244**	**Townsville Daily Bulletin, 2 November 191, p. 2**	**15 000 sheep killed in fires around Charleville, now mostly under control**	**??**
Nov.	**1951**	**Charleville**	**–26.407**	**146.244**	**Courier Mail, 27 November 1951, p. 1**	**Two big fires near town**	**??**
Dec.	1951	South-west of Cunnamulla	–28.263	145.529	Cairns Post, 7 December 1951, p. 1	No further details	??
Dec.	1951	Charleville	–26.407	146.244	Cairns Post, 7 December 1951, p. 1	No further details	??
Jan.	**1952**	**Southern Mulga Lands**	**–28.263**	**145.529**	**McKellar (2000, p. 57)**	**Extensive fires in southern Mulga Lands; no further details**	**??**
Dec.	1952	Thurlby, Charleville	–26.361	146.157	Courier Mail, 12 September 1952, p. 1	Burnt 3000 acres (12 km^2), mostly grassland	2
Dec.	**1954**	**Mulga Forest area, Charleville**	**–26.246**	**146.075**	**Courier Mail, 30 July 1954, p. 1**	**In heavily timbered country 10 miles north-west of Charleville**	**<10**
Jan.	1956	Charleville area	–26.407	146.244	Central Queensland Herald, 12 January 1956, p. 29	Some fodder destroyed, but little damage; firefighters weary	??
Jan.	1956	Wallen, Cunnamulla	–27.616	145.822	Central Queensland Herald, 12 January 1956, p. 29; Cunnamulla Watchman, 11 January 1956, p. 2	Five-mile front, 6000 (24 km^2) acres burnt; now under control	20
Nov.	1956	Cheepie district	–26.636	145.027	Central Queensland Herald, 22 November 1956, p. 32	5000 acres (20 km^2) burnt 80 miles west of Charleville	20
Nov.	1956	Quilpie area	–26.612	144.254	Central Queensland Herald, 22 November 1956, p. 32	Fire extinguished itself	??
Jan.	**1957**	**Hungerford area**	**–28.996**	**144.411**	**Canberra Times, 6 January 1957, p. 1**	**'A huge bush fire burning in the far north-west of NSW for the past 5 days has swept across the Queensland border. The fire was raging 60 miles north of Wanaaring or ~30 miles inside the Queensland border. They said the fire racing northward and westward was uncontrolled.'**	**400**
Jan.	**1957**	**Moombidary, Hungerford**	**–28.932**	**143.899**	**Canberra Times, 6 January 1957, p. 1**	**'...nearly exhausted fire-fighters were to-night fighting to save Moombidary sheep station near the NSW border.'**	**300**
Jan.	**1957**	**Currawinya, Hungerford**	**–28.840**	**144.491**	**Canberra Times, 6 January 1957, p. 1**	**'Earlier, volunteers believed they checked a fire on Currawinya Station in the Hungerford district, but it leapt fire breaks and surged towards [M]oombidary.'**	**200**

Jan.	**1957**	**Zenoni, Hungerford**	**–28.566**	**143.802**	**Canberra Times, 6 January 1957, p. 1**	**'About 100 000 acres of grassland has been lost to a fire which was checked today at Zenoni Station, 45 miles south of Thargomindah.'**	**400**
Jan.	**1957**	**Dynevor Downs, Thargomindah**	**–28.086**	**144.356**	**Ian Pike, pers. comm.**	**Fire extinguished on Dynevor Lakes**	**200**
Nov.	1957	Cunnamulla area	–28.071	145.695	Cunnamulla Watchman, 20 November 1957, p. 1	Dry storms, dust storms and bushfires: 11 bushfires started in Cunnamulla area and high winds making fire fighting difficult; main fire south-east of Cunnamulla in grassland	100
Nov.	**1957**	**West of Wyandra**	**–27.171**	**145.551**	**Peter Lucas, pers. comm.**	**Fire burnt from Yalli (paddock neighbouring Cliffdale) north almost to Cooladdi, through hard mulga ridges and softer box country**	**400**
Dec.	1974	Comongin, Quilpie	–26.614	144.450	Western Times, 12 December 1974, p. 1	Bushfire burnt 7000 acres (mostly mulga)	30
Dec.	1974	Beltram Park, Quilpie	–26.300	144.601	Western Times, 12 December 1974, p. 1	Bushfire from Comongin swept across and burnt down homestead	See above
Nov.	**1976**	**Cunnamulla area**	**–28.071**	**145.695**	**Cunnamulla Watchman, 17 November 1976, p. 2**	**Severe dry storms caused 13 reported bushfires and damage to town buildings**	**100**
Dec.	**1976**	**Cunnamulla area**	**–28.071**	**145.695**	**Cunnamulla Watchman, 8 December 1976, p. 1**	**Fires in past week had burnt out 300 000 acres (1200 km^2) of grassland and mulga in district**	**500**
Jan.	1978	Victo, Cunnamulla	–27.667	145.924	Cunnamulla Watchman, 28 January 1978, p. 1	Lighting started fires, including one along powerline on Victo that burnt 1000 acres (4 km^2); grassland in this area	20
Feb.	**1978**	**East of Cunnamulla**	**–28.040**	**145.951**	**Cunnamulla Watchman, 1 February 1878, p. 5**	**Sound organisation of fire brigades kept most fires to a minimum, an exception being a fire east of Cunnamulla which burnt 121 500 ha (1215 km^2); not much mulga within 30 km east of town**	**50**